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[Intervention Review]

Cell salvage for minimising perioperative allogeneic blood transfusion in adults undergoing elective surgery

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ABSTRACT

Background

Concerns regarding the safety and availability of transfused donor blood have prompted research into a range of techniques to minimise allogeneic transfusion requirements. Cell salvage (CS) describes the recovery of blood from the surgical field, either during or after surgery, for reinfusion back to the patient.

Objectives

To examine the effectiveness of CS in minimising perioperative allogeneic red blood cell transfusion and on other clinical outcomes in adults undergoing elective or non-urgent surgery.

Search methods

We searched CENTRAL, MEDLINE, Embase, three other databases and two clinical trials registers for randomised controlled trials (RCTs) and systematic reviews from 2009 (date of previous search) to 19 January 2023, without restrictions on language or publication status.

Selection criteria

We included RCTs assessing the use of CS compared to no CS in adults (participants aged 18 or over, or using the study's definition of adult) undergoing elective (non-urgent) surgery only.

Data collection and analysis

We used standard methodological procedures expected by Cochrane.

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Main results

We included 106 RCTs, incorporating data from 14,528 participants, reported in studies conducted in 24 countries. Results were published between 1978 and 2021. We analysed all data according to a single comparison: CS versus no CS. We separated analyses by type of surgery.

The certainty of the evidence varied from very low certainty to high certainty. Reasons for downgrading the certainty included imprecision (small sample sizes below the optimal information size required to detect a difference, and wide confidence intervals), inconsistency (high statistical heterogeneity), and risk of bias (high risk from domains including sequence generation, blinding, and baseline imbalances).

Aggregate analysis (all surgeries combined: primary outcome only)

Very low-certainty evidence means we are uncertain if there is a reduction in the risk of allogeneic transfusion with CS (risk ratio (RR) 0.65, 95% confidence interval (CI) 0.59 to 0.72; 82 RCTs, 12,520 participants).

Cancer: 2 RCTs (79 participants)

Very low-certainty evidence means we are uncertain whether there is a difference for mortality, blood loss, infection, or deep vein thrombosis (DVT). There were no analysable data reported for the remaining outcomes.

Cardiovascular (vascular): 6 RCTs (384 participants)

Very low- to low-certainty evidence means we are uncertain whether there is a difference for most outcomes. No data were reported for major adverse cardiovascular events (MACE).

Cardiovascular (no bypass): 6 RCTs (372 participants)

Moderate-certainty evidence suggests there is probably a reduction in risk of allogeneic transfusion with CS (RR 0.82, 95% CI 0.69 to 0.97; 3 RCTs, 169 participants).

Very low- to low-certainty evidence means we are uncertain whether there is a difference for volume transfused, blood loss, mortality, re-operation for bleeding, infection, wound complication, myocardial infarction (MI), stroke, and hospital length of stay (LOS). There were no analysable data reported for thrombosis, DVT, pulmonary embolism (PE), and MACE.

Cardiovascular (with bypass): 29 RCTs (2936 participants)

Low-certainty evidence suggests there may be a reduction in the risk of allogeneic transfusion with CS, and suggests there may be no difference in risk of infection and hospital LOS.

Very low- to moderate-certainty evidence means we are uncertain whether there is a reduction in volume transfused because of CS, or if there is any difference for mortality, blood loss, re-operation for bleeding, wound complication, thrombosis, DVT, PE, MACE, and MI, and probably no difference in risk of stroke.

Obstetrics: 1 RCT (1356 participants)

High-certainty evidence shows there is no difference between groups for mean volume of allogeneic blood transfused (mean difference (MD) -0.02 units, 95% CI -0.08 to 0.04; 1 RCT, 1349 participants).

Low-certainty evidence suggests there may be no difference for risk of allogeneic transfusion. There were no analysable data reported for the remaining outcomes.

Orthopaedic (hip only): 17 RCTs (2055 participants)

Very low-certainty evidence means we are uncertain if CS reduces the risk of allogeneic transfusion, and the volume transfused, or if there is any difference between groups for mortality, blood loss, re-operation for bleeding, infection, wound complication, prosthetic joint infection (PJI), thrombosis, DVT, PE, stroke, and hospital LOS. There were no analysable data reported for MACE and MI.

Orthopaedic (knee only): 26 RCTs (2568 participants)

Very low- to low-certainty evidence means we are uncertain if CS reduces the risk of allogeneic transfusion, and the volume transfused, and whether there is a difference for blood loss, re-operation for bleeding, infection, wound complication, PJI, DVT, PE, MI, MACE, stroke, and hospital LOS. There were no analysable data reported for mortality and thrombosis.

Orthopaedic (spine only): 6 RCTs (404 participants)

Moderate-certainty evidence suggests there is probably a reduction in the need for allogeneic transfusion with CS (RR 0.44, 95% CI 0.31 to 0.63; 3 RCTs, 194 participants).

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Very low- to moderate-certainty evidence suggests there may be no difference for volume transfused, blood loss, infection, wound complication, and PE. There were no analysable data reported for mortality, re-operation for bleeding, PJI, thrombosis, DVT, MACE, MI, stroke, and hospital LOS.

Orthopaedic (mixed): 14 RCTs (4374 participants)

Very low- to low-certainty evidence means we are uncertain if there is a reduction in the need for allogeneic transfusion with CS, or if there is any difference between groups for volume transfused, mortality, blood loss, infection, wound complication, PJI, thrombosis, DVT, MI, and hospital LOS. There were no analysable data reported for re-operation for bleeding, MACE, and stroke.

Authors' conclusions

In some types of elective surgery, cell salvage may reduce the need for and volume of allogeneic transfusion, alongside evidence of no difference in adverse events, when compared to no cell salvage. Further research is required to establish why other surgeries show no benefit from CS, through further analysis of the current evidence. More large RCTs in under-reported specialities are needed to expand the evidence base for exploring the impact of CS.

PLAIN LANGUAGE SUMMARY

Can collecting blood that is lost during surgery, and returning it to the patient, reduce the need to use donated blood for that patient?

Key messages

This review assessed any study that looked at elective, non-urgent (not trauma) surgery that compared using cell salvage to no cell salvage. Because of the variation in types of surgery, this review is very broad. We have split the evidence according to surgery type, to help doctors and patients locate evidence relevant to them.

There is not a lot of evidence for cancer surgery, heart surgery without a bypass machine, and vascular surgery (on major blood vessels).

Most of the evidence suggested there may be a reduction in the need for donated blood when cell salvage is used. There is uncertain evidence that it causes no additional complications over usual care (there was no difference between the cell salvage and no cell salvage groups), suggesting it may be beneficial overall. But more research is needed that focuses on what else is affecting the evidence, before we can make any strong conclusions.

What is 'cell salvage' and why is it used?

Some people who have surgery require blood transfusions to compensate for the blood lost during the procedure. 'Blood transfusion' is a routine medical procedure where someone receives blood through a thin tube inserted into a vein, usually in the arm. Often the blood used for the transfusion has been donated by a volunteer. Blood transfusions can save lives, but can also increase the risk of complications from surgery and should be avoided where possible. Hospitals have looked for ways to reduce the need for donor blood by (1) reducing how much blood is lost in the first place, and (2) returning the blood lost back to the patient using 'cell salvage'.

'Cell salvage' or 'autotransfusion' involves the collection of a patient's own blood from surgical sites which can be transfused back into the same person during or after surgery, as required. This is blood that would otherwise have been discarded.

What did we want to find out?

We wanted to find out if (1) using cell salvage reduces the need for a transfusion of donated blood, and (2) if people still needed a transfusion, did it reduce the amount of donated blood that they needed. We also wanted to check if people who have cell salvage have more complications than those who don't.

What did we do?

We searched for studies that compared using cell salvage versus no cell salvage (usual care) in adults having elective operations: that is, the operations were planned in advance, not needed urgently because of a trauma. We compared and summarised the results of the studies and rated our confidence in the evidence, based on factors such as study methods and sizes.

What did we find?

We found 106 studies involving 14,528 participants from 24 countries, published between 1978 and 2021. Studies focused on different types of surgery.

Main results

Cancer: 2 studies (79 participants)

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Inconclusive evidence means we are unsure of the impact of cell salvage.

Vascular (major blood vessels) surgery:6 studies (384 participants)

Inconclusive evidence means we are unsure of the impact of cell salvage.

Cardiovascular (heart surgery without bypass):6 studies (372 participants)

There is probably a reduction in the risk of needing a transfusion of donated blood because of cell salvage. For other outcomes, we are uncertain of the impact of cell salvage.

Cardiovascular (heart surgery with bypass):29 studies (2936 participants)

There may be a reduction in the risk of needing a transfusion of donated blood because of cell salvage. For other outcomes, we are uncertain of the impact of cell salvage.

Obstetrics (Caesarean section):1 study (1356 participants)

Inconclusive evidence suggests there may be no difference in the risk of needing a transfusion of donated blood, alongside strong evidence that suggests there is no difference in the average amount of donated blood that is needed by the patient, because of cell salvage.

Hip replacement surgery only:17 studies (2055 participants)

Inconclusive evidence means we are unsure of the impact of cell salvage.

Knee replacement surgery only:26 studies (2568 participants)

Inconclusive evidence means we are unsure of the impact of cell salvage.

Spinal surgery only:6 studies (404 participants)

There is probably a reduction in the risk of needing a transfusion of donated blood because of cell salvage. For other outcomes, we are uncertain of the impact of cell salvage.

Mix of hip, knee, and spinal surgeries:14 RCTs (4374 participants)

Inconclusive evidence means we are unsure of the impact of cell salvage.

What are the limitations of the evidence?

We have little confidence in the evidence for some outcomes and are not confident about the evidence for others. This is because it is possible that the people in the studies were aware of which treatment they were getting, and some of the studies were small.

How up-to-date is the evidence?

The evidence is up-to-date to January 2023, and it expands and updates the evidence reported in the previous review (2010).

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SUMMARY OF FINDINGS

Summary of findings 1. Cell salvage compared to no cell salvage in cancer surgery

Cell salvage compared to no cell salvage in cancer surgery

Patient or population: cancer surgery

Setting: hospital

Intervention: cell salvage

Comparison: no cell salvage

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no cell salvage	Risk with cell salvage				
Transfusions *(during hospital stay)* - not reported	-	-	-	-	-	No data were available for this outcome
Volume (PPT) *(during hospital stay)* - not reported	-	-	-	-	-	No data were available for this outcome
Mortality *(up to 90 days)*	98 per 1000	**55 per 1000** (11 to 273)	**RR 0.56** (0.11 to 2.80)	79 (2 RCTs)	⊕◯◯◯ Very low[a,b]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on mortality risk
DVT *(up to 90 days)*	167 per 1000	**83 per 1000** (8 to 802)	**RR 0.50** (0.05 to 4.81)	24 (1 RCT)	⊕◯◯◯ Very low[b,c]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on DVT risk
Infection *(up to 90 days)*	448 per 1000	**345 per 1000** (179 to 672)	**RR 0.77** (0.40 to 1.50)	55 (1 RCT)	⊕◯◯◯ Very low[a,d]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on infection risk
MI *(up to 90 days)* - not reported	-	-	-	-	-	No data were available for this outcome
CVA (stroke) *(up to 90 days)* - not reported	-	-	-	-	-	No data were available for this outcome

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*The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: confidence interval; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **MD:** mean difference; **MI:** myocardial infarction; **MID:** minimally important difference; **OIS:** optimal information size; **POR:** Peto odds ratio; **PPT:** per person transfused; **RD:** risk difference; **ROB:** risk of bias; **RR:** risk ratio; **SD:** standard deviation

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

[a]Downgraded once for ROB due to judgement of unclear or low risk in all domains (mostly unclear)
[b]Downgraded three times for imprecision: very wide confidence intervals (crosses both boundaries for MID: 0.8 to 1.25), and OIS is far below that needed for rare events
[c]Downgraded twice for ROB due to judgement of unclear and high ROB in all domains
[d]Downgraded twice for imprecision: wide confidence intervals (crosses both boundaries for MID: 0.8 to 1.25)

Summary of findings 2. Cell salvage compared to no cell salvage in cardiovascular (vascular) surgeries

Cell salvage compared to no cell salvage in cardiovascular (vascular) surgeries

Patient or population: cardiovascular (vascular) surgeries

Setting: hospital

Intervention: cell salvage

Comparison: no cell salvage

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no cell salvage	Risk with cell salvage				
Transfusions *(during hospital stay)*	704 per 1000	**429 per 1000** (225 to 809)	**RR 0.61** (0.32 to 1.15)	266 (4 RCTs)	⊕◯◯◯ Very low[a,b,c]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on allogeneic transfusion risk
Volume of transfusion (units) (PPT)	The mean volume of transfusion (units)	MD **0.05 higher** (0.64 lower to 0.74 higher)	-	74 (2 RCTs)	⊕⊕◯◯ Low[d,e]	There may be no difference between cell salvage use and no cell salvage use for the volume of transfusion required PPT

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(during hospital stay)	(PPT) ranged from 1.5 to 3.19 units					
Mortality *(up to 90 days)*	31 per 1000	**36 per 1000** (12 to 104)	**POR 1.19** (0.39 to 3.65)[f]	384 (6 RCTs)	⊕◯◯◯ Very low[a,g]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on mortality risk
DVT *(up to 90 days)*	0 per 1000	**0 per 1000** (0 to 0)	**RD 0.00** (-0.04 to 0.04)	100 (1 RCT)	⊕◯◯◯ Very low[a,h]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on DVT risk
Infection *(up to 90 days)*	66 per 1000	**15 per 1000** (2 to 130)	**RR 0.23** (0.03 to 1.98)	117 (2 RCTs)	⊕◯◯◯ Very low[a,i]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on infection risk
MI *(up to 90 days)*	39 per 1000	**30 per 1000** (7 to 122)	**POR 0.76** (0.17 to 3.41)[f]	203 (3 RCTs)	⊕◯◯◯ Very low[a,i]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on MI risk
CVA (stroke) *(up to 90 days)*	20 per 1000	**3 per 1000** (0 to 122)	**POR 0.14** (0.00 to 6.82)[f]	100 (1 RCT)	⊕◯◯◯ Very low[a,g]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on CVA risk

*__The risk in the intervention group__ (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: confidence interval; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **MD:** mean difference; **MI:** myocardial infarction; **MID:** minimally important difference; **OIS:** optimal information size; **POR:** Peto odds ratio; **PPT:** per person transfused; **RD:** risk difference; **ROB:** risk of bias; **RR:** risk ratio; **SD:** standard deviation

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

[a]Downgraded once for ROB due to judgement of unclear and low risk in the majority of domains (mostly unclear)
[b]Downgraded twice for inconsistency: I^2 = 82%, high heterogeneity
[c]Downgraded once for imprecision: confidence interval crosses one boundary for minimally important difference (MID: 0.8 to 1.25)
[d]Downgraded twice for ROB due to judgement of majority at unclear risk, but with 3 high risk domains in one study which contributed 33% of the weight
[e]MID calculated as +/- 0.5*SD in control group = +/- 0.5*1.61
[f]Peto OR used due to low event rate in both groups (< 5%)
[g]Downgraded three times for imprecision: very wide confidence intervals (crosses both boundaries for MID: 0.8 to 1.25) and far below OIS for this outcome
[h]Downgraded twice for imprecision: sample size far below OIS required for this outcome (rare events)
[i]Downgraded twice for imprecision: confidence interval crosses both boundaries for MID (0.8 to 1.25)

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Summary of findings 3. Cell salvage compared to no cell salvage in cardiovascular (no bypass) surgeries

Cell salvage compared to no cell salvage in cardiovascular (no bypass) surgeries

Patient or population: cardiovascular (no bypass) surgeries

Setting: hospital

Intervention: cell salvage

Comparison: no cell salvage

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no cell salvage	Risk with cell salvage				
Transfusions *(during hospital stay)*	624 per 1000	**511 per 1000** (430 to 605)	**RR 0.82** (0.69 to 0.97)	169 (3 RCTs)	⊕⊕⊕◯ Moderate[a]	There is probably an impact from cell salvage in reducing the risk of requiring allogeneic transfusion
Volume of transfusion (units) (PPT) *(during hospital stay)*	The mean volume of transfusion (units) (PPT) ranged from 1.57 to 2.4 units	MD **0.13 higher** (0.8 lower to 1.07 higher)	-	56 (2 RCTs)	⊕⊕◯◯ Low[b,c]	There may be no difference between cell salvage use and no cell salvage use for the volume of transfusion required PPT
Mortality *(up to 90 days)*	19 per 1000	**3 per 1000** (0 to 39)	**POR 0.13** (0.01 to 2.07)[d]	209 (4 RCTs)	⊕◯◯◯ Very low[e]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on mortality risk
DVT *(up to 90 days)* - not reported	-	-	-	-	-	No data were available for this outcome
Infection *(up to 90 days)*	18 per 1000	**36 per 1000** (4 to 273)	**POR 2.06** (0.21 to 20.61)[d]	110 (2 RCTs)	⊕◯◯◯ Very low[a,e]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on infection risk
MI *(up to 90 days)*	17 per 1000	**32 per 1000** (3 to 247)	**POR 1.98** (0.20 to 19.32)[d]	120 (2 RCTs)	⊕◯◯◯ Very low[e,f]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on MI risk
CVA (stroke) *(up to 90 days)*	13 per 1000	**12 per 1000** (1 to 166)	**POR 0.98** (0.06 to 15.72)[d]	160 (3 RCTs)	⊕◯◯◯ Very low[e,g]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on CVA risk

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*The risk in the intervention group (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: confidence interval; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **MD:** mean difference; **MI:** myocardial infarction; **MID:** minimally important difference; **OIS:** optimal information size; **POR:** Peto odds ratio; **PPT:** per person transfused; **RD:** risk difference; **ROB:** risk of bias; **RR:** risk ratio; **SD:** standard deviation

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

[a]Downgraded once for ROB due to judgement of low and unclear risk in the majority of domains (mostly unclear)
[b]Downgraded twice for ROB due to low and unclear risk in all domains, but with the study contributing most having some baseline imbalance (recent MI), which may impact volume transfused
[c]MID calculated as +/-0.5*SD in control group = +/-0.5*3.79
[d]Peto OR used due to low event rate in both groups (< 5%)
[e]Downgraded three times for imprecision due to very wide confidence intervals and sample size far below OIS for this outcome (rare event)
[f]Downgraded once for inconsistency: I^2 = 64%, moderate heterogeneity
[g]Downgraded once for inconsistency: I^2 = 51%, moderate heterogeneity

Summary of findings 4. Cell salvage compared to no cell salvage in cardiovascular (with bypass) surgeries

Cell salvage compared to no cell salvage in cardiovascular (with bypass) surgeries

Patient or population: cardiovascular (with bypass) surgeries

Setting: hospital

Intervention: cell salvage

Comparison: no cell salvage

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no cell salvage	Risk with cell salvage				
Transfusions *(during hospital stay)*	630 per 1000	**510 per 1000** (460 to 560)	**RR 0.81** (0.73 to 0.89)	2676 (25 RCTs)	⊕⊕◯◯ Low[a,b]	There may be an impact from cell salvage in reducing the risk of requiring allogeneic transfusion

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Volume of transfusion (units) (PPT) ***(during hospital stay)***	The mean volume of transfusion (units) (PPT) ranged from 0.75 to 7.15 units	MD **0.8 lower** (1.21 lower to 0.4 lower)	-	1264 (16 RCTs)	⊕◯◯◯ Very low[a,c,d]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on the volume of transfusion required PPT
Mortality ***(up to 90 days)***	22 per 1000	**19 per 1000** (11 to 33)	**RR 0.86** (0.50 to 1.48)	2491 (21 RCTs)	⊕◯◯◯ Very low[a,e]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on mortality risk
DVT ***(up to 90 days)***	0 per 1000	**0 per 1000** (0 to 0)	**RD 0.00** (-0.12 to 0.12)	30 (1 RCT)	⊕◯◯◯ Very low[a,f]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on DVT risk
Infection ***(up to 90 days)***	94 per 1000	**110 per 1000** (78 to 152)	**RR 1.16** (0.83 to 1.61)	1231 (8 RCTs)	⊕⊕◯◯ Low[g,h]	There may be no difference between cell salvage use and no cell salvage use for infection risk
MI ***(up to 90 days)***	34 per 1000	**29 per 1000** (16 to 52)	**POR 0.86** (0.47 to 1.58)[i]	1376 (9 RCTs)	⊕◯◯◯ Very low[e,g]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on MI risk
CVA (stroke) ***(up to 90 days)***	30 per 1000	**16 per 1000** (7 to 37)	**RR 0.54** (0.23 to 1.24)	1018 (5 RCTs)	⊕⊕⊕◯ Moderate[h]	There is probably no impact of cell salvage on CVA risk

*__The risk in the intervention group__ (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: confidence interval; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **MD:** mean difference; **MI:** myocardial infarction; **MID:** minimally important difference; **OIS:** optimal information size; **POR:** Peto odds ratio; **PPT:** per person transfused; **RD:** risk difference; **ROB:** risk of bias; **RR:** risk ratio; **SD:** standard deviation

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

[a]Downgraded once for ROB due to assessment of unclear and low risk in most domains (mostly unclear)
[b]Downgraded once for inconsistency: I^2 = 64%, moderate heterogeneity
[c]Downgraded twice for inconsistency: I^2 = 91%, high heterogeneity
[d]MID calculated as +/-0.5*SD in control group = +/-0.5*1.704
[e]Downgraded twice for imprecision: CI crosses both boundaries for MID (0.8 to 1.25)
[f]Downgraded twice for imprecision due to small sample size, below OIS for this outcome
[g]Downgraded once for ROB as most studies were at overall low or unclear risk, with some high ROB for randomisation and blinding, though these were in studies contributing less weight

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[h]Downgraded once for imprecision: CI crosses one boundary for MID (0.8 to 1.25)
[i]Peto OR used due to low event rate in both groups (< 5%)

Summary of findings 5. Cell salvage compared to no cell salvage in obstetrics

Cell salvage compared to no cell salvage in obstetric surgeries

Patient or population: obstetric surgeries

Setting: hospital

Intervention: cell salvage

Comparison: no cell salvage

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no cell salvage	Risk with cell salvage				
Transfusions *(during hospital stay)*	22 per 1000	**18 per 1000** (8 to 38)	**POR 0.82** (0.38 to 1.76)[a]	1349 (1 RCT)	⨁⨁◯◯ Low[b]	There may be no impact from cell salvage in reducing the risk of requiring allogeneic transfusion
Volume of transfusion (units) (PPT) *(during hospital stay)*	The mean volume of transfusion (units) (PPT) was 3.33 units	MD **0.41 lower** (2.26 lower to 1.44 higher)	-	27 (1 RCT)	⨁⨁◯◯ Low[c]	There may be no difference between cell salvage use and no cell salvage use for the volume of transfusion required PPT
Mortality *(up to 90 days)* - not reported	-	-	-	-	-	No data were available for this outcome
DVT *(up to 90 days)* - not reported	-	-	-	-	-	No data were available for this outcome
Infection *(up to 90 days)* - not reported	-	-	-	-	-	No data were available for this outcome
MI *(up to 90 days)* - not reported	-	-	-	-	-	No data were available for this outcome

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CVA (stroke) *(up to 90 days)* - not reported	-	-	-	-	-	No data were available for this outcome

***The risk in the intervention group** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: confidence interval; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **MD:** mean difference; **MI:** myocardial infarction; **MID:** minimally important difference; **OIS:** optimal information size; **POR:** Peto odds ratio; **PPT:** per person transfused; **RD:** risk difference; **ROB:** risk of bias; **RR:** risk ratio; **SD:** standard deviation

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

[a]POR used due to low event rate in both groups (< 5%)
[b]Downgraded twice for imprecision: very wide confidence intervals (crosses both boundaries for MID: 0.8 to 1.25)
[c]Downgraded twice for imprecision: crosses both boundaries for MID (calculated as +/- 0.5* SD in control group = +/- 0.5*2.53)

Summary of findings 6. Cell salvage compared to no cell salvage in orthopaedic (hip) surgeries

Cell salvage compared to no cell salvage in orthopaedic (hip) surgeries

Patient or population: orthopaedic (hip)

Setting: hospital

Intervention: cell salvage

Comparison: no cell salvage

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no cell salvage	Risk with cell salvage				
Transfusions *(during hospital stay)*	262 per 1000	**136 per 1000** (100 to 189)	**RR 0.52** (0.38 to 0.72)	1641 (14 RCTs)	⊕◯◯◯ Very low[a,b]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on allogeneic transfusion risk

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Volume of transfusion (units) (PPT) *(during hospital stay)*	The mean volume of transfusion (units) (PPT) ranged from 2 to 2.73 units	MD **1.74 lower** (2.92 lower to 0.55 lower)	-	63 (4 RCTs)	⊕◯◯◯ Very low[c,d]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on the volume of transfusion required PPT
Mortality *(up to 90 days)*	8 per 1000	**4 per 1000** (1 to 27)	**POR 0.46** (0.06 to 3.33)[e]	651 (4 RCTs)	⊕◯◯◯ Very low[f,g]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on mortality risk
DVT *(up to 90 days)*	17 per 1000	**18 per 1000** (4 to 90)	**POR 1.05** (0.20 to 5.60)[e]	343 (3 RCTs)	⊕◯◯◯ Very low[g,h]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on DVT risk
Infection *(up to 90 days)*	16 per 1000	**12 per 1000** (3 to 47)	**POR 0.72** (0.17 to 2.98)[e]	549 (4 RCTs)	⊕◯◯◯ Very low[g,i]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on infection risk
MI *(up to 90 days)* - not reported	-	-	-	-	-	No data were available for this outcome
CVA (stroke) *(up to 90 days)*	0 per 1000	**0 per 1000** (0 to 0)	**RR 3.00** (0.13 to 68.26)	30 (1 RCT)	⊕◯◯◯ Very low[g,j]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on CVA risk

*__The risk in the intervention group__ (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: confidence interval; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **MD:** mean difference; **MI:** myocardial infarction; **MID:** minimally important difference; **OIS:** optimal information size; **POR:** Peto odds ratio; **PPT:** per person transfused; **RD:** risk difference; **ROB:** risk of bias; **RR:** risk ratio; **SD:** standard deviation

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

[a]Downgraded twice for ROB due to unclear risk in most domains, with an even split of low and high risk for blinding across higher-weight studies, but also unclear and high for randomisation
[b]Downgraded once for inconsistency: I^2 = 58%, moderate heterogeneity
[c]Downgraded twice for ROB due to unclear risk in most domains, with high-weight studies at high risk for blinding and unclear for randomisation
[d]Downgraded three times for imprecision due to CI crossing both boundaries for MID (MID calculated as +/-0.5*SD in control group = +/-0.5*0.425) and sample size far below OIS required for this outcome
[e]Peto OR used due to low event rate in both groups (< 5%)
[f]Downgraded once for ROB due to unclear risk in most domains, with most studies at low risk for blinding
[g]Downgraded three times for imprecision: very wide confidence intervals

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[h]Downgraded once for ROB due to unclear or low risk in most domains, with high risk in blinding and randomisation in the lowest weighted study only
[i]Downgraded twice for ROB as most domains were unclear risk, with high risk for blinding
[j]Downgraded once for ROB due to unclear risk in most domains and high risk due to baseline imbalance that would potentially impact this outcome

Summary of findings 7. Cell salvage compared to no cell salvage in orthopaedic (knee) surgeries

Cell salvage compared to no cell salvage in orthopaedic (knee) surgeries

Patient or population: orthopaedic (knee)

Setting: hospital

Intervention: cell salvage

Comparison: no cell salvage

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no cell salvage	Risk with cell salvage				
Transfusions *(during hospital stay)*	450 per 1000	**221 per 1000** (167 to 297)	**RR 0.49** (0.37 to 0.66)	2214 (21 RCTs)	⊕◯◯◯ Very low[a,b]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on allogeneic transfusion risk
Volume of transfusion (units) (PPT) *(during hospital stay)*	The mean volume of transfusion (units) (PPT) ranged from 1.78 to 2.21 units	MD **0.54 lower** (0.9 lower to 0.19 lower)	-	221 (3 RCTs)	⊕◯◯◯ Very low[c,d,e]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on the volume of transfusion required PPT
Mortality *(up to 90 days)* - not reported	-	-	-	-	-	No data were available for this outcome
DVT *(up to 90 days)*	30 per 1000	**38 per 1000** (17 to 84)	**POR 1.29** (0.56 to 2.95)[f]	793 (9 RCTs)	⊕◯◯◯ Very low[g,h]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on DVT risk
Infection *(up to 90 days)*	28 per 1000	**21 per 1000** (8 to 52)	**POR 0.74** (0.28 to 1.94)[f]	730 (5 RCTs)	⊕◯◯◯ Very low[c,i]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on infection risk

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MI *(up to 90 days)*	0 per 1000	**0 per 1000** (0 to 0)	**POR 7.02** (0.14 to 354.40)[f]	115 (1 RCT)	⊕◯◯◯ Very low[h]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on MI risk
CVA (stroke) *(up to 90 days)*	0 per 1000	**0 per 1000** (0 to 0)	**RD 0.00** (-0.06 to 0.06)	60 (1 RCT)	⊕⊕◯◯ Low[g,j]	There may be no difference between cell salvage use and no cell salvage use for CVA risk

*__The risk in the intervention group__ (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: confidence interval; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **MD:** mean difference; **MI:** myocardial infarction; **MID:** minimally important difference; **OIS:** optimal information size; **POR:** Peto odds ratio; **PPT:** per person transfused; **RD:** risk difference; **ROB:** risk of bias; **RR:** risk ratio; **SD:** standard deviation

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

[a]Downgraded twice for ROB as majority were at unclear risk and at least half the studies were at high risk for blinding
[b]Downgraded twice for inconsistency: I^2 = 81%, high heterogeneity
[c]Downgraded twice as most domains were at unclear or high risk of bias (including blinding and randomisation)
[d]Downgraded once for inconsistency: I^2 = 66%, moderate heterogeneity
[e]MID calculated as +/-0.5*SD in control group = +/-0.5*0.69
[f]Peto OR used due to low event rate in both groups (< 5%)
[g]Downgraded once for ROB as most domains were unclear risk, with none at high risk
[h]Downgraded three times for imprecision: very wide confidence intervals
[i]Downgraded twice for imprecision as CI crosses both MID boundaries (0.8 to 1.25)
[j]Downgraded once for imprecision as sample size is below OIS for this outcome

Summary of findings 8. Cell salvage compared to no cell salvage in orthopaedic (spinal) surgeries

Cell salvage compared to no cell salvage in orthopaedic (spinal) surgeries

Patient or population: orthopaedic (spinal)

Setting: hospital

Intervention: cell salvage

Comparison: no cell salvage

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Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no cell salvage	Risk with cell salvage				
Transfusions *(during hospital stay)*	558 per 1000	**245 per 1000** (173 to 351)	**RR 0.44** (0.31 to 0.63)	194 (3 RCTs)	⨁⨁⨁◯ Moderate[a]	Cell salvage probably reduces the risk of requiring allogeneic transfusion
Volume of transfusion (units) (PPT) *(during hospital stay)*	The mean volume of transfusion (units) (PPT) was 1.78 units	MD **0.59 higher** (0.09 lower to 1.27 higher)	-	45 (1 RCT)	⨁◯◯◯ Very low[b,c]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on the volume of transfusion required PPT
Mortality *(up to 90 days)* - not reported	-	-	-	-	-	No data were available for this outcome
DVT *(up to 90 days)* - not reported	-	-	-	-	-	No data were available for this outcome
Infection *(up to 90 days)*	0 per 1000	**0 per 1000** (0 to 0)	**RD 0.00** (-0.06 to 0.06)	63 (1 RCT)	⨁⨁◯◯ Low[b,d]	There may be no difference between cell salvage use and no cell salvage use for infection risk
MI *(up to 90 days)* - not reported	-	-	-	-	-	No data were available for this outcome
CVA (stroke) *(up to 90 days)* - not reported	-	-	-	-	-	No data were available for this outcome

*__The risk in the intervention group__ (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: confidence interval; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **MD:** mean difference; **MI:** myocardial infarction; **MID:** minimally important difference; **OIS:** optimal information size; **POR:** Peto odds ratio; **PPT:** per person transfused; **RD:** risk difference; **ROB:** risk of bias; **RR:** risk ratio; **SD:** standard deviation

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

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[a]Downgraded once for ROB due to a mixture of unclear and low risk across most domains, and high risk in more than half for blinding
[b]Downgraded once for ROB, with a mixture of low and unclear risk across all domains except blinding, which were high risk
[c]Downgraded twice for imprecision due to CI crossing both MID boundaries (MID calculated as +/-0.5*SD in control group = +/-0.5*1.05)
[d]Downgraded once for imprecision as sample size is below OIS for this outcome

Summary of findings 9. Cell salvage compared to no cell salvage in orthopaedic (mixed) surgeries

Cell salvage compared to no cell salvage in orthopaedic (mixed) surgeries

Patient or population: orthopaedic (mixed)

Setting: hospital

Intervention: cell salvage

Comparison: no cell salvage

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no cell salvage	Risk with cell salvage				
Transfusions *(during hospital stay)*	163 per 1000	**104 per 1000** (73 to 146)	**RR 0.64** (0.45 to 0.90)	4011 (11 RCTs)	⊕◯◯◯ Very low[a,b]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on allogeneic transfusion risk
Volume of transfusion (units) (PPT) *(during hospital stay)*	The mean volume of transfusion (units) (PPT) ranged from 1.3 to 2.65 units	MD **0.24 lower** (0.73 lower to 0.24 higher)	-	395 (5 RCTs)	⊕◯◯◯ Very low[c,d,e]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on the volume of transfusion required PPT
Mortality *(up to 90 days)*	0 per 1000	**0 per 1000** (0 to 0)	**RD 0.00** (-0.07 to 0.07)	69 (1 RCT)	⊕◯◯◯ Very low[f]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on mortality risk
DVT *(up to 90 days)*	3 per 1000	**1 per 1000** (0 to 6)	**OR 0.41** (0.09 to 1.92)[g]	3295 (4 RCTs)	⊕⊕◯◯ Low[h]	There may be no difference between cell salvage use and no cell salvage use for DVT risk
Infection *(up to 90 days)*	0 per 1000	**0 per 1000** (0 to 0)	**RD 0.00** (-0.02 to 0.02)	239 (1 RCT)	⊕◯◯◯ Very low[a,i]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on infection risk

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MI *(up to 90 days)*	4 per 1000	**3 per 1000** (1 to 10)	**OR 0.62** (0.17 to 2.22)[g]	3017 (2 RCTs)	⨁◯◯◯ Very low[j]	Very low-certainty evidence means we are uncertain whether cell salvage has an impact on MI risk
CVA (stroke) *(up to 90 days)* - not reported	-	-	-	-	-	No data were available for this outcome

*__The risk in the intervention group__ (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: confidence interval; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **MD:** mean difference; **MI:** myocardial infarction; **MID:** minimally important difference; **OIS:** optimal information size; **POR:** Peto odds ratio; **PPT:** per person transfused; **RD:** risk difference; **ROB:** risk of bias; **RR:** risk ratio; **SD:** standard deviation

GRADE Working Group grades of evidence
High certainty: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.
Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

[a]Downgraded twice for ROB due to unclear risk in most domains and high risk in blinding domain
[b]Downgraded once for inconsistency: I^2 = 72%, moderate to high heterogeneity
[c]Downgraded once for ROB due to unclear and low risk in most domains, but with high risk for randomisation in one study and high risk for blinding in one study
[d]Downgraded twice for inconsistency: I^2 = 75%, moderate to high heterogeneity
[e]Downgraded once for imprecision as CI crosses one MID boundary (MID calculated as +/-0.5*SD in control group = +/-0.5*0.96)
[f]Downgraded three times for imprecision as sample size is far below OIS for this outcome
[g]Peto OR used due to low event rate in both groups (< 5%)
[h]Downgraded twice for imprecision as CI crosses both MID boundaries (0.8 to 1.25)
[i]Downgraded once for imprecision as sample size is below OIS for this outcome
[j]Downgraded three times for imprecision: very wide confidence intervals

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BACKGROUND

Allogeneic, or donor, blood is a valuable yet scarce resource (Shah 2022). Identifying methods to encourage more people to donate blood is a priority for patients and healthcare professionals; however, concerns regarding availability of donor blood persist (Murphy 2020; Shah 2022). Perioperative bleeding and allogeneic blood transfusions increase the risk of complications and healthcare cost (Fowler 2015; Kim 2017).

Over 80% of patients are anaemic following surgery and approximately one-third of all blood transfused in the United Kingdom is transfused to surgical patients (Lloyd 2020; Shander 2004; Tinegate 2016). Over 75% of surgical procedures are performed as planned, non-urgent interventions and the number of surgical interventions performed each year continues to grow worldwide (Dobbs 2021; Weiser 2015).

Description of the condition

While potentially lifesaving in the perioperative period, the risk associated with allogeneic blood transfusion can be significant (Bellamy 2021). Exposure to blood transfusion is also associated with adverse postoperative outcomes, including increased risk of surgical site infection, cardiovascular morbidity, and mortality (Kim 2017; Musallam 2011; Rasouli 2016; Saleh 2014). Interventions to reduce allogeneic blood exposure in patients undergoing planned surgery may help to conserve blood stock, reduce costs, and mitigate risk to patients.

Patient blood management (PBM) strategies have been implemented to reduce exposure to allogeneic blood transfusions and are increasingly being used in routine patient care (Goel 2019; Hibbs 2015; Mueller 2018; Murphy 2021; Shah 2020; Williamson 2013). These strategies typically fall into one of three categories: (1) the administration of agents to diminish blood loss (e.g. tranexamic acid); (2) agents that promote red blood cell production (e.g. iron therapy); and (3) techniques for reinfusing a patient's own blood (e.g. pre-operative autologous donation, acute normovolaemic haemodilution, cell salvage).

Cell salvage has previously been shown to be effective in reducing exposure to donated blood in patients undergoing non-urgent surgical procedures; however, precise indications for the use of cell salvage within different surgical procedures remains undefined (Carless 2010; Klein 2018; NICE 2015; Palmer 2020a).

Description of the intervention

Cell salvage, alternatively known as 'autotransfusion', describes the recovery of blood from the surgical field, either during or after surgery, for reinfusion back to the patient. This blood would otherwise be discarded. During the intraoperative period, blood is typically retrieved from the operative field using a sucker-aspirator. Postoperatively, blood is typically collected via wound drains. Salvaged blood is collected and anticoagulated. The blood is filtered to remove non-cellular matter and, depending on the device, centrifugally washed and re-suspended before reinfusion. Blood salvaged intraoperatively is usually washed, whereas blood salvaged postoperatively is usually unwashed.

How the intervention might work

As suggested in the previous review (Carless 2010), collecting and re-transfusing a patient's own blood may reduce the need for allogeneic blood transfusion perioperatively, with no increase in adverse events. Minimising blood loss and the need for allogeneic blood transfusion may improve patient outcomes, reduce demand on blood stocks, and reduce cost. Allogeneic blood can give rise to transfusion reactions and an immunogenic response, which increases the risk of complications.

Why it is important to do this review

Indications for cell salvage and its use in elective surgical procedures have been expanded (Esper 2011; Rajasekaran 2021; Waters 2003). This review aims to update and build on the previous examined evidence for the effectiveness of cell salvage, used both during and after surgery, across different planned surgical interventions, and in the context of other patient blood management interventions, implementation of which has increased over the past decade (Murphy 2021).

This is an update review; the previous version was published in 2010 (Carless 2010).

OBJECTIVES

To examine the effectiveness of cell salvage (the reinfusion of blood that would otherwise have been discarded) in minimising perioperative allogeneic red blood cell transfusion and on other clinical outcomes in adults undergoing elective or non-urgent surgery.

METHODS

Criteria for considering studies for this review

Types of studies

We included randomised controlled trials (RCTs) only. If the process of randomisation was unclear, we contacted the trial authors to obtain further information. If we were unable to contact the authors, we included the trial in the review, but assessed it as having an unclear risk of bias (ROB) for this domain (see ROB for each study in Characteristics of included studies). We included quasi-RCTs, defined as studies that described themselves as randomised but did not use a truly random method of allocation. We assessed these studies as having a high risk of bias for random sequence generation and allocation concealment.

To be eligible, trials must have compared: active treatment (cell salvage) versus placebo or standard care (no cell salvage); cell salvage plus another active treatment versus that active treatment alone; or any similar scenario wherein we could assess the impact of cell salvage alone. We used both abstracts and full-text publications if they reported adequate information about study design, participant characteristics, and interventions.

We did not include cross-over trials as this is not an appropriate study design for this intervention. We did not identify any cluster-RCTs, but we planned to include cluster-randomised trials if they had at least two intervention sites and two control sites. In future updates, we will exclude cluster-randomised trials that have only one intervention or control site because the intervention (or comparison) may be confounded by study site, making it difficult to

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attribute any observed differences to the intervention rather than to other site-specific variables.

We carefully considered excluding unregistered (or retrospectively registered) trials due to the evidence highlighting issues surrounding false data (Carlisle 2021; Roberts 2015). Prospective registration reduces the chance of publication biases, has been recommended since the 1980s, and mandated for randomised controlled trials by the International Committee of Medical Journal Editors since 2005 (ICJME). Trials that have not been registered (or were registered retrospectively) since 2005 are less likely to be reliable (Roberts 2015). However, we did not exclude these trials as cell salvage is not considered to be a medicinal product under the guidance of the 2001 EU Clinical Trials Directive (EU Clinical Trial Directive 2001; EU Regulations 2014), and as a result, the number of trials prospectively registered are few. Instead, we have performed sensitivity analyses to investigate the impact of registration status on the results.

Types of participants

The study participants were adults (over 18 years) undergoing elective or non-urgent surgery. Where the minimum participant age was unclear, we accepted the study definition of an adult.

We included any elective surgery, but have analysed and reported the data separately by surgical specialities.

We excluded any participants undergoing emergency surgery (trauma), as this population group is covered in a separate review (Li 2015).

Where populations were mixed (e.g. both elective and trauma surgeries in a study), we included the study but only extracted data for the population of interest. Where the subset of data was not readily available, we contacted the trialists for these data. We deemed the study as 'awaiting classification' if we could not obtain the eligible subset.

Types of interventions

The intervention considered was cell salvage, where blood that would otherwise have been discarded, was reinfused into the participant during or after surgery. We included studies with a combination of active comparisons if cell salvage was the only difference between the two groups.

Types of outcome measures

We planned to assess the following outcome measures.

Primary outcomes

- Risk of transfusion of allogeneic blood (during hospital stay)
- Volume of allogeneic blood transfused per person who received a transfusion (during hospital stay)

Volume is a continuous outcome that is often not normally distributed, hence we expected data to be presented either as mean and standard deviation (if normally distributed) or as median and interquartile range (IQR) (if not normally distributed). We considered the data as reported by the study, and have presented in Table 1 any data that could not be included in meta-analysis (i.e. median, IQR).

Secondary outcomes

- Risk of all-cause mortality (up to 90 days)
- Volume of blood loss (during hospital stay)
- Risk of re-operation for bleeding (during hospital stay)
- Risk of postoperative complications (up to 90 days; or one year for prosthetic joint infection (PJI)):
  - Infection (including localised and systemic infection, and wound complications)
  - Thrombosis (cerebrovascular accident (CVA)/stroke, venous thromboembolism (VTE) including deep vein thrombosis (DVT) and pulmonary embolism (PE))
  - Myocardial infarction (MI)
  - Major adverse cardiac events (MACE) *
- Length of hospital stay (LOS)

We did not include TIA (transient ischaemic event) in the category of stroke.

We extracted any continuous outcomes that were reported in a form that could not be included in the meta-analysis (e.g. median, IQR), and presented these as reported by the study in a separate table (Table 1).

* MACE is a composite outcome commonly used in cardiovascular research. MACE has no concrete definition: three-point, four-point and five-point scales of MACE have previously been reported within cardiovascular research. These scales may include total death, MI, stroke, hospitalisation because of heart failure and revascularisation, including percutaneous coronary intervention and coronary artery bypass graft (Bosco 2021; Hicks 2018; Poudel 2019). We accepted any definition of MACE used by a study and reported the definition used by each.

Search methods for identification of studies

One review author (CD) performed the search in conjunction with Cochrane Injuries.

We searched for all relevant published and unpublished trials without restrictions on language or publication status, from the date of the previous search (June 2009) to 19 January 2023.

Electronic searches

The previous (2010) review drew on the literature searches that were constructed as part of the International Study of Perioperative Transfusion (ISPOT) (Huet 1999). These searches were last conducted in June 2009, and based on the MEDLINE strategy shown in Appendix 1. Terms were then modified as appropriate to the specifications of each database.

In this 2023 update review, we developed and expanded the original search strategies, and added new data sources. Full strategies for each database are presented in Appendix 2.

The following databases were searched on 19 January 2023 for systematic reviews and randomised controlled trials published from 2009 onward:

- Cochrane Central Register of Controlled Trials (CENTRAL; 2023, Issue 1) in the Cochrane Library;
- MEDLINE (Ovid, 2009 onward);

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- Embase (Ovid, 2009 onward);
- Epistemonikos Systematic Review Database (Epistemonikos Foundation, 2009 onward);
- PubMed (NLM, for e-publications ahead of print only);
- Transfusion Evidence Library (Evidentia, 2009 onward);
- International HTA Database (INAHTA, 2009 onward);
- Web of Science Conference Proceedings Index (CPCI-S) (Clarivate, 2009 onward).

The searches above were not restricted by language or publication status.

We searched the following resources for ongoing trials:

- CENTRAL (2023, Issue 1) in the Cochrane Library;
- ClinicalTrials.gov;
- World Health Organization (WHO) International Clinical Trials Registry Platform (ICTRP).

Searches of trials registers were not restricted by language.

Searching other resources

We handsearched reference lists of included trials and relevant systematic reviews and health technology assessments (HTAs) in order to identify further relevant trials.

Data collection and analysis

We performed the systematic review using methods described in Chapter 5 of the *Cochrane Handbook for Systematic Reviews of Interventions* (Li 2020). Analyses were run using Review Manager 5 (Review Manager 2020).

Selection of studies

At least two of the review authors (TDL, LJG, TB, KB, WM, SJF) independently screened for eligibility the titles and abstracts of citations identified by the electronic searches. If the title and abstract of the citation were found to be irrelevant, we excluded the record at this stage. The same review authors then independently screened the full-text articles of the citations thought to be eligible against the criteria set out in the protocol for this review. We resolved disagreements through discussion or through consultation with another review author (MFM/AJRP).

We kept records of the study selection process and used the information to generate a PRISMA flowchart (Moher 2009). We recorded the reasons why potentially relevant studies failed to meet the eligibility criteria.

Translations of data published in languages other than English were provided by colleagues or individuals responding to calls we made via Cochrane resources, such as Task Exchange (now Cochrane Engage (https://engage.cochrane.org/)).

Data extraction and management

For studies assessed as eligible for inclusion (see above), pairs of review authors (of TDL, LJG, KB, WM, SJF) independently extracted relevant data according to Cochrane guidelines (Li 2020). We resolved disagreements by consensus or through arbitration by another author (LJG/SJB/MFM/AJRP). During the process of selecting studies or extracting/assessing data, no review author was blinded to the identity of trial investigators or institutions.

We extracted data from included studies on a structured, piloted form, as follows.

- General information: name of review author carrying out data extraction, date of data extraction, study identifier, surname and contact address of first study author, and language in which trial was reported.
- Information on trial conduct: features of RCT design (e.g. location of where the trial was run, setting, sample size, study dates, power calculation, treatment arms, randomisation, inclusion and exclusion criteria, comparability of groups, timings of assessment and maximum follow-up, and whether the trial had been prospectively registered).
- Characteristics of participants: age, sex, weight or body mass index (BMI), breakdown of total numbers for those randomised and analysed, type of surgery, dropouts (percentage in each arm) with reasons and protocol violations, type of operation (primary, revision, hip/knee/cardiac, etc.)
- Characteristics of interventions: number of treatment arms, description of experimental arm(s), description of control arm(s), timing of intervention, and other differences between intervention arms.
- Outcomes: allogeneic blood transfusion, volume of red cell transfused, postoperative complications, all-cause mortality, length of stay (LOS), blood loss, re-operation for bleeding, and timing of outcome measurement.
- Study conduct (risk of bias assessment): sequence generation, allocation concealment, blinding (participants, personnel, outcome assessors), incomplete outcome data, selective outcome reporting, other sources of bias.

We extracted data for allogeneic blood transfusion if these data were expressed as whole blood or packed red cells. We converted transfusion data expressed in millilitres to units by dividing by 300.

Where a transfusion threshold was reported, we converted these into a standard scale of haemoglobin (Hb) in g/L. If data were presented for Hct (haematocrit) as a percentage, we converted these by dividing by three (WHO 1968), and when Hb was presented in mmol, we converted these data by dividing by 18 (standard conversion).

We have categorised (subgrouped) by whether the transfusion threshold was "restrictive" (Hb ≤ 80 g/L) or "liberal" (Hb > 80 g/L) (Carson 2021; NICE 2015).

We used all relevant sources of data for each study, including full-text publications (with or without supplements), trial registration documents, published protocols, and preliminary results released in the form of abstracts. We used one data extraction form for each unique study. Where sources did not provide sufficient information, we contacted authors for additional details.

In addition, two review authors (of KB, WM, TDL, LJG, SJB) compared data extraction against the previously published review (Carless 2010). We contracted trial authors to request provision of missing data where possible.

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One review author (LJG) entered data into Review Manager 5 (Review Manager 2020), and performed GRADE assessments with a second author (TDL).

Assessment of risk of bias in included studies

Two review authors (of TDL, LJG, SJF, KB, WM) independently assessed the risk of bias (ROB) for relevant domains relating to study conduct within each trial and assigned classifications of low, high, or unclear risk (Higgins 2011; Higgins 2017). We assessed the impact of blinding (performance bias and detection bias) on each outcome separately, categorising them as objective, low-risk subjective, or high-risk subjective, depending on the presence of clear diagnostic criteria described in the methods, trial registration, or protocol of each study.

Two review authors (TDL, LJG) additionally re-assessed the ROB for all domains for trials included in the 2010 review, as these had only been assessed for selection bias (randomisation and allocation concealment) and blinding as a single category for all outcomes. We resolved disagreements through discussion.

We assessed risk of bias in the following domains:

- selection bias (random sequence generation and allocation concealment);
- performance bias (blinding of participants, personnel and outcome assessors);
- detection bias (blinding of outcome assessment);
- attrition bias (incomplete outcome data);
- reporting bias (selective reporting);
- other forms of bias (including: block randomisation in an unblinded trial, conflicts of interest, source of funding, and any other potential sources of bias that we noticed).

Measures of treatment effect

Dichotomous outcomes

When extracting data for dichotomous outcomes (proportion of participants needing an allogenic blood transfusion, mortality, re-operation due to bleeding, adverse events), we recorded the number of participants and events in both the intervention and control arms.

Continuous outcomes

We extracted arm-level data for continuous outcomes (e.g. mean number of allogenic blood transfusions per participant). We recorded means, standard deviations (SD) (or medians with interquartile ranges (IQR) or range), and the total number of participants in both the intervention and control arms. Where only study-level data were available, we noted the reported effect size and standard errors.

Unit of analysis issues

For trials with multiple treatment or comparator groups, we included subgroups that were considered relevant to the analysis. Where subgroups were used, or where a study had more than one relevant intervention arm but one control group, we split the control group to avoid double-counting the controls.

If appropriate, we combined eligible groups to create a single pair-wise comparison. Where this was not possible, we selected the most appropriate pair of trial arms (intervention and comparator) and excluded the others (Higgins 2022).

We analysed the data using the participant as the unit of analysis. No trials randomised participants more than once.

In future updates, in the event that we identify and include one or more cluster-RCTs, we will follow the guidance in Chapter 23 of the *Cochrane Handbook* (Higgins 2022), using the generic inverse-variance approach in Review Manager and an appropriate intraclass correlation coefficient to allow for the clusters. We will also carefully consider the potential risk of bias associated with the method of randomisation described.

Dealing with missing data

We recorded the number of participants lost to follow-up for each trial. Where possible, we used data reported on an intention-to-treat (ITT) basis, but if insufficient data were available, we used the reported per-protocol data. We handled missing data using the approach discussed in Chapter 10 of the *Cochrane Handbook for Systematic Reviews of Interventions* (Deeks 2022).

Assessment of heterogeneity

We assessed statistical heterogeneity of treatment effects between trials using a Chi^2 test with a significance level at $P < 0.1$. We used the I^2 statistic to measure the percentage of total variability due to between-study heterogeneity, and classified heterogeneity as moderate if I^2 was greater than 50%, or considerable if I^2 was greater than 75%. Where heterogeneity was considerable, we also checked the direction and magnitude of the effect.

We assessed potential causes of heterogeneity by sensitivity and subgroup analyses (Deeks 2022).

We used the random-effects model as we anticipated that we would identify at least moderate clinical and methodological heterogeneity within the trials selected for inclusion.

Assessment of reporting biases

Where a single analysis included at least 10 studies, we performed a formal assessment of publication bias using a funnel plot for each comparison and outcome (Sterne 2011), and utilised this information in the assessment of the certainty of the evidence (GRADE).

We have presented the funnel plot (subgrouped by type of surgery) for the aggregate analysis for the primary outcome (risk of transfusion) only.

Data synthesis

We performed direct treatment comparisons using methods described in Chapter 10 of the *Cochrane Handbook for Systematic Reviews of Interventions* (Deeks 2022). Where data were homogeneous enough to do so, we performed meta-analyses in Review Manager 5 (Review Manager 2020). Forest plots illustrating these results are shown with 95% confidence intervals (CIs) for all analyses.

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Dichotomous outcomes

We have presented analyses using risk ratio (RR), risk difference (RD) where there were zero cases in both arms, or Peto odds ratio (POR) for rare events (< 5% in each arm), always with 95% CIs.

Continuous outcomes

When reported as mean and standard deviation (SD), using the same scale, we analysed using mean difference (MD) with a 95% CI. Some of the included studies reported our continuous outcomes in a non-analysable format (reported as median and IQR/range), and we presented these separately, as reported by the study, in Table 1.

For the outcome "Volume transfused", some studies reported data as mean and SD per person randomised (PPR) (including zero units where someone did not require transfusion), and other studies reported data per person transfused (PPT) (excluding those for whom transfusion was not required). To combine these data appropriately, we re-scaled all data as both PPT and PPR, and have presented these data in Appendix 3.

Subgroup analysis and investigation of heterogeneity

We examined statistical heterogeneity using both the I^2 and Chi^2 statistics, as described in Assessment of heterogeneity.

We performed prespecified subgroup analyses to determine whether effect sizes varied according to factors such as:

- timing of cell salvage (intra- or postoperative, or both); we considered the timing to be the time that the blood was collected, not necessarily when/if it was reinfused (i.e. collection intraoperatively for postoperative reinfusion would be classed as "intraoperative" timing);
- transfusion threshold used within the trial (when reported).

We have performed all analyses and reported them separately by the type of surgery identified (cancer, cardiac, obstetrics, orthopaedics, vascular, etc.), subgrouping within those surgical specialities for timing and transfusion threshold, in order to accurately answer whether cell salvage is safe and effective in specific surgeries/populations, and to ascertain where there are gaps in the literature.

However, to reflect what previous versions of this review reported, we performed an aggregate analysis (combining all surgical groups identified) for the primary outcome (risk of allogeneic transfusion), which we then used for our sensitivity analyses (see Sensitivity analysis).

We did not subgroup by the type of salvaged blood re-transfused (washed/unwashed) as assessed in the previous versions of this review. Washing and re-suspension of red blood cells is performed for the majority of current cell salvage practice. Unwashed techniques are frequently used when blood is salvaged from surgical drains. The expectation was therefore that most intraoperatively salvaged blood would be washed, and postoperatively salvaged would be unwashed, so negating the need to perform both timing and washing subgroup analyses.

We did not perform subgroup analysis by trial methodology (described in the original protocol and previous versions of this review), and have instead performed sensitivity analyses to investigate the impact of only using those assessed as having a low risk of bias overall (low risk of bias for random sequence generation and blinding (performance bias and detection bias) for the primary outcome: risk of transfusion).

Sensitivity analysis

We only performed sensitivity analyses on the primary outcome (number of people receiving an allogeneic transfusion), where all types of surgeries were combined into a single analysis. We then split the data according to type of surgery for all other analyses.

We determined a priori that we would investigate the impact of trials published from 2010 onward that were not prospectively registered, using a modified strategy that did not exclude such trials (as recommended in Roberts 2015), but which sought to assess evidence of differential impact.

We also conducted sensitivity analysis by including only studies assessed as having a low risk of bias for both random sequence generation and blinding (performance bias and detection bias for transfusions).

Summary of findings and assessment of the certainty of the evidence

We used the GRADE approach to generate summary of findings tables, as suggested in the *Cochrane Handbook for Systematic Reviews of Interventions* (Schünemann 2022). Using GRADEpro software (GRADEpro GDT), we employed the GRADE approach to rate the certainty of the evidence as 'high', 'moderate', 'low', or 'very low', according to the five GRADE considerations:

- risk of bias (serious or very serious);
- inconsistency (serious or very serious);
- indirectness (serious or very serious);
- imprecision (serious, very serious, or extremely serious);
- publication bias (suspected or undetected).

Cochrane summary of findings (SOF) tables are restricted to seven outcomes. We have therefore only presented data in the SOF tables for the following outcomes:

- primary – risk of transfusion of allogeneic (donated) blood;
- primary – volume (units) of allogeneic blood transfused, per person transfused (PPT);
- risk of death (all-cause mortality);
- risk of deep vein thrombosis (DVT);
- risk of infection;
- risk of myocardial infarction (MI);
- risk of stroke/cerebrovascular accident (CVA).

Need for allogeneic blood transfusion and volume of allogeneic red blood cells (RBCs) transfused (number of units)

The number of participants who receive red cell transfusions is more important than the number of red cells per participant, as the complete avoidance of RBC transfusion is more important for the avoidance of additional risks, such as transfusion reactions and other postoperative adverse events, in people undergoing surgery than reducing the units transfused. However, the volume of blood transfused is vital information for planning surgeries according to available blood stocks, and accurately reflects whether the intervention reduces need for donor (allogeneic) blood.

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Volume per person transfused (PPT) is more clinically useful than volume per person randomised (PPR) for understanding the volume of blood an individual may require if they need an allogeneic transfusion.

Thromboembolic events

Venous thromboembolism (pulmonary embolism (PE) or deep vein thrombosis (DVT)) is an important outcome for this patient group. DVTs occur more commonly than a PE, and therefore any potential harm will be detected with a smaller number of participants.

Infections and wound complications

Infection and wound complications are often variably reported: whereas we required the number of people who experienced an event, it is often reported differently (as number of events, listing multiple issues; see Table 2 for a full breakdown of events). However, infection is an important outcome because surgical site infection has been associated with allogeneic blood transfusions as a result of immunomodulation. Infection is a cause of patient morbidity and mortality, and represents a considerable healthcare cost.

Myocardial infarction (MI) and stroke (CVA)

Perioperative anaemia has been associated with myocardial infarction and CVA due to reduced oxygenation to tissues. Both are a cause of patient morbidity and mortality, and are therefore important to report in the SOF.

We did not include the remaining outcomes in the SOF tables, but have performed full analyses and report these in the Effects of interventions*:*

Blood loss

Whilst blood loss is an important outcome for individuals, the intervention is not designed to reduce blood loss, and is therefore more descriptive of the individual than assessment of the intervention. The need to transfuse, and the volume of the transfusion, are therefore more indicative of cell salvage effectiveness, especially when a clear transfusion protocol is in place. However, we do acknowledge that the ongoing presence of a drain and re-transfusion tube may cause greater bleeding overall (Parker 2007).

Re-operation for bleeding

Re-operation for bleeding is a rare complication, and not expected to be closely related to anaemia or the use of cell salvage. However, it has been included in this review, and previous versions of this review, due to suggestions that the use of cell salvage may be associated with increased postoperative bleeding, blood product usage, and derangement of coagulation parameters, possibly secondary to depletion of plasma coagulation proteins during centrifugation, washing, and subsequent reinfusion. These risks have predominantly been highlighted in the setting of cardiac surgery, when cell salvage is used alongside cardiopulmonary bypass (CPB) (Ashworth 2010; Rubens 2007; Son 2020).

Length of hospital stay

Short hospital stays are associated with fewer hospital-acquired complications, and can be representative of better outcomes related to the surgery. It is an important outcome for resource management and overall cost. However, hospital length of stay (LOS) may not be a true representation of being discharge-ready, as it can be affected by other external factors unrelated to the intervention.

Major adverse cardiovascular events (MACE)

This composite is a useful outcome for cardiovascular outcomes, but we deemed the individual outcomes that contribute to this composite to be more useful for assessing adverse events, and so we used MI and CVA/stroke in the SOF tables instead.

RESULTS

Description of studies

See also Characteristics of included studies; Characteristics of excluded studies; Characteristics of studies awaiting classification; Characteristics of ongoing studies

Results of the search

See PRISMA flow diagram (Figure 1) for this update review.

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Figure 1. Study flow diagram. The Niranjan 2006 study reported for both on-cardiopulmonary bypass and off-cardiopulmonary bypass, and so is counted in both "with bypass" and "no bypass" groups.

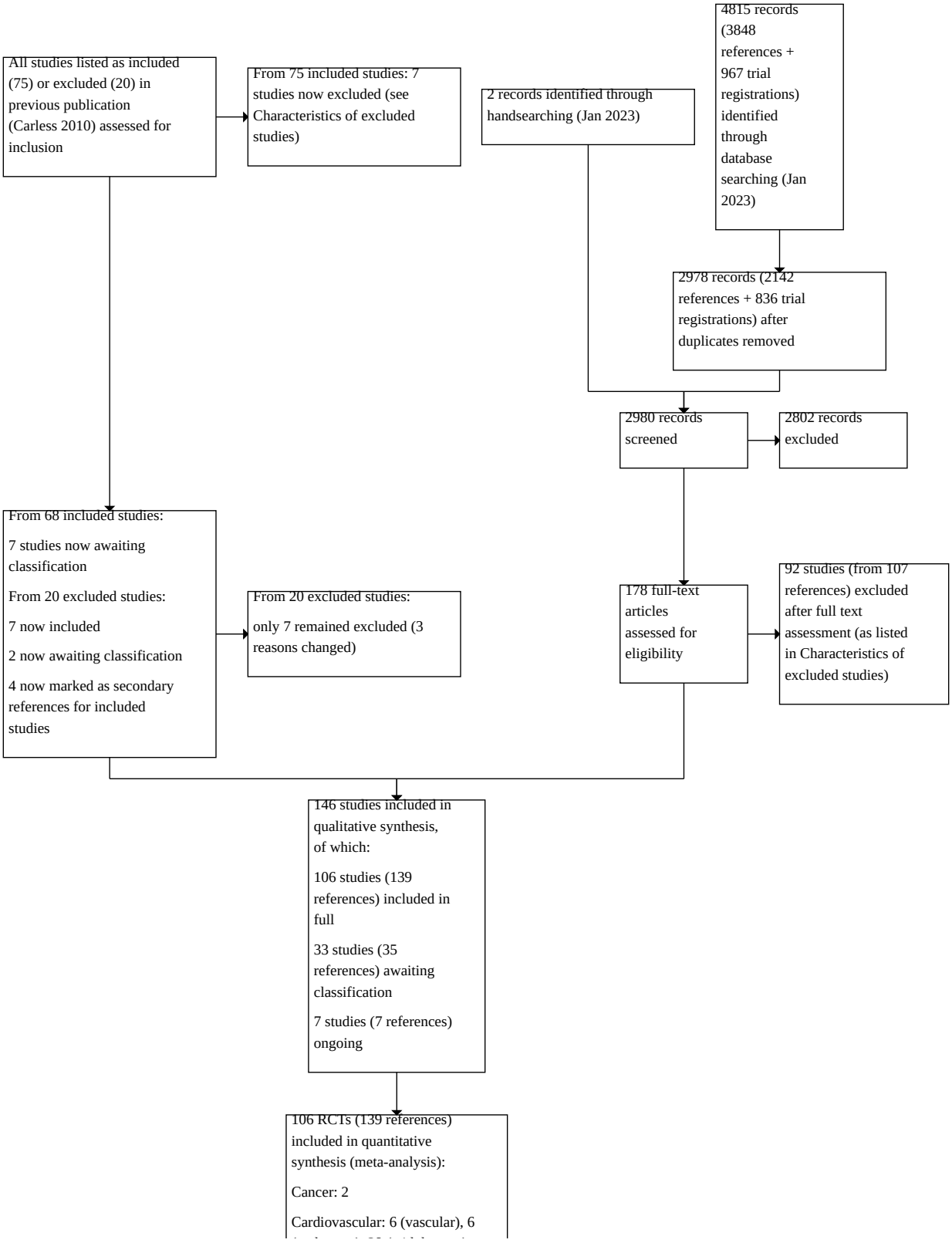

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Figure 1. (Continued)

Cardiovascular: 6 (vascular), 6 (no bypass), 29 (with bypass)

Obstetrics: 1

Orthopaedic: 17 (hip), 26 (knee), 6 (spinal), 14 (mixed)

After de-duplication, the update search (January 2023) identified 2980 new references for assessment. We excluded 2802 references as irrelevant based on title and abstract, and therefore assessed 178 references as full-text publications.

We also checked the included (75) and excluded (20) studies identified in the previous version of this review.

Previously excluded studies

Of studies excluded for being a "duplicate article", we reclassified four as secondary references for already included studies (Dalrymple-Hay 1999; Schaff 1978; Schmidt 1996; Spark 1997). One that had been marked as a duplicate was in fact an independent trial with an ineligible comparison, and so remained excluded but with a new reason (Schmidt 1997).

Of studies excluded for having "insufficient data", we reclassified seven as eligible for inclusion (Adan 1988; Breakwell 2000; Jacobi 1997; Kristensen 1992; Mac 1993; McShane 1987; Thompson 1990). Two studies remained excluded, with the reasons for exclusion changed to 'no control group' (Deramoudt 1991), and 'ineligible intervention' (Mayer 1985). We reclassified two studies as 'awaiting classification': one due to a mixed population (emergency and elective) with no subgrouping reported (conference abstract only: Skoura 1997), and one due to a lack of information regarding cardiopulmonary bypass blood processing (Bell 1992).

We checked the remaining excluded studies from the previous version, and these remained excluded (four studies: Bartels 1996; Elawad 1992; Trubel 1995; Vertrees 1996).

Previously included studies

Of the previously included studies, we reclassified four as excluded for the following reasons: ineligible intervention (Naumenko 2003); non-RCT (no mention of randomisation: Sirvinskas 2007; Slagis 1991); and a complex intervention where the impact of cell salvage alone could not be assessed (Zacharopoulos 2007). We also reclassified five studies as 'awaiting classification': two had a mixed population (elective and emergency) with no subgrouping (Bouboulis 1994; Fragnito 1995); and three lacked detail regarding the intervention and comparison methods (Dietrich 1989; Ritter 1994; Simpson 1994).

Due to an update in cardiopulmonary bypass guidelines in 2011 (Ferraris 2011), we reassessed previous trials to identify those that were 'complex' in nature (i.e. they compared cell salvage and processed cardiopulmonary bypass blood versus no cell salvage and unprocessed cardiopulmonary bypass blood). The updated guidelines, and the evidence on which they were based, highlighted the benefits of processing residual cardiopulmonary bypass blood by reducing inflammation and concentrating red blood cells, leading to a reduction in the need for blood transfusion and other adverse events (Ferraris 2011; Moran 1978). Therefore, we have excluded studies where there was a difference in the treatment of cardiopulmonary bypass blood between groups (complex interventions), as the effect of the cell salvage intervention alone cannot be determined (Laub 1993; McGill 2002; Tempe 1996; Tempe 2001). Where we were unable to determine if the cardiopulmonary bypass blood was treated differently, we have assessed the study as awaiting classification until more information becomes available (Murphy 2004; Wiefferink 2007).

Consequently, we have included only 60 of the 75 studies included in the previous version of this review, and we have now included seven of the 20 studies excluded in the previous version.

Included studies

Please see an overview of included studies (Table 3; Table 4; Table 5; Table 6; Table 7; Table 8; Table 9; Table 10; Table 11) and Characteristics of included studies for further detail of the included studies.

Study selection

We included a total of 67 RCTs from the previous review (Carless 2010), and 39 RCTs from the updated search (2023) that fulfilled the predefined inclusion criteria, giving a total of 106 RCTs involving 14,528 participants.

Setting

Included trials were published from the late 1970s (Schaff 1978; Thurer 1979) to 2021 (Touzopoulos 2021): 44 (42%) were published before 2000, and 34 (32%) since 2010.

Most of the included studies were conducted in the UK (25 RCTs, 24%) and USA (17 RCTs, 16%). Studies were conducted in 24 different countries:

- Australia (2 RCTs);
- Asia (China (8 RCTs), Hong Kong (1), India (1), Turkey (2));
- Europe (Austria (1), Croatia (1), Denmark (4), France (3), Germany (4), Greece (4), Ireland (1), Italy (1), Norway (2), Poland (2), Romania (2), Serbia (1), Spain (1), Sweden (7), Switzerland (1), the Netherlands (14), UK (25));
- North America (Canada (1), USA (17)).

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Participants

All data are for adults (over 18 years) undergoing an elective (non-urgent) surgery. We categorised trials into:

- cancer surgery (genitourinary medicine: 2 RCTs, 79 participants, Table 3);
- cardiovascular surgery (vascular: 6 RCTs, 384 participants, Table 4; no bypass: 6 RCTs, 372 participants, Table 5; with bypass: 29 RCTs, 2936 participants, Table 6);
- obstetrics (Caesarean section: 1 RCT, 1356 participants, Table 7);
- orthopaedic surgery (hip: 17 RCTs, 2055 participants, Table 8; knee: 26 RCTs, 2568 participants, Table 9; spinal: 6 RCTs, 404 participants, Table 10; mixed: 14 RCTs, 4374 participants, Table 11).

One study reported two populations (no bypass and with bypass: Niranjan 2006).

Intervention

Devices used for cell salvage were varied and wide-ranging (see Table 3; Table 4; Table 5; Table 6; Table 7; Table 8; Table 9; Table 10; Table 11; and Appendix 4).

All included studies compared the use of cell salvage (autotransfusion) to no cell salvage (no autotransfusion), where the effect of cell salvage alone could be assessed. Participants randomised to receive no cell salvage received standard care given to both groups. This included allogeneic blood transfusions as required, and may also have included pharmacological methods to reduce overall blood loss. Where this information was available, it has been presented in Characteristics of included studies.

Timing of collection

Studies assessed cell salvage of blood collected intraoperatively (30 RCTs), postoperatively (63 RCTs), or during both periods (15 RCTs), and three studies reported for more than one collection period (timing subgroups: Blatsoukas 2010; Parrot 1991; Rollo 1995). We were unable to determine the timing in one trial (NCT00839241), though they also reported no usable data.

Studies that reported collecting blood intraoperatively only were published between 1987 and 2019. Of these, 18 (60%) were published since 2000, including 12 (40%) since 2010. Studies that reported collecting blood postoperatively only were published between 1978 and 2021. Of these, 35 (56%) were published since 2000, including 16 (25%) since 2010.

Studies that collected throughout the perioperative period (both intraoperatively and postoperatively) were published between 1991 and 2014. Six studies (40%) were pre-2000, and six (40%) were published since 2010.

Washing before retransfusion

Salvaged blood was described (or could be determined from the manufacturer's description of the reported cell salvage machine) as washed (36 RCTs), unwashed (62 RCTs), or both (3 RCTs) before re-transfusion. Washing was not reported or inferred in eight RCTs (Djurasovic 2018; Mah 1995; Menges 1992; Pavelescu 2014; Sait 1999; Schmidt 1996; Shirvani 1991; Westerberg 2004).

As with timing, the same three RCTs reported more than one process (Blatsoukas 2010; Parrot 1991; Rollo 1995), as intraoperative blood was washed, and postoperative blood was unwashed, resulting in those that collected blood over both periods using both washed and unwashed blood throughout the study period.

Intraoperatively-collected blood was washed in 23/30 studies (77%) and unwashed in 5/30 studies (17%); postoperatively-collected blood was washed in only 6/63 studies (10%) and unwashed in 53/63 studies (84%).

Transfusion threshold

Studies reported using a restrictive transfusion threshold (Hb ≤ 80 g/L) in 32 studies, a liberal threshold (Hb > 80 g/L) in 47 studies, and no threshold or protocol was reported in the remaining studies. Studies utilising a restrictive threshold were published between 1993 and 2019, though only two studies were from pre-2000 (Kelley-Patteson 1993; Ward 1993), and 19 (59%) were published since 2010.

In contrast, a liberal threshold was reported in publications between 1978 and 2021, but only 17 (36%) studies that reported using a liberal threshold were published since 2000, including just six (13%) since 2010.

Outcomes and follow-up

Our primary outcomes were reported in most studies: risk of transfusion in 85 RCTs (analysable data in 82 studies), and volume of transfusion in 85 RCTs (but only in an analysable form in 44 studies).

Blood loss was reported by 77 RCTs (only analysable in 49 studies due to reporting as median and IQR or range, or without reporting the spread of the data in any way). Similarly, hospital length of stay (LOS) was reported in 39 RCTs, but was only analysable in 20 studies.

The remaining outcomes were reported in less than half of studies: all-cause mortality (37 studies), wound complication (22 studies), re-operation (21 studies), DVT (20 studies), MI (17 studies), PE (14 studies), CVA/stroke (10 studies), venous thromboembolism (VTE)/thrombosis (six studies), MACE (two studies).

Data for infection could only be analysed from 24 studies (reported number of people who experienced an infection). For the remaining studies that reported infections, these were reported as infectious event (where an individual could have multiple infections), and have been presented separately (Table 2).

When reported, transfusion outcomes (number of people and volume transfused) were reported as perioperative or "during hospital stay", but mostly limited to nine days, though one study reported up to three months (So-Osman 2014). Mortality was reported variably from the perioperative and the immediate postoperative period (Adan 1988; Marberg 2010; McShane 1987; Schönberger 1993), up to 60 days (Thomassen 2011), three months (Horstmann 2014a), and one year (Vermeijden 2015).

Volume of transfusion (PPR and PPT)

Studies reported the volume of transfusion variably: some studies reported mean and standard deviation calculated per person

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randomised (PPR: including zeroes, i.e. where a transfusion was not required; 30 studies: Altinel 2007; Atay 2010; Axford 1994; Blatsoukas 2010; Clagett 1999; Dalrymple-Hay 1999; Davies 1987; Djurasovic 2018; Ekback 1995; Gäbel 2013a; Goel 2007; Heddle 1992; Kirkos 2006; Koopman-van Gemert 1993a; Koopman-van Gemert 1993b; Lepore 1989; Nemani 2019; Niranjan 2006; Page 1989; Savvidou 2009; Schaff 1978; Schönberger 1993; Shen 2016; Shirvani 1991; So-Osman 2014; Tripkovic 2008; Vermeijden 2015; Xie 2015; Zhao 1996; Zhao 2017), and per person transfused (PPT: excluding zeroes, i.e. where a transfusion was not required; 14 studies: Adalberth 1998; Elawad 1991; Eng 1990; Horstmann 2012; Horstmann 2013; Kelley-Patteson 1993; Khan 2017 (SALVO); Martin 2000; Murphy 2005; Parrot 1991; So-Osman 2006; Unsworth 1996; Zhang 2008; Zhao 2003). Where we had sufficient data, we were able to convert PPR to PPT (and vice versa) to combine more data together (see Appendix 3 for further information on these conversions. Conversion data can be found here). We have analysed all PPR data separately from all PPT data.

Trial registration

Of the 36 studies published from 2010 onwards, only 15 were registered on a clinical trials database: nine were retrospectively registered (date of registration was after the study start date: Cheung 2010; NCT00839241; NCT01251042; So-Osman 2014; Springer 2016; Teetzman 2014; Thomassen 2014; Touzopoulos 2021; Vermeijden 2015), and six were prospectively registered (registered before the study start date: Djurasovic 2018; Galaal 2019 (TIC TOC); Khan 2017 (SALVO); Shen 2016; Thomassen 2011; Xie 2015).

We did not actively search for trial registrations for studies published before 2010, but have made a note in the Characteristics of included studies if one was identified.

Excluded studies

See Characteristics of excluded studies for detailed reasons for exclusion.

We excluded a total of 92 studies for the following reasons.

- Non-RCT (only established from full-text assessment) (24 studies): Bisleri 2016; Cheng 2014; ChiCTR1800018689; ChiCTR-OCC-15006016; ChiCTR-ORN-17013372; Choi 2019; Duramaz 2018; JPRN UMIN 000019726; JPRN UMIN 000025157; JPRN UMIN 000043920; Khan 2022; McNair 2020; Morisaki 2013; NCT02654028; NCT05164406; NCT04588350; NTR2712; Nunes 2019; Quispe-Fernández 2020; Santiago-Lopez 2021; Sirvinskas 2007; Slagis 1991; Ubee 2010; Zhou 2014
- Ineligible study design (one study): Conn 2018
- Ineligible comparison (11 studies): Bosboom 2022; Djaiani 2012 (NCT00296985); DRKS00025454; Elawad 1992; Gäbel 2013b; Gorki 2017 (HEPCON II); Hogan 2014; Hogan 2015; ISRCTN59539154 (MASS III); NCT05545930; Ulrich 2014
- Ineligible population (non-elective, two studies): Dickenson 2022 (WHITE-9); Starlinger 2016
- Ineligible intervention (21 studies): ChiCTR1800016656; Ela 2009; Gunaydin 2013; Han 2021; Harlaar 2012; Hasan 2017; JPRN UMIN 000022227; Mayer 1985; McNair 2013; Naumenko 2003; NCT00176657; Whitlock 2013; NCT02338947; NCT03995160; NCT04304287; NCT05401175; NTR1589; Schmidt 1997; Soliman 2022; Sridhar 2019; Zhou 2020
- Ineligible comparator (one study): ISRCTN87590585
- No control group (16 studies): Albano 2010; Barbara 2010; Bartels 1996; Boyle 2019; Chen 2020; Deramoudt 1991; Garg 2015; Gu 2009; Gunaydin 2018; Jenni 2011; NCT01435304; Trubel 1995; Vertrees 1996; Vonk 2012; Wang 2012; Weltert 2013
- Complex intervention (12 studies): Campbell 2012b; ISRCTN85756518; Karlsson 2019; Laub 1993; McGill 2002; Tachias 2022; Tempe 1996; Tempe 2001; Wong 2002; Wu 2019; Xing 2014; Zacharopoulos 2007
- Systematic review, with references checked for inclusion (four systematic reviews): Khanuja 2023; Murtha-Lemekhova 2022; Wang 2022; Zacharowski 2022

Studies awaiting classification

We identified 33 studies that are awaiting classification due to a lack of information regarding the methods (study design), population, and intervention and comparator detail. We have contacted study authors for more information, though many studies were completed more than two years ago.

These studies include: 15 in cardiac surgery (coronary artery bypass graft (CABG): Aghdaii 2012; Bouboulis 1994; Cavolli 2011; Damgaard 2010; Matkovic 2010; Murphy 2004; myocardial re-vascularisation: Dietrich 1989; Fragnito 1995; Srndic 2014; Wiefferink 2007; valve replacement: Narula 2015; mixed/any cardiac: Bell 1992; NCT00950547; NCT02058134; Washington 2009); four in obstetric surgery (Caesarean section: Lei 2022; Liu 2020; Rainaldi 1998; Yu 2022); and 14 in orthopaedic surgery (hip, knee, or both: Güzel 2016; ISRCTN24531848; ISRCTN55488814; Martin 2009; Morgenschweis 2011; NCT01468129; Ritter 1994; Sintes 2009; Stamenic 2009; spinal: ChiCTR-IOR-17010508; Liang 2015; Shen 2013; any joint: Simpson 1994; other: Skoura 1997).

See Table 12 for an overview of studies awaiting classification, and Characteristics of studies awaiting classification for more detail.

Ongoing studies

We identified seven ongoing studies: three in cancer surgeries (spinal metastasis: ChiCTR1800018118; kidney cancer: NCT04922307 (RESTRICT); liver cancer: NCT05612477), three in cardiac surgeries (CABG: DRKS00021914; NCT04574128; any procedure: NCT02595385 (CONSERVE)); and one in obstetrics (Caesarean section: NCT03429790).

See Table 13 for an overview of ongoing studies, and Characteristics of ongoing studies for more detail.

Risk of bias in included studies

The previous review (2010) only assessed included studies based on selection bias (random sequence generation, and allocation concealment), and a single domain for blinding. We have re-assessed all of these studies for risk of bias using Cochrane ROB1, as described in Assessment of risk of bias in included studies.

Please refer to the risk of bias figures (Figure 2; Figure 3) for visual representation of risk across all studies and for individual studies. For more detail, see the risk of bias section in the Characteristics of included studies, and the assessment by each individual outcome in Table 14.

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Figure 2. Methodological quality summary: review authors' judgements about each methodological quality item for each included study.

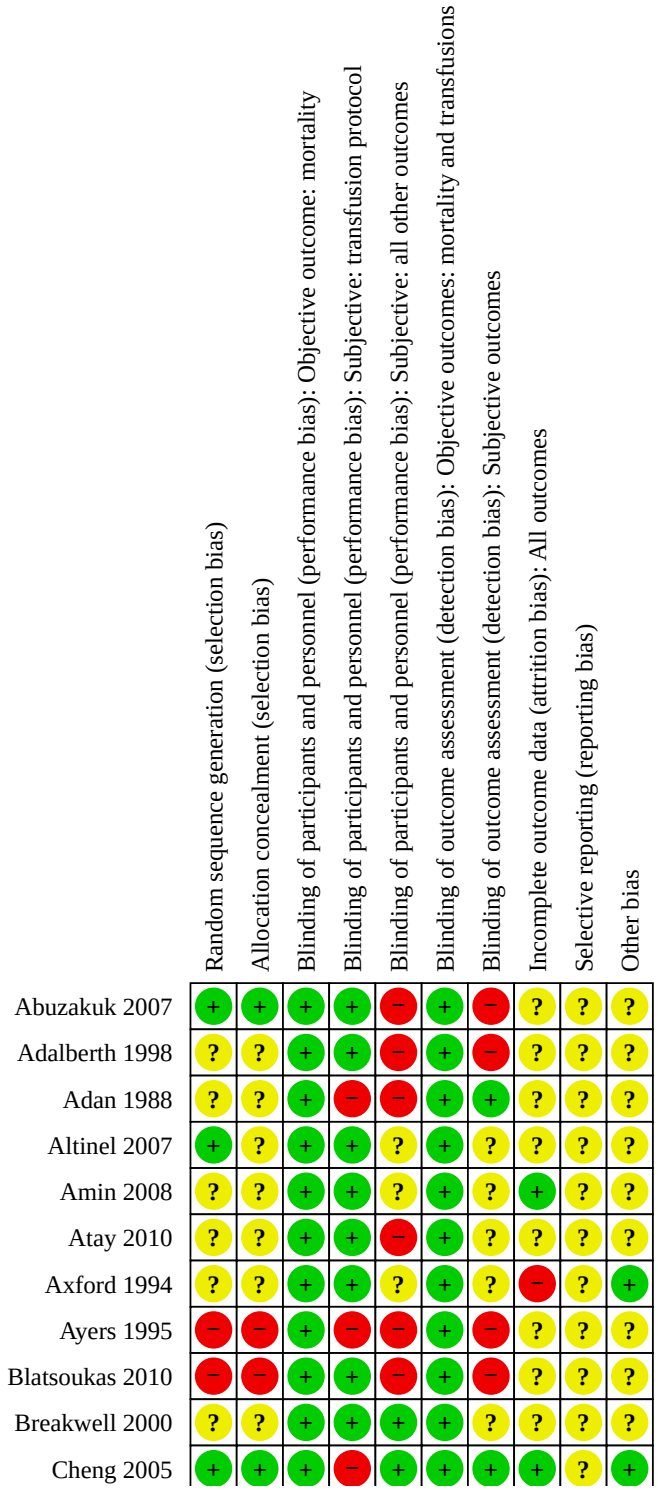

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Figure 2. (Continued)

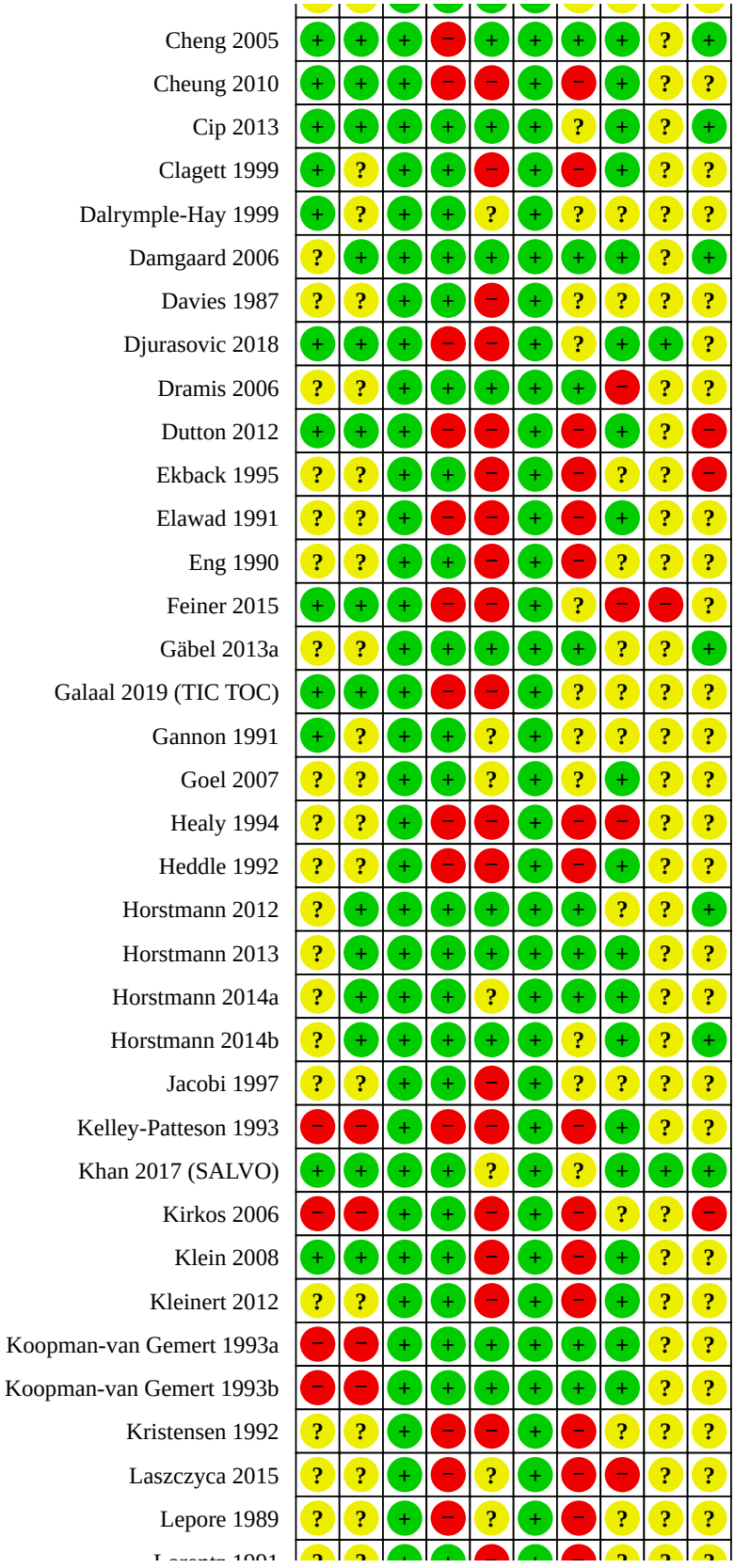

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Figure 2. (Continued)

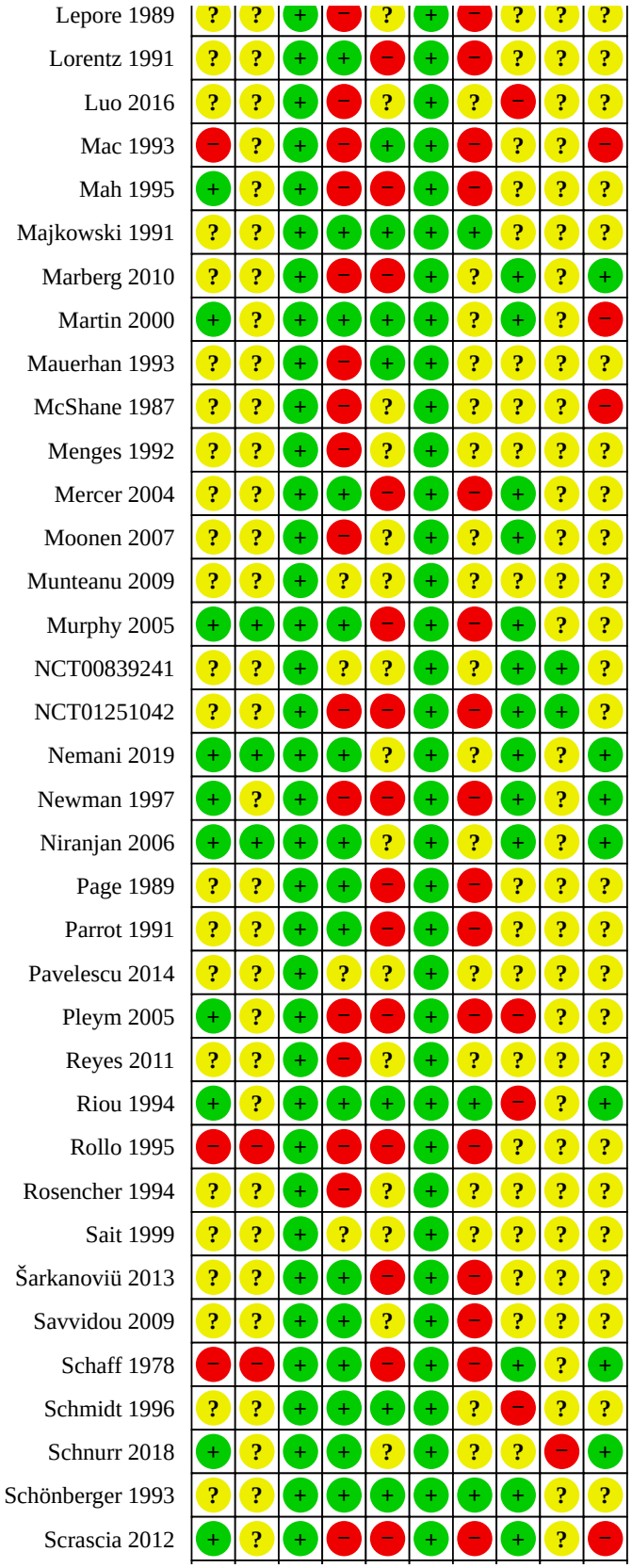

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Figure 2. (Continued)

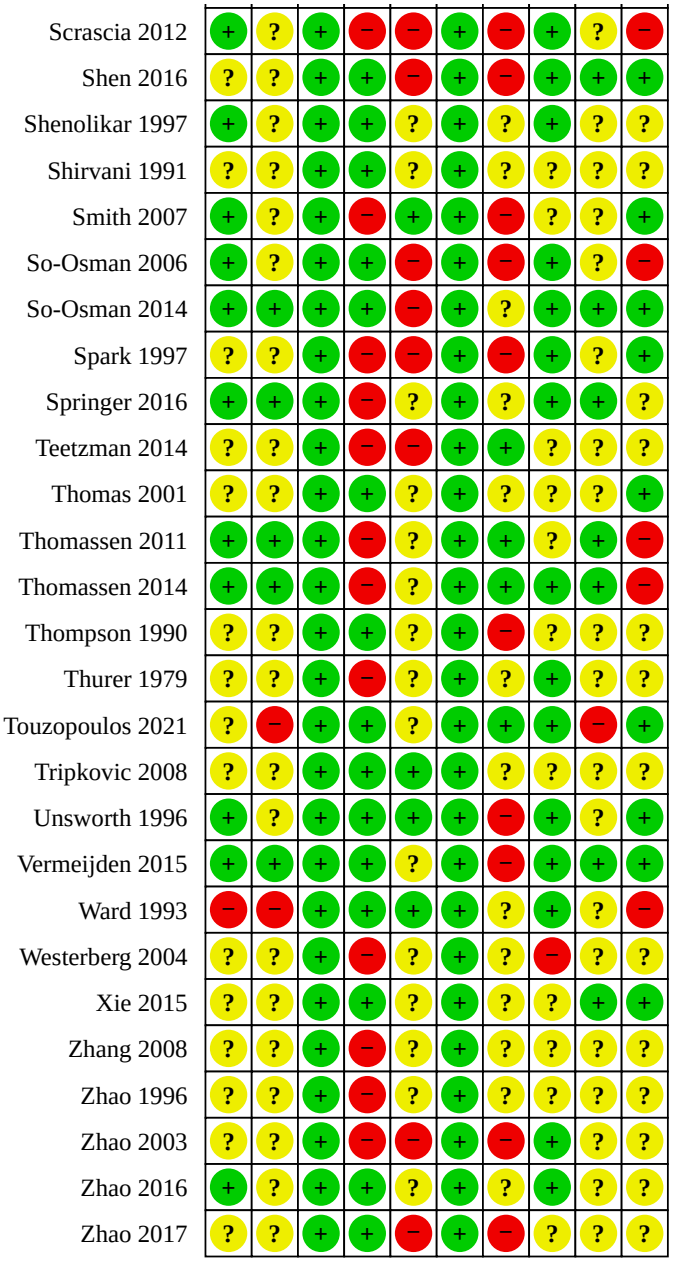

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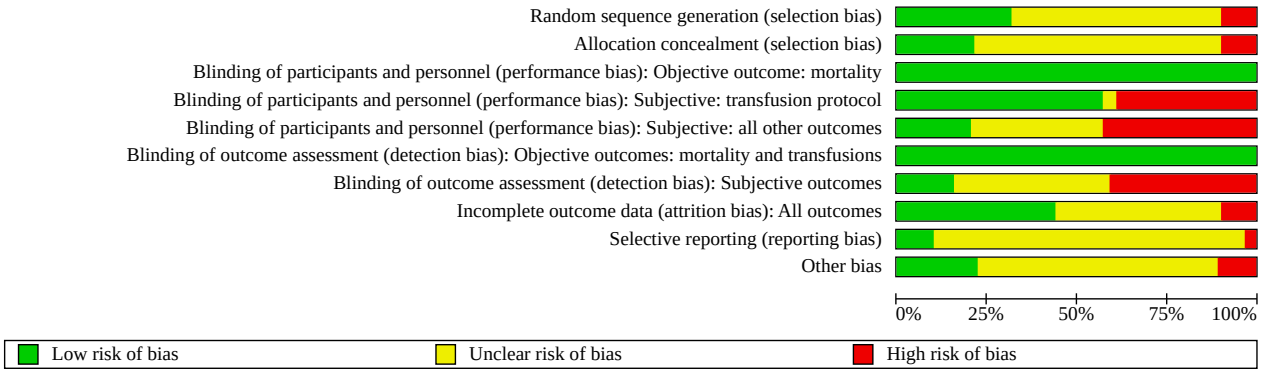
Figure 3. Methodological quality graph: review authors' judgements about each methodological quality item presented as percentages across all included studies.



Sensitivity analysis of study conduct (risk of bias)

Individual risk of bias domains are described below (Allocation (selection bias); Blinding (performance bias and detection bias); Incomplete outcome data (attrition bias); Selective reporting (reporting bias); Other potential sources of bias). None of the included studies were assessed as having a high risk of bias in the majority of domains. However, we also determined a priori that we would perform sensitivity analyses based on the evidence from studies with a low risk of bias for both random sequence generation and blinding (performance bias and detection bias) for the primary outcome (risk of transfusion).

Only the following 20 RCTs were assessed as having a low risk of bias in these domains (see Figure 2), and were therefore included in the sensitivity analysis.

- Cardiovascular (vascular): Clagett 1999
- Cardiovascular (no bypass): Murphy 2005; Niranjan 2006
- Cardiovascular (with bypass): Dalrymple-Hay 1999; Klein 2008; Martin 2000; Niranjan 2006; Unsworth 1996; Vermeijden 2015
- Obstetrics: Khan 2017 (SALVO)
- Orthopaedic (hip): Zhao 2016
- Orthopaedic (knee): Abuzakuk 2007; Altinel 2007; Cip 2013; Schnurr 2018; Shenolikar 1997
- Orthopaedic (spinal); Nemani 2019; Riou 1994
- Orthopaedic (mixed): Gannon 1991; So-Osman 2006; So-Osman 2014

Allocation

Random sequence generation (selection bias)

We assessed 10 RCTs as high risk of bias due to: openly alternating between the intervention and control groups (Kelley-Patteson 1993; Kirkos 2006; Koopman-van Gemert 1993a; Koopman-van Gemert 1993b), or using the individual's hospital or other identification number (Ayers 1995; Blatsoukas 2010; Schaff 1978; Ward 1993), or month of birth (Rollo 1995). In one study, the initial randomisation method was unclear, but then randomisation was broken, with the operating surgeon reassigning some participants to the intervention group (Mac 1993).

We deemed 34 RCTs as low risk of bias due to adequately describing the method of randomisation, including computer/web-based randomisation, coin toss, and shuffling cards: Abuzakuk 2007; Altinel 2007; Cheng 2005; Cheung 2010; Cip 2013; Clagett 1999; Dalrymple-Hay 1999; Djurasovic 2018; Dutton 2012; Feiner 2015; Galaal 2019 (TIC TOC); Gannon 1991; Khan 2017 (SALVO); Klein 2008; Mah 1995; Martin 2000; Murphy 2005; Nemani 2019; Newman 1997; Niranjan 2006; Pleym 2005; Riou 1994; Schnurr 2018; Scrascia 2012; Shenolikar 1997; Smith 2007; So-Osman 2006; So-Osman 2014; Springer 2016; Thomassen 2011; Thomassen 2014; Unsworth 1996; Vermeijden 2015; Zhao 2016.

We assessed the remaining 62 RCTs as unclear risk of bias due to lack of detailed information about the randomisation methods, often due to historical reporting guidelines.

Allocation concealment (selection bias)

Nine studies that were at high risk of bias for inadequate sequence generation were thus also at high risk of bias for inadequate allocation concealment (Ayers 1995; Blatsoukas 2010; Kelley-Patteson 1993; Kirkos 2006; Koopman-van Gemert 1993a; Koopman-van Gemert 1993b; Rollo 1995; Schaff 1978; Ward 1993). Additionally, one study was described as having an unblinded randomisation process, suggesting no allocation concealment (Touzopoulos 2021).

We deemed 23 RCTs as low risk of bias due to adequately described allocation concealment, including using opaque sealed envelopes, or a central allocation system (those that were also low risk for method of sequence generation: Abuzakuk 2007; Cheng 2005; Cheung 2010; Cip 2013; Djurasovic 2018; Dutton 2012; Feiner 2015; Galaal 2019 (TIC TOC); Khan 2017 (SALVO); Klein 2008; Murphy 2005; Nemani 2019; Niranjan 2006; So-Osman 2014; Springer 2016; Thomassen 2011; Thomassen 2014; Vermeijden 2015; and those with unclear risk for sequence generation: Damgaard 2006; Horstmann 2012; Horstmann 2013; Horstmann 2014a; Horstmann 2014b).

We assessed the remaining 74 RCTs as unclear risk of bias due to lack of detailed information about the method or presence of allocation concealment, often due to historical reporting guidelines.

Blinding

For assessment of performance bias from blinding, we separately assessed the risk for mortality (objective outcome), transfusion

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protocol (for the primary outcome, subjective) and "other subjective" outcomes. For detection bias from blinding, we assessed the risk for mortality and transfusion (objective) and all other subjective outcomes.

We considered the only objective outcome to be all-cause mortality for performance bias, but both mortality and transfusion were deemed objective for detection bias, as the participant either did or did not receive a transfusion and so lack of blinding would not impact the recording of whether a transfusion was received. In comparison, lack of blinding may impact the decision to give a transfusion (performance bias).

For subjective outcomes, we assessed each outcome separately depending on the information available in the study methods, registration, or protocol ("subjective: low risk of bias" where clear protocols or diagnostic criteria were in place; and "subjective: high risk of bias" where no protocols/ diagnostic criteria were used or described). See Table 14 for our ROB assessment per outcome for blinding.

Blinding of participants and personnel (performance bias)

Objective outcome (all-cause mortality)

Due to the objective nature of the outcome, we considered all RCTs reporting this as an outcome to be low risk for both performance and detection bias: 38 studies reported mortality: Adan 1988; Axford 1994; Cheung 2010; Clagett 1999; Dalrymple-Hay 1999; Damgaard 2006; Davies 1987; Dutton 2012; Eng 1990; Galaal 2019 (TIC TOC); Goel 2007; Horstmann 2014a; Jacobi 1997; Kelley-Patteson 1993; Khan 2017 (SALVO); Lepore 1989; Marberg 2010; Martin 2000; McShane 1987; Mercer 2004; Murphy 2005; NCT01251042; Nemani 2019; Niranjan 2006; Parrot 1991; Reyes 2011; Schaff 1978; Schönberger 1993; Scrascia 2012; Shen 2016; Teetzman 2014; Thomassen 2011; Thompson 1990; Thurer 1979; Unsworth 1996; Vermeijden 2015; Ward 1993; Xie 2015.

The remaining studies did not report mortality (or did not report it clearly enough to determine death per group), though we have also recorded these as low risk, in case data become available in the future.

Subjective outcome (transfusion protocol)

We assessed risk of bias for outcomes related to the use of a strict transfusion protocol (stating an absolute threshold for transfusion) for the two primary outcomes (number of people requiring/ receiving a transfusion, and the volume of blood transfused). Where no transfusion threshold was reported, the transfusion protocol was also based on "clinical signs", or people were transfused at the "clinician's discretion", we deemed this to be at high risk of bias when the personnel were aware of allocation (unblinded study), or where there was poor randomisation/allocation concealment. Studies were deemed at high risk of performance bias regarding the decision to transfuse, reported as either number of people or volume (40 RCTs: Adan 1988; Ayers 1995; Cheung 2010; Cheng 2005; Djurasovic 2018; Dutton 2012; Elawad 1991; Feiner 2015; Galaal 2019 (TIC TOC); Healy 1994; Heddle 1992; Kelley-Patteson 1993; Kristensen 1992; Laszczyca 2015; Lepore 1989; Mac 1993; Mah 1995; Marberg 2010; Mauerhan 1993; McShane 1987; Menges 1992; Moonen 2007; NCT01251042; Newman 1997; Pleym 2005; Reyes 2011; Rollo 1995; Rosencher 1994; Scrascia 2012; Smith 2007; Spark 1997; Springer 2016; Teetzman 2014; Thomassen 2011; Thomassen 2014; Thurer 1979; Westerberg 2004; Zhang 2008; Zhao 1996; Zhao 2003).

One study reported no transfusion protocol (high risk of bias), and then excluded anyone who received an allogeneic transfusion, but did not report on numbers who had been excluded as a result (Luo 2016).

Four studies lacked information to make a clear assessment, and so were assessed as unclear risk of bias (no data available: NCT00839241; conference abstract only: Pavelescu 2014; Sait 1999; mentions targets instead of thresholds, but this may be due to a translation limitation: Munteanu 2009).

The remaining 61 studies provided sufficient detail to be sure of a strict transfusion protocol, using clear thresholds, or where all personnel (those deciding whether to transfuse) were blinded to allocation.

Subjective outcomes (all other outcomes)

Where study personnel and participants were unblinded, we assessed whether clear definitions or guidelines had been prepared (and reported) for clinical decision-making within each study (e.g. decision to re-admit/re-operate, early or delayed treatment that may affect other outcomes).

We assessed 45 RCTs as high risk of bias as they were unblinded and had no criteria for decision-making, with large risk of subjectivity and between-participant variability (Abuzakuk 2007; Adalberth 1998; Adan 1988; Atay 2010; Ayers 1995; Blatsoukas 2010; Cheung 2010; Clagett 1999; Davies 1987; Djurasovic 2018; Dutton 2012; Ekback 1995; Elawad 1991; Eng 1990; Feiner 2015; Galaal 2019 (TIC TOC); Healy 1994; Heddle 1992; Jacobi 1997; Kelley-Patteson 1993; Kirkos 2006; Klein 2008; Kleinert 2012; Kristensen 1992; Lorentz 1991; Mah 1995; Marberg 2010; Mercer 2004; Murphy 2005; NCT01251042; Newman 1997; Page 1989; Parrot 1991; Pleym 2005; Rollo 1995; Šarkanoviü 2013; Schaff 1978; Scrascia 2012; Shen 2016; So-Osman 2006; So-Osman 2014; Spark 1997; Teetzman 2014; Zhao 2003; Zhao 2017).

We assessed 21 RCTs as low risk due to blinding of clinical personnel or implementation of clear criteria in the decision-making process (Breakwell 2000; Cheng 2005; Cip 2013; Damgaard 2006; Dramis 2006; Gäbel 2013a; Horstmann 2012; Horstmann 2013; Horstmann 2014b; Koopman-van Gemert 1993a; Koopman-van Gemert 1993b; Mac 1993; Majkowski 1991; Martin 2000; Mauerhan 1993; Riou 1994; Schmidt 1996; Schönberger 1993; Smith 2007; Unsworth 1996; Ward 1993).

We deemed the remaining studies as unclear risk due to lack of clarity over whether clinicians and participants were blinded, and whether there were guidelines in place for each study.

Blinding of outcome assessment (detection bias)

Objective outcome (all-cause mortality and transfusion protocol)

Due to the objective nature of mortality, we considered all RCTs reporting this as an outcome to be low risk for both performance and detection bias (detailed under 'performance bias', above).

We did not assess detection bias based on the use of a transfusion protocol as a subjective outcome, as once the decision to transfuse has been made (performance bias), the detection of whether

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someone has been transfused (and the volume) is clear, and similar in nature to the assessment of mortality (they either did or did not receive a transfusion).

Subjective outcomes (all other outcomes)

Where outcome assessors were unblinded, we assessed whether clear diagnostic criteria or definitions were prepared (and reported) for each outcome (e.g. definitions of infection, thromboembolic events, discharge criteria for length of stay).

We assessed 43 RCTs as high risk of bias as assessors were unblinded and did not report any diagnostic criteria or guidelines to remove or minimise biases for the subjective outcomes (Abuzakuk 2007; Adalberth 1998; Ayers 1995; Blatsoukas 2010; Cheung 2010; Clagett 1999; Dutton 2012; Ekback 1995; Elawad 1991; Eng 1990; Healy 1994; Heddle 1992; Kelley-Patteson 1993; Kirkos 2006; Klein 2008; Kleinert 2012; Kristensen 1992; Laszczyca 2015; Lepore 1989; Lorentz 1991; Mac 1993; Mah 1995; Mercer 2004; Murphy 2005; NCT01251042; Newman 1997; Page 1989; Parrot 1991; Pleym 2005; Rollo 1995; Šarkanoviü 2013; Savvidou 2009; Schaff 1978; Scrascia 2012; Shen 2016; Smith 2007; So-Osman 2006; Spark 1997; Thompson 1990; Unsworth 1996; Vermeijden 2015; Zhao 2003; Zhao 2017).

We assessed 17 RCTs as low risk due to adequate blinding to group allocation or implementation of clear diagnostic criteria (Adan 1988; Cheng 2005; Damgaard 2006; Dramis 2006; Gäbel 2013a; Horstmann 2012; Horstmann 2013; Horstmann 2014a; Koopman-van Gemert 1993a; Koopman-van Gemert 1993b; Majkowski 1991; Riou 1994; Schönberger 1993; Teetzman 2014; Thomassen 2011; Thomassen 2014; Touzopoulos 2021).

We deemed the remaining studies as unclear risk due to lack of clarity over whether outcome assessors were blinded, and whether there were guidelines in place for each study.

Incomplete outcome data

We assessed attrition though the description of participant flow through the study, examining reasons for exclusions, dropouts, and follow-up, and whether analyses were per-protocol (PP) or intention-to-treat (ITT).

We assessed 11 RCTs as high risk of bias due to: large loss to follow-up (greater than 20%: Axford 1994; Riou 1994); cross-over or re-allocation of participants after randomisation from one group to another (Dramis 2006; Feiner 2015; Laszczyca 2015); unbalanced dropout across groups (Healy 1994; Westerberg 2004); and invalid exclusions (Luo 2016; Pleym 2005; Schmidt 1996).

We assessed 46 RCTs as low risk of attrition bias (Amin 2008; Cheng 2005; Cip 2013; Clagett 1999; Damgaard 2006; Djurasovic 2018; Dutton 2012; Elawad 1991; Goel 2007; Heddle 1992; Horstmann 2013; Horstmann 2014a; Horstmann 2014b; Kelley-Patteson 1993; Khan 2017 (SALVO); Klein 2008; Kleinert 2012; Koopman-van Gemert 1993a; Koopman-van Gemert 1993b; Marberg 2010; Martin 2000; Mercer 2004; Moonen 2007; Murphy 2005; NCT00839241; NCT01251042; Nemani 2019; Newman 1997; Niranjan 2006; Schaff 1978; Schönberger 1993; Scrascia 2012; Shen 2016; Shenolikar 1997; So-Osman 2006; So-Osman 2014; Spark 1997; Springer 2016; Thomassen 2014; Thurer 1979; Touzopoulos 2021; Unsworth 1996; Vermeijden 2015; Ward 1993; Zhao 2003; Zhao 2016).

We deemed the remaining studies as unclear risk due to inadequate reporting, likely due to historical standards.

Selective reporting

Where a protocol or trial registration was available, we compared this to the reporting of outcomes in the full publication (or wherever the result data were published, including conference abstracts and in the trial registration itself). Where all outcomes were reported as defined in the protocol/trial registration, we deemed the study as low risk of reporting bias (11 RCTs: Djurasovic 2018; Khan 2017 (SALVO); NCT00839241; NCT01251042; Shen 2016; So-Osman 2014; Springer 2016; Thomassen 2011; Thomassen 2014; Vermeijden 2015; Xie 2015).

We assessed three studies as high risk of bias, as outcomes or methods differed significantly between trial registration/protocol and full report. One study changed its trial after study commencement (Feiner 2015); one had significant differences between the published methods and results within the full publication (with no protocol available: Schnurr 2018); and one study predefined only one outcome in the trial registration, but reported multiple outcomes in the full publication (Touzopoulos 2021).

We deemed all remaining studies as unclear risk as no protocols or trial registrations were available, often due to historical reporting standards for RCTs.

Other potential sources of bias

Other biases that we considered included: baseline imbalances; block randomisation in an unblinded trial; and sources of funding (pharmaceutical and non-pharmaceutical) and conflict of interest reporting. We also noted where data were being drawn from a non-peer reviewed publication, and any other potential risks.

We assessed 11 RCTs as high risk of other biases due to: significant protocol deviations (Dutton 2012); baseline imbalance (Ekback 1995; Kirkos 2006; Mac 1993; Martin 2000; McShane 1987; Scrascia 2012; So-Osman 2006; Ward 1993); and involvement in the design, conduct, and analyses by the funding source (commercial pharmaceutical company: Thomassen 2011; Thomassen 2014).

We assessed 23 RCTs as low risk of bias as they presented data highlighting no baseline imbalance, and/or reported conflicts and funding sources that would have no impact on the study bias (Axford 1994; Cheng 2005; Cip 2013; Damgaard 2006; Gäbel 2013a; Horstmann 2012; Horstmann 2014b; Khan 2017 (SALVO); Marberg 2010; Nemani 2019; Newman 1997; Niranjan 2006; Riou 1994; Schaff 1978; Schnurr 2018; Smith 2007; So-Osman 2014; Spark 1997; Thomas 2001; Touzopoulos 2021; Unsworth 1996; Vermeijden 2015; Xie 2015).

We assessed the remaining studies as unclear, usually due to lack of reporting/statements regarding conflicts and funding sources. This is likely due to historical reporting standards.

Effects of interventions

See: **Summary of findings 1** Cell salvage compared to no cell salvage in cancer surgery; **Summary of findings 2** Cell salvage compared to no cell salvage in cardiovascular (vascular) surgeries; **Summary of findings 3** Cell salvage compared to no cell salvage in cardiovascular (no bypass) surgeries; **Summary of findings 4**

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Cell salvage compared to no cell salvage in cardiovascular (with bypass) surgeries; **Summary of findings 5** Cell salvage compared to no cell salvage in obstetrics; **Summary of findings 6** Cell salvage compared to no cell salvage in orthopaedic (hip) surgeries; **Summary of findings 7** Cell salvage compared to no cell salvage in orthopaedic (knee) surgeries; **Summary of findings 8** Cell salvage compared to no cell salvage in orthopaedic (spinal) surgeries; **Summary of findings 9** Cell salvage compared to no cell salvage in orthopaedic (mixed) surgeries

There was only one comparison of interest from these studies: cell salvage versus no cell salvage. We excluded any studies where we were unable to isolate the impact of cell salvage alone (i.e. in complex interventions where not all elements were controlled for).

Sensitivity analyses

Before undertaking analyses for all outcomes, we performed the sensitivity analyses on our primary outcome measure (risk of transfusion of allogeneic blood in the study observation period) to assess the impact of prospective trial registration and study conduct (risk of bias, ROB) (as described in Sensitivity analysis).

Initial analyses included all studies reporting the primary outcome measure (number of people who received a transfusion of allogeneic blood in the study observation period), subgrouped by the type of surgery. We performed sensitivity analyses based on trial registration status and ROB on these data (Analysis 1.1; Analysis 1.2; Analysis 1.3). They are summarised below.

Outcome: risk of a transfusion of allogeneic blood

Data in **bold** in the table below show no difference between intervention and control groups (no clear effect of the intervention).

Type of surgery	All data RR (95% CI) (Analysis 1.1)	Sensitivity analysis: registration status (Analysis 1.2)	Sensitivity analysis: low ROB in domains of interest (Analysis 1.3)
All surgeries (aggregate analysis)	0.65 (0.59, 0.72) 82 RCTs N = 12,520	0.62 (0.55, 0.70) 58 RCTs N = 6353	0.74 (0.61, 0.89) 17 RCTs N = 6398
Cancer	No data for this outcome	No data for this outcome	No data for this outcome
Cardiovascular (vascular)	**0.61 (0.32, 1.15)** **4 RCTs** **N = 266**	**0.61 (0.32, 1.15)** **4 RCTs** **N = 266**	**0.92 (0.70, 1.19)** **1 RCT** **N = 100**
Cardiovascular (no bypass)	0.82 (0.69, 0.97) 3 RCTs N = 169	0.82 (0.69, 0.97) 3 RCTs N = 169	**0.59 (0.19, 1.81)** **1 RCT** **N = 61**
Cardiovascular (with bypass)	0.81 (0.73, 0.89) 25 RCTs N = 2676	0.79 (0.70, 0.89) 20 RCTs N = 1756	0.82 (0.70, 0.97) 5 RCTs N = 1344
Obstetrics	**0.82 (0.38, 1.76)** **1 RCT** **N = 1349**	**0.82 (0.38, 1.76)** **1 RCT** **N = 1349**	**0.82 (0.38, 1.76)** **1 RCT** **N = 1349**
Orthopaedic (hip)	0.52 (0.38, 0.72) 14 RCTs N = 1641	0.47 (0.27, 0.80) 7 RCTs N = 585	0.36 (0.26, 0.51) 1 RCT N = 200

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Orthopaedic (knee)	0.49 (0.37, 0.66) 21 RCTs N = 2214	0.40 (0.26, 0.60) 13 RCTs N = 1210	**0.66 (0.29, 1.50)** **4 RCTs** **N = 544**
Orthopaedic (spinal)	0.44 (0.31, 0.63) 3 RCTs N = 194	0.54 (0.34, 0.85) 2 RCTs N = 145	**0.50 (0.05, 5.17)** **1 RCT** **N = 50**
Orthopaedic (mixed)	0.64 (0.45, 0.90) 11 RCTs N = 4011	0.53 (0.39, 0.72) 8 RCTs N = 873	**0.74 (0.35, 1.59)** **3 RCTs** **N = 2750**

Registration status appears to make little to no difference on the summary statistic (favours cell salvage in all surgeries except obstetrics and cardiovascular (vascular)). The sensitivity analysis including only those with low ROB in the most important domains for this review (random sequence generation and blinding (performance bias and detection bias) for the primary outcome used in the sensitivity analysis: risk of transfusion), removed the clear effect of the intervention in cardiovascular (no bypass), orthopaedic (knee), orthopaedic (spinal), and orthopaedic (mixed populations).

We are therefore confident to continue our analyses including all trials that were not registered, or were registered retrospectively, that were published since 2010.

We have also continued to include all studies regardless of ROB status, as no studies had high risk of bias in the majority of domains, and were largely classified as unclear risk in the relevant domains, usually due to historical reporting standards. However, we have considered these findings in our interpretation, including downgrading the certainty of the evidence.

Aggregate analysis (primary outcome only)

Eight-two studies with a total of 12,520 participants reported the number of people who required a transfusion (risk of allogeneic transfusion).

The aggregate analysis showed a clear effect of the intervention, reducing the need for allogeneic transfusion as a result of cell salvage, overall (RR 0.65, 95% CI 0.59 to 0.72; very low-certainty evidence; Analysis 1.1), and in all subgroups except 'timing of collection: both', which only just touched the line of no effect (intraoperative collection: RR 0.70, 95% CI 0.60 to 0.82; low-certainty evidence; postoperative collection: RR 0.58, 95% CI 0.50 to 0.68; very low-certainty evidence; both: RR 0.84, 95% CI 0.71 to 1.00; low-certainty evidence; restrictive threshold: RR 0.72, 95% CI 0.61 to 0.85; low-certainty evidence; liberal threshold: RR 0.59, 95% CI 0.50 to 0.69; very low-certainty evidence; no threshold: RR 0.64, 95% CI 0.49 to 0.83; very low-certainty evidence).

See Table 15 for the results of the analyses (subgrouped by timing: Analysis 1.4; and subgrouped by transfusion threshold: Analysis 1.5)

We were able to assess publication bias using a funnel plot (Figure 4, subgrouped by type of surgery). There is some evidence of missing smaller trials that may be in favour of no cell salvage (control), though these would be unlikely to impact the overall summary statistic.

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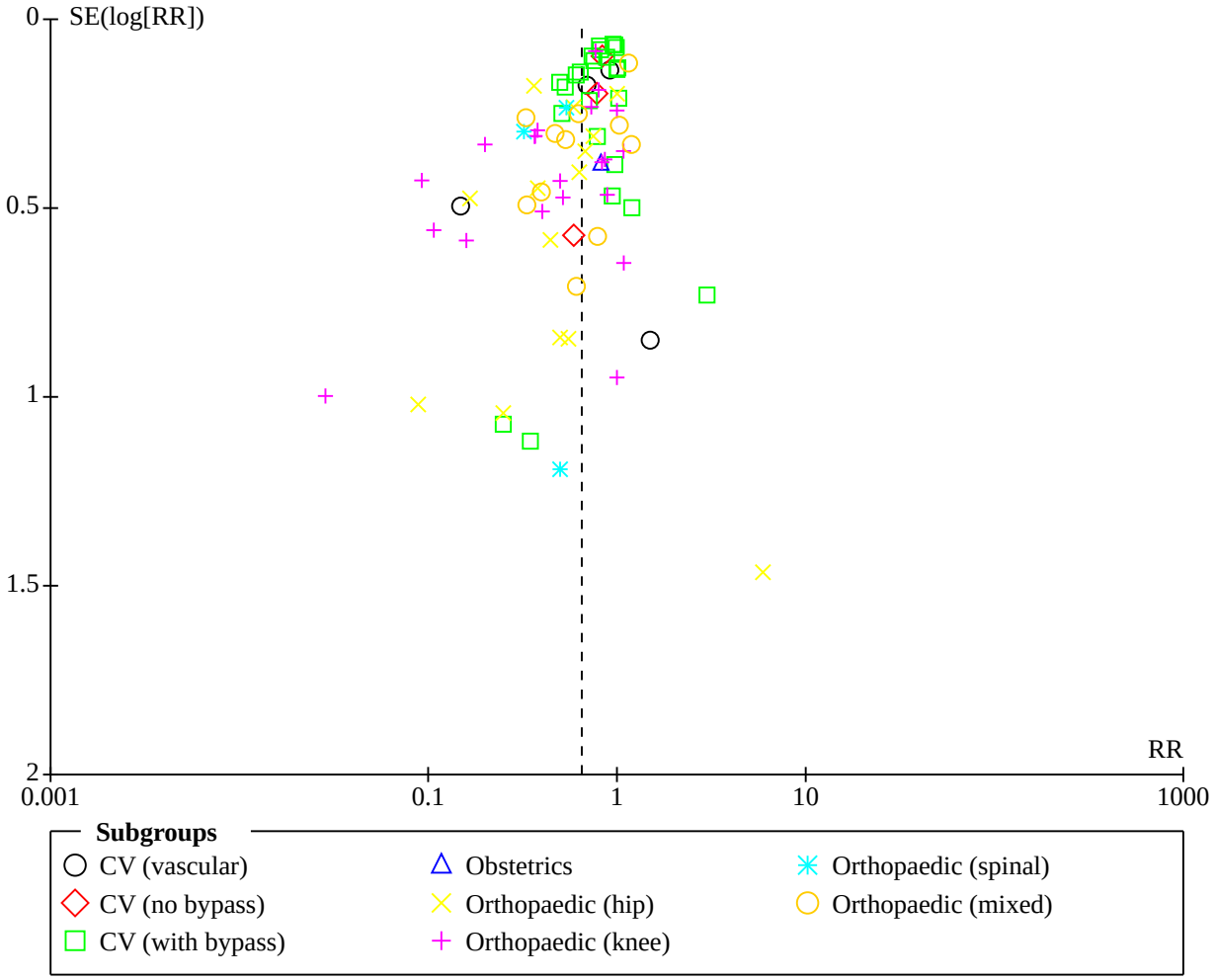
Figure 4.



Cancer

Two RCTs with a total of 79 participants assessed cell salvage use in people undergoing cancer surgeries: both were genitourinary cancers. See Table 16 for the results of all analyses.

Overall

Very low-certainty evidence means we are uncertain whether there is a difference between groups for mortality, blood loss, infection, or DVT.

There were no analysable data reported for risk of allogeneic transfusion, volume transfused, re-operation for bleeding, wound complication, VTE/thrombosis, PE, MACE, MI, CVA/stroke, and hospital LOS.

Subgroups

Subgroup: timing (intraoperative only)

All data were for intraoperative collection.

Subgroup: transfusion threshold (no threshold reported)

All data were for no transfusion threshold.

Analyses and overview of the evidence

See Table 16 for the results of all analyses (subgrouped by timing: Analysis 2.1; Analysis 2.2; Analysis 2.3; Analysis 2.4; subgrouped by transfusion threshold: Analysis 3.1; Analysis 3.2; Analysis 3.3; Analysis 3.4) and Summary of findings 1.

Cardiovascular (vascular)

Six RCTs with a total of 384 participants assessed cell salvage use in vascular surgeries: abdominal aortic aneurysm and aorto-femoral bypass. See Table 17 for the results of all analyses.

Overall

Low-certainty evidence suggests there may be no difference between groups for volume transfused, blood loss, and hospital LOS.

Very low-certainty evidence means we are uncertain whether there is a difference between groups for risk of allogeneic

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transfusion, mortality, re-operation for bleeding, infection, wound complication, VTE/thrombosis, DVT, PE, MI, and CVA/stroke.

There were no analysable data reported for MACE.

Subgroups

Subgroup: timing (intraoperative only)

All data were for intraoperative collection.

Subgroup: transfusion threshold (liberal and restrictive)

Subgrouping had no impact on direction of the effect (no difference between groups), or certainty of the evidence for: risk of transfusion, volume transfused (PPR and PPT), all-cause mortality, blood loss, re-operation, infection, wound complication, VTE/thrombosis, DVT, PE, MI, CVA/stroke, and hospital LOS.

Analyses and overview of the evidence

See Table 17 for the results of all analyses (subgrouped by timing: Analysis 4.1; Analysis 4.2; Analysis 4.3; Analysis 4.4; Analysis 4.5; Analysis 4.6; Analysis 4.7; Analysis 4.8; Analysis 4.9; Analysis 4.10; Analysis 4.11; Analysis 4.12; Analysis 4.13; Analysis 4.14; subgrouped by transfusion threshold: Analysis 5.1; Analysis 5.2; Analysis 5.3; Analysis 5.4; Analysis 5.5; Analysis 5.6; Analysis 5.7; Analysis 5.8; Analysis 5.9; Analysis 5.10; Analysis 5.11; Analysis 5.12; Analysis 5.13; Analysis 5.14) and Summary of findings 2.

Cardiovascular (no bypass)

Six RCTs with a total of 372 participants assessed cell salvage use in cardiac surgery without bypass, or did not mention the use of bypass in the publication. See Table 18 for the results of all analyses.

Overall

Moderate-certainty evidence suggests there is probably a reduction in risk of allogeneic transfusion as a result of cell salvage.

Low-certainty evidence suggests there may be no difference between groups for volume transfused (PPT) and blood loss.

Very low-certainty evidence means we are uncertain whether there is a reduction in volume transfused (PPR) as a result of cell salvage, or if there is any difference between groups for mortality, re-operation for bleeding, infection, wound complication, MI, CVA/stroke, and hospital LOS.

There were no analysable data reported for VTE/thrombosis, DVT, PE, and MACE.

Subgroups

Subgroup: timing (intraoperative and postoperative)

Subgrouping had no impact on direction of the effect (no difference between groups), or certainty of the evidence for: volume transfused (PPT), all-cause mortality, blood loss, re-operation, infection, wound complication, MI, CVA/stroke, and hospital LOS.

For risk of transfusion, subgrouping now showed no difference between groups (previously favoured cell salvage) in all subgroups, alongside a reduction in certainty of the evidence (from moderate to low certainty) due to greater imprecision (wider confidence intervals).

For volume transfused (PPR), there was no change in the direction of the effect (favours cell salvage) and certainty of the evidence (very low) in the postoperative subgroup. In contrast, the intraoperative subgroup now showed no difference between groups (previously favoured cell salvage), with very low-certainty evidence (unchanged).

Subgroup: transfusion threshold (no transfusion threshold, liberal, and restrictive threshold)

Subgrouping had no impact on direction of the effect (no difference between groups), or certainty of the evidence for: volume transfused (PPT), all-cause mortality, blood loss, re-operation, infection, wound complication, MI, CVA/stroke, and hospital LOS.

For risk of transfusion, there was no change in the direction of the effect (favours cell salvage) and certainty of the evidence (moderate certainty) in the liberal threshold subgroup. In contrast, the restrictive threshold subgroup now showed no difference between groups (previously favoured cell salvage) with reduced certainty (from moderate to low certainty) due to greater imprecision (wider confidence intervals).

For volume transfused (PPR), there was no change in the direction of the effect (favours cell salvage) and certainty of the evidence (very low) in the no threshold subgroup. In contrast, the liberal and restrictive threshold subgroups showed no difference between groups (previously favoured cell salvage), with very low-certainty evidence (unchanged).

Analyses and overview of the evidence

See Table 18 for the results of all analyses (subgrouped by timing: Analysis 6.1; Analysis 6.2; Analysis 6.3; Analysis 6.4; Analysis 6.5; Analysis 6.6; Analysis 6.7; Analysis 6.8; Analysis 6.9; Analysis 6.10; Analysis 6.11; subgrouped by transfusion threshold: Analysis 7.1; Analysis 7.2; Analysis 7.3; Analysis 7.4; Analysis 7.5; Analysis 7.6; Analysis 7.7; Analysis 7.8; Analysis 7.9; Analysis 7.10; Analysis 7.11) and Summary of findings 3.

Cardiovascular (with bypass)

Twenty-nine RCTs with a total of 2936 participants assessed cell salvage use in cardiac surgery with bypass: coronary artery bypass graft (CABG) and valve replacement. Data were available for all outcomes. See Table 19 for the results of all analyses.

Overall

Moderate-certainty evidence suggests there is probably no difference between groups for risk of CVA/stroke.

Low-certainty evidence suggests there may be a reduction in the risk of allogeneic transfusion as a result of cell salvage, and suggests there may be no difference in risk of infection and hospital LOS.

Very low-certainty evidence means we are uncertain whether there is a reduction in volume transfused as a result of cell salvage, or if there is any difference between groups for mortality, blood loss, re-operation for bleeding, wound complication, VTE/thrombosis, DVT, PE, MACE, and MI.

Subgroups

Subgroup: timing (intraoperative, postoperative, both)

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Subgrouping had no impact on direction of the effect (no difference between groups), or certainty of the evidence for: all-cause mortality, blood loss, re-operation, infection, wound complication, VTE/thrombosis, DVT, PE, MACE, MI, and CVA/stroke.

For risk of transfusion, most studies were of postoperative timing, and therefore the direction and size of the effect (favours cell salvage) and certainty of the evidence (low certainty) remained unchanged. For the intraoperative subgroup, direction of the effect did not change (favours cell salvage) with lower certainty of the evidence (from low to very low certainty) due to greater heterogeneity (source of increased heterogeneity unidentified). In contrast, the "both" timing subgroup now showed no difference between groups (previously favoured cell salvage), with reduced certainty of the evidence (from low to very low certainty) due to greater emphasis from one study with high ROB (randomisation and allocation concealment).

For volume transfused (PPR), there was no impact on the direction of the effect (favours cell salvage) in all subgroups, and certainty of the evidence improved in the intraoperative subgroup only (from very low to low certainty) due to reduced heterogeneity.

For volume transfused (PPT), there was no impact from subgrouping on the direction of the effect (favours cell salvage) and certainty of the evidence (very low certainty) in the postoperative and "both" timing subgroups. In contrast, the intraoperative subgroup now showed no difference between groups (previously favoured cell salvage), with no change in certainty of the evidence (very low certainty).

For hospital LOS, most studies used intraoperative collection, and the direction and certainty of the evidence remained unchanged in this subgroup (no difference between groups, low-certainty evidence). In contrast, in the postoperative subgroup, the direction of the effect changed (from no difference to favouring cell salvage), with certainty of the evidence unchanged (low certainty).

Subgroup: transfusion threshold (no transfusion threshold, liberal threshold, restrictive threshold)

Subgrouping had no impact on direction of the effect (no difference between groups), or certainty of the evidence for: all-cause mortality, blood loss, re-operation, infection, wound complication, VTE/thrombosis, DVT, PE, MACE, MI, and CVA/stroke.

For risk of transfusion, the direction and size of the effect (favours cell salvage) and certainty of the evidence (low certainty) remained unchanged for no threshold and liberal threshold subgroups. The direction of the effect remained unchanged in the restrictive threshold subgroup (favours cell salvage), but certainty reduced (from low to very low certainty) due to greater emphasis from studies with higher ROB (baseline imbalance that would impact this outcome).

For volume transfused (PPR), there was no impact on the direction of the effect (favours cell salvage) and certainty of the evidence (very low) in all subgroups.

For volume transfused (PPT), there was no impact from subgrouping on the direction of the effect (favours cell salvage) and certainty of the evidence (very low certainty) in the liberal threshold subgroup. In contrast, the no transfusion threshold and restrictive threshold subgroups now showed no difference between groups (previously favoured cell salvage), with no change in certainty of the evidence (very low certainty).

For hospital LOS, direction and certainty of the evidence remained unchanged in the no threshold and restrictive threshold subgroups (no difference between groups, low-certainty evidence). In contrast, the liberal threshold subgroup now showed a change in the direction of the effect (favouring cell salvage, previously no difference), with low-certainty evidence (unchanged).

Analyses and overview of the evidence

See Table 19 for the results of all analyses (subgrouped by timing: Analysis 8.1; Analysis 8.2; Analysis 8.3; Analysis 8.4; Analysis 8.5; Analysis 8.6; Analysis 8.7; Analysis 8.8; Analysis 8.9; Analysis 8.10; Analysis 8.11; Analysis 8.12; Analysis 8.13; Analysis 8.14; Analysis 8.15; subgrouped by transfusion threshold Analysis 9.1; Analysis 9.2; Analysis 9.3; Analysis 9.4; Analysis 9.5; Analysis 9.6; Analysis 9.7; Analysis 9.8; Analysis 9.9; Analysis 9.10; Analysis 9.11; Analysis 9.12; Analysis 9.13; Analysis 9.14; Analysis 9.15) and Summary of findings 4.

Obstetrics

One RCT with 1356 participants assessed cell salvage in women undergoing elective Caesarean section. See Table 20 for the results of all analyses.

Overall

High-certainty evidence shows there is no difference between groups for volume transfused (PPR), reflected in low-certainty evidence that suggests there may be no difference in volume transfused (PPT).

Low-certainty evidence suggests there may be no difference between groups for risk of allogeneic transfusion.

There were no analysable data reported for mortality, blood loss, re-operation for bleeding, infection, wound complication, VTE/thrombosis, DVT, PE, MACE, MI, CVA/stroke, and hospital LOS.

Subgroups

Subgroup: timing (intraoperative)

All data were for intraoperative collection.

Subgroup: transfusion threshold (no transfusion threshold)

All data were for no transfusion threshold.

Analyses and overview of the evidence

See Table 20 for the results of all analyses (subgrouped by timing: Analysis 10.1; Analysis 10.2; Analysis 10.3; subgrouped by transfusion threshold: Analysis 11.1; Analysis 11.2; Analysis 11.3) and Summary of findings 5.

Orthopaedic (hip)

Seventeen RCTs with a total of 2055 participants assessed cell salvage use in hip surgery (16 in arthroplasty, and one assessed any hip surgery). See Table 21 for the results of all analyses.

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Overall

Very low-certainty evidence means we are uncertain if cell salvage reduces the risk of allogeneic transfusion, and the volume transfused, or if there is any difference between groups for mortality, blood loss, re-operation for bleeding, infection, wound complication, prosthetic joint infection (PJI), VTE/thrombosis, DVT, PE, CVA/stroke, and hospital LOS.

There were no analysable data reported for MACE and MI.

Subgroups

Subgroup: timing (intraoperative, postoperative, both)

Subgrouping had no impact on direction of the effect (no difference between groups), or certainty of the evidence for: all-cause mortality, blood loss, re-operation, infection, wound complication, PJI, VTE/thrombosis, DVT, PE, CVA/stroke, and hospital LOS.

For risk of transfusion, most studies were in the postoperative subgroup, and there was no change in the direction and size of the effect (favours cell salvage) or the certainty of the evidence (very low certainty) in this subgroup. There was no change in direction of the effect in the intraoperative subgroup (favours cell salvage), with improved certainty of the evidence (from very low to low certainty) due to reduced heterogeneity. The "both" timing subgroup now showed no difference between groups (previously favouring cell salvage), again with improved certainty (from very low- to low-certainty evidence) due to reduced heterogeneity.

For volume transfused (PPR and PPT), for the intraoperative subgroup, the direction of the effect did not change (favours cell salvage), with certainty of the evidence improving (from very low to low certainty) due to reduced heterogeneity (PPT), and no change in certainty (very low certainty) for the PPR outcome. Postoperative and "both" timing subgroups now showed no difference between groups (previously favoured cell salvage), with no change in certainty of the evidence (remained very low certainty) for postoperative subgroup (PPR and PPT) and improved certainty (from very low to moderate certainty) for the "both" subgroup for PPR due to reduced heterogeneity and imprecision (narrower confidence intervals).

Subgroup: transfusion threshold (no transfusion threshold, liberal threshold, restrictive threshold)

Subgrouping had no impact on direction of the effect (no difference between groups), or certainty of the evidence for: all-cause mortality, blood loss, re-operation, infection, wound complication, PJI, VTE/thrombosis, DVT, PE, CVA/stroke, and hospital LOS.

For risk of transfusion, there was no change in the direction and size of the effect (favours cell salvage) or the certainty of the evidence (very low certainty) in the liberal threshold subgroup. There was no change in the direction of the effect (favours cell salvage) in the restrictive threshold subgroup, but with improved certainty of the evidence (from very low to moderate certainty) due to reduced heterogeneity and greater imprecision (narrower confidence intervals). The no threshold subgroup now showed no difference between groups (previously favoured cell salvage), again with very low-certainty evidence (unchanged).

For volume transfused (PPR and PPT), direction of the effect did not change (favours cell salvage) in the liberal threshold subgroup (both PPR and PPT), with an improved certainty of the evidence (from very low to low (PPT) and to moderate (PPR)) due to reduced heterogeneity. In contrast, the restrictive threshold subgroup now showed no difference between groups (previously favoured cell salvage), with a change in the certainty of the evidence: in one (PPR from very low to moderate certainty) due to reduced heterogeneity, and no change in certainty in the other (PPT remained very low certainty).

Analyses and overview of the evidence

See Table 21 for the results of all analyses (subgrouped by timing: Analysis 12.1; Analysis 12.2; Analysis 12.3; Analysis 12.4; Analysis 12.5; Analysis 12.6; Analysis 12.7; Analysis 12.8; Analysis 12.9; Analysis 12.10; Analysis 12.11; Analysis 12.12; Analysis 12.13; Analysis 12.14; subgrouped by transfusion threshold: Analysis 13.1; Analysis 13.2; Analysis 13.3; Analysis 13.4; Analysis 13.5; Analysis 13.6; Analysis 13.7; Analysis 13.8; Analysis 13.9; Analysis 13.10; Analysis 13.11; Analysis 13.12; Analysis 13.13; Analysis 13.14) and Summary of findings 6.

Orthopaedic (knee)

Twenty-six RCTs with a total of 2568 participants assessed cell salvage use in knee arthoplasty (replacement). See Table 22 for the results of all analyses.

Overall

Low-certainty evidence suggests there may be a reduction in the volume transfused (PPR) as a result of cell salvage, reflected in very low-certainty evidence that means we are uncertain if there is a reduction in volume transfused (PPT) and risk of allogeneic transfusion.

Low-certainty evidence suggests there may be no difference between groups for blood loss, MACE, and CVA/stroke.

Very low-certainty evidence means we are uncertain if there is a difference between groups for re-operation for bleeding, infection, wound complication, PJI, DVT, PE, MI, and hospital LOS.

There were no analysable data reported for mortality and VTE/thrombosis.

Subgroups

Subgroup: timing (postoperative, both)

Subgrouping had no impact on direction of the effect (no difference between groups), or certainty of the evidence for: blood loss, re-operation, infection, wound complication, PJI, DVT, PE, MACE, MI, CVA/stroke, and hospital LOS.

For risk of transfusion, there was no change in the size and direction of the effect (favours cell salvage) or certainty of the evidence (very low-certainty evidence). For the "both" timing group, there was a change in the direction of the effect, from favouring cell salvage to no difference between groups, with slightly improved certainty of the evidence (change from very low- to low-certainty evidence) due to a reduction in heterogeneity.

For volume transfused (PPR), there was no change in the postoperative and "both" timing subgroups in the direction of the

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effect (favours cell salvage) and certainty of the evidence (low certainty).

For volume transfused (PPT), there was no change in the "both" timing subgroup in the direction of the effect (favours cell salvage), but with an improvement in the certainty of the evidence (from very low to low certainty) due to reduced heterogeneity. For the postoperative subgroup, there was a change in the direction of the effect, from favouring cell salvage to no difference between groups, with very low-certainty evidence (unchanged).

Subgroup: transfusion threshold (no transfusion threshold, liberal threshold, restrictive threshold)

Subgrouping had no impact on direction of the effect (no difference between groups), or certainty of the evidence for: re-operation, infection, wound complication, PJI, DVT, PE, MACE, MI, and CVA/stroke.

For risk of transfusion, most studies used a liberal threshold, and there was no change in the size and direction of the effect (favours cell salvage) and certainty of the evidence (very low certainty) in this subgroup. The no transfusion threshold and restrictive threshold subgroups now showed no difference between groups (previously in favour of cell salvage), with no change in the certainty of the evidence for no transfusion threshold (very low certainty), and improved certainty in the restrictive threshold group (changed from very low- to low-certainty evidence) due to reduced heterogeneity.

All studies reporting volume transfused (PPR and PPT) used a liberal transfusion threshold, and so subgrouping was not possible for these outcomes.

For blood loss, the liberal and no threshold subgroups remained unchanged in the direction of the effect (no difference between groups). However, one subgroup improved in certainty of the evidence (liberal threshold, from low to moderate certainty) due to reduced heterogeneity, and the other subgroup (no threshold) reduced the certainty (from low- to very low-certainty evidence) due to greater emphasis on a single study with larger imprecision (wider confidence intervals). The restrictive threshold changed the direction of the effect (from no difference to favouring cell salvage) with improved certainty of the evidence (from low to moderate certainty) due to reduced heterogeneity.

For hospital LOS, the liberal subgroup remained unchanged in direction of the effect (no difference between groups), but the no threshold subgroup changed direction of the effect to favouring cell salvage. Both subgroups improved the certainty of the evidence (from very low to low certainty) due to reduced heterogeneity.

Analyses and overview of the evidence

See Table 22 for the results of all analyses (subgrouped by timing: Analysis 14.1; Analysis 14.2; Analysis 14.3; Analysis 14.4; Analysis 14.5; Analysis 14.6; Analysis 14.7; Analysis 14.8; Analysis 14.9; Analysis 14.10; Analysis 14.11; Analysis 14.12; Analysis 14.13; Analysis 14.14; subgrouped by transfusion threshold: Analysis 15.1; Analysis 15.2; Analysis 15.3; Analysis 15.4; Analysis 15.5; Analysis 15.6; Analysis 15.7; Analysis 15.8; Analysis 15.9; Analysis 15.10; Analysis 15.11; Analysis 15.12; Analysis 15.13; Analysis 15.14) and Summary of findings 7.

Orthopaedic (spinal)

Six RCTs with a total of 404 participants assessed cell salvage use in spinal surgery: fusion, correction of deformity, or any spinal surgery. See Table 23 for the results of all analyses.

Overall

Moderate-certainty evidence suggests there is probably a reduction in the need for allogeneic transfusion as a result of cell salvage.

Moderate-certainty evidence suggests there is probably no difference between groups for blood loss.

Low-certainty evidence suggests there may be no difference between groups for infection.

Very low-certainty evidence means we are uncertain if there is any difference between groups for volume transfused, wound complication, and PE.

There were no analysable data reported for mortality, re-operation for bleeding, PJI, VTE/thrombosis, DVT, MACE, MI, CVA/stroke, and hospital LOS.

Subgroups

Subgroup: timing (intraoperative, postoperative)

Subgrouping had no impact on direction of the effect (no difference between groups), or certainty of the evidence for: volume transfused (PPR and PPT), blood loss, infection, wound complication, and PE.

For risk of transfusion, there was no change in the intraoperative subgroup in the size and direction of the effect (favours cell salvage) and certainty of the evidence (moderate certainty). The postoperative subgroup now showed no difference between groups but with very low certainty of the evidence (previously in favour of cell salvage, with moderate certainty).

Subgroup: transfusion threshold (no transfusion threshold, liberal threshold, restrictive threshold)

Subgrouping had no impact on direction of the effect (no difference between groups), or certainty of the evidence for: volume transfused (PPR and PPT), blood loss, infection, wound complication, and PE.

For risk of transfusion, there was no change in the restrictive subgroup in the size and direction of the effect (favours cell salvage) and certainty of the evidence (moderate certainty). The no transfusion subgroup remained in favour of cell salvage, but there was a reduction in certainty (to low certainty) due to greater emphasis on a study with high risk of bias (blinding and randomisation). The liberal threshold subgroup now showed no difference between groups but with very low certainty of the evidence (previously in favour of cell salvage, with moderate certainty).

Analyses and overview of the evidence

See Table 23 for the results of all analyses (subgrouped by timing: Analysis 16.1; Analysis 16.2; Analysis 16.3; Analysis 16.4; Analysis 16.5; Analysis 16.6; Analysis 16.7; subgrouped by transfusion threshold: Analysis 17.1; Analysis 17.2; Analysis 17.3; Analysis 17.4;

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Analysis 17.5; Analysis 17.6; Analysis 17.7) and Summary of findings 8.

Orthopaedic (mixed)

Fourteen RCTs with a total of 4374 participants assessed cell salvage use in a mixture of orthopaedic surgeries (mixture of hip, knee, spine, or any orthopaedic surgery). See Table 24 for the results of all analyses.

Overall

Low-certainty evidence suggests there may be no difference between groups for blood loss, VTE/thrombosis, and DVT.

Very low-certainty evidence means we are uncertain if there is a reduction in the need for allogeneic transfusion as a result of cell salvage, or if there is any difference between groups for volume transfused, mortality, infection, wound complication, PJI, MI, and hospital LOS.

There were no analysable data reported for re-operation for bleeding, MACE, and CVA/stroke.

Subgroups

Subgroup: timing (intraoperative, postoperative, both)

Subgrouping had no impact on direction of the effect (no difference between groups), or certainty of the evidence for: all-cause mortality, blood loss, infection, wound complication, PJI, VTE/thrombosis, DVT, PE, MI, and hospital LOS.

For risk of transfusion, most studies were postoperative collection, and the direction and size of the effect, and certainty of the evidence, remained in favour of cell salvage for this timing of collection only.

In comparison, for volume of transfusion (PPT and PPR), the intraoperative subgroup changed direction (previously no effect) in favour of cell salvage, but remained very low certainty. The other two groups remained unchanged (no evidence of an effect, very low certainty).

Subgroup: transfusion threshold (no transfusion threshold, liberal threshold, restrictive threshold)

Subgrouping had no impact on direction of the effect (no difference between groups), or certainty of the evidence for: all-cause mortality, blood loss, infection, wound complication, PJI, VTE/thrombosis, DVT, PE, MI, and hospital LOS.

For risk of transfusion, the direction of the effect remained unchanged, but the certainty of the evidence improved for two subgroups (no transfusion threshold, and liberal threshold) to low-certainty evidence in favour of cell salvage, due to a reduction in heterogeneity.

For volume of transfusion (PPR), two subgroups (no transfusion threshold and liberal threshold) changed direction (previously no evidence of an effect) in favour of cell salvage, with an improvement in the certainty in the liberal subgroup (to low-certainty evidence), again due to a reduction in heterogeneity.

Analyses and overview of the evidence

See Table 24 for the results of all analyses (subgrouped by timing: Analysis 18.1; Analysis 18.2; Analysis 18.3; Analysis 18.4; Analysis 18.5; Analysis 18.6; Analysis 18.7; Analysis 18.8; Analysis 18.9; Analysis 18.10; Analysis 18.11; Analysis 18.12; Analysis 18.13; subgrouped by transfusion threshold: Analysis 19.1; Analysis 19.2; Analysis 19.3; Analysis 19.4; Analysis 19.5; Analysis 19.6; Analysis 19.7; Analysis 19.8; Analysis 19.9; Analysis 19.10; Analysis 19.11; Analysis 19.12; Analysis 19.13) and Summary of findings 9.

DISCUSSION

While potentially lifesaving in the perioperative period, allogeneic blood transfusion increases the risk of complications. Cell salvage describes the collection of blood from the surgical field, which is then transfused back into the same person during or after surgery. This blood would otherwise have been discarded.

In this review, we have examined the evidence for the use of cell salvage to reduce the need for allogeneic blood transfusion in adults undergoing elective (planned) surgery.

We identified 106 randomised controlled trials (RCTs) with a total of 14,528 participants that met our inclusion criteria. Trials were published between 1978 and 2021, across 24 different countries. Only 82 of these studies provided analysable data for our primary outcome.

All data were analysed according to a single comparison: cell salvage versus no cell salvage. We separated data by type of surgery.

Summary of main results

Cell salvage reduced the need for allogeneic blood transfusions when we combined all data (all surgeries) into a single analysis (aggregate analysis), though the evidence was of very low certainty. Sensitivity analyses to investigate the impact of higher-quality (low risk of bias) studies, lessened the size of the effect, though confidence intervals were much wider and sample sizes were much smaller, causing downgrading for imprecision instead of for risk of bias, resulting in lower certainty of the evidence according to GRADE principles. Therefore, we included all data for the remaining analyses.

Cancer

Two RCTs with a total of 79 participants assessed cell salvage use in people undergoing cancer surgeries. Very low-certainty evidence means we are uncertain whether there is a difference between groups for mortality, blood loss, infection, or deep vein thrombosis (DVT).

There were no analysable data reported for risk of allogeneic transfusion, volume transfused, re-operation for bleeding, wound complication, venous thromboembolism (VTE)/thrombosis, pulmonary embolism (PE), major adverse cardiac events (MACE), myocardial infarction (MI), cerebrovascular accident (CVA)/stroke, and hospital length of stay (LOS).

Cardiovascular (vascular)

Six RCTs with a total of 384 participants assessed cell salvage use in vascular surgeries.

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Low-certainty evidence suggests there may be no difference between groups for volume transfused, blood loss, and hospital LOS.

Very low-certainty evidence means we are uncertain whether there is a difference between groups for risk of allogeneic transfusion, mortality, re-operation for bleeding, infection, wound complication, VTE/thrombosis, DVT, PE, MI, and CVA/stroke.

There were no analysable data reported for MACE.

Cardiovascular (no bypass)

Six RCTs with a total of 372 participants assessed cell salvage use in cardiac surgery without bypass, or did not mention the use of bypass in the publication.

Moderate-certainty evidence suggests there is probably a reduction in risk of allogeneic transfusion as a result of cell salvage.

Low-certainty evidence suggests there may be no difference between groups for volume transfused (per person transfused (PPT)) and blood loss.

Very low-certainty evidence means we are uncertain whether there is a reduction in volume transfused (per person randomised (PPR)) as a result of cell salvage, or if there is any difference between groups for mortality, re-operation for bleeding, infection, wound complication, MI, CVA/stroke, and hospital LOS.

There were no analysable data reported for VTE/thrombosis, DVT, PE, and MACE.

Cardiovascular (with bypass)

Twenty-nine RCTs with a total of 2936 participants assessed cell salvage use in cardiac surgery with bypass: coronary artery bypass graft (CABG) and valve replacement. Data were available for all outcomes.

Moderate-certainty evidence suggests there is probably no difference between groups for risk of CVA/stroke.

Low-certainty evidence suggests there may be a reduction in the risk of allogeneic transfusion as a result of cell salvage, and suggests there may be no difference in risk of infection and hospital LOS.

Very low-certainty evidence means we are uncertain whether there is a reduction in volume transfused as a result of cell salvage, or if there is any difference between groups for mortality, blood loss, re-operation for bleeding, wound complication, VTE/thrombosis, DVT, PE, MACE, and MI.

Obstetrics

One RCT with a total of 1356 participants assessed cell salvage use in women undergoing elective Caesarean section.

High-certainty evidence shows there is no difference between groups for volume transfused (PPR), reflected in low-certainty evidence that suggests there may be no difference in volume transfused (PPT).

Low-certainty evidence suggests there may be no difference between groups for risk of allogeneic transfusion.

There were no analysable data reported for mortality, blood loss, re-operation for bleeding, infection, wound complication, VTE/thrombosis, DVT, PE, MACE, MI, CVA/stroke, and hospital LOS.

Orthopaedic (hip)

Seventeen RCTs with a total of 2055 participants assessed cell salvage use in hip surgery.

Very low-certainty evidence means we are uncertain if cell salvage reduces the risk of allogeneic transfusion, and the volume transfused, or if there is any difference between groups for mortality, blood loss, re-operation for bleeding, infection, wound complication, prosthetic joint infection (PJI), VTE/thrombosis, DVT, PE, CVA/stroke, and hospital LOS.

There were no analysable data reported for MACE and MI.

Orthopaedic (knee)

Twenty-six RCTs with a total of 2568 participants assessed cell salvage use in knee arthroplasty (replacement).

Low-certainty evidence suggests there may be a reduction in the volume transfused (PPR) as a result of cell salvage, reflected in very low-certainty evidence that means we are uncertain if there is a reduction in volume transfused (PPT) and risk of allogeneic transfusion.

Low-certainty evidence suggests there may be no difference between groups for blood loss, MACE, and CVA/stroke.

Very low-certainty evidence means we are uncertain if there is a difference between groups for re-operation for bleeding, infection, wound complication, PJI, DVT, PE, MI, and hospital LOS.

There were no analysable data reported for mortality and VTE/thrombosis.

Orthopaedic (spinal)

Six RCTs with a total of 404 participants assessed cell salvage use in spinal surgery.

Moderate-certainty evidence suggests there is probably a reduction in the need for allogeneic transfusion as a result of cell salvage, and probably no difference between groups for blood loss.

Low-certainty evidence suggests there may be no difference between groups for infection.

Very low-certainty evidence means we are uncertain if there is any difference between groups for volume transfused, wound complication, and PE.

There were no analysable data reported for mortality, re-operation for bleeding, PJI, VTE/thrombosis, DVT, MACE, MI, CVA/stroke, and hospital LOS.

Orthopaedic (mixed)

Fourteen RCTs with a total of 4374 participants assessed cell salvage use in a mixture of orthopaedic surgeries.

Low-certainty evidence suggests there may be no difference between groups for blood loss, VTE/thrombosis, and DVT.

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Very low-certainty evidence means we are uncertain if there is a reduction in the need for allogeneic transfusion as a result of cell salvage, or if there is any difference between groups for volume transfused, mortality, infection, wound complication, PJI, MI, and hospital LOS.

There were no analysable data reported for re-operation for bleeding, MACE, and CVA/stroke.

Overall completeness and applicability of evidence

Since the previous version of this review was published in 2010, we have identified and included a further 39 RCTs in this update. Since 2010, the number of trials assessing the effectiveness of cell salvage in reducing allogeneic blood requirements has continued to increase. We have included a total of 63 trials assessing cell salvage use in orthopaedic procedures and 35 trials assessing its use in cardiac surgery. Cell salvage use as part of surgical management in other specialities has expanded. In this update, we have examined its use in cancer surgery (two trials) and obstetrics (one trial). The findings of this update review are therefore more broadly applicable across numerous surgical contexts. Broad applicability also results in increased heterogeneity. The number of studies identified and included in this review has therefore facilitated presentation of results according to clinical context.

Cancer surgery

Two RCTs assessed cell salvage use in people undergoing surgery for cancer. In both trials, people were undergoing surgery for cancer of the genitourinary system. Neither study contributed data to the primary outcome measure but, with very low-certainty evidence, demonstrated no association between cell salvage and blood loss, postoperative risk of death, infection, or DVT. Historically, the use of cell salvage during cancer surgery was not advocated due to fear of tumour dissemination with reinfusion. Studies have shown that the use of leucocyte depletion filters may be able to reduce the presence of cancer cells for specific procedures and cancer cell types (Catling 2008; Rajasekaran 2021). Both of the included studies have been newly added to this update. No trials of cell salvage use in cancer surgery were included in the previous version of this review. We have identified three ongoing studies of cell salvage use in cancer surgery (renal, hepatocellular, and spinal metastases) that will contribute additional information on the benefit and safety of cell salvage in this population in future and increase the generalisability of the data (ChiCTR1800018118; NCT04922307 (RESTRICT); NCT05612477).

Cardiovascular (vascular) surgery

All included trials were performed in the context of elective abdominal aortic aneurysm, aortoiliac or aorto-femoral surgery. The findings for this group are therefore specific to this population. In total, we included six trials of participants undergoing vascular surgery. No new trials have been completed since the previous version of the review was published, despite recommendations for further high-quality evidence due to the risk of bias in existing studies (Takagi 2007). Cell salvage was not effective at reducing allogeneic transfusion in this population (very low-certainty evidence); however, surgical and anaesthetic management has progressed significantly since the publication of these studies, and so we are unable to determine whether this finding is representative of current clinical practice.

Cardiovascular (with or without bypass) surgery

Trials of cell salvage use in participants undergoing cardiac surgery were performed either with cardiopulmonary bypass or without cardiopulmonary bypass. Six trials of cardiac surgery without bypass are included, in comparison to 29 trials of cardiac surgery with bypass, representative of the more commonly used technique of on-bypass cardiac surgery in clinical practice (Mack 2004).

In people undergoing cardiac surgery with bypass, intraoperative cell salvage was typically performed prior to and following completion of cardiopulmonary bypass. In contrast, cell salvage was used throughout the procedure when cardiac surgery was performed without bypass. Postoperative cell salvage was performed by collecting blood lost to chest drains postoperatively for reinfusion. We excluded studies which assessed the impact of processing compared to no processing of blood collected in the cardiotomy reservoir or remaining in the cardiopulmonary bypass machine at the end of the procedure, as this represents a complex intervention aimed at reducing the inflammatory response to reinfusion and achieving haemoconcentration (Ferraris 2011; Moran 1978), separate from the salvage of blood from the operative field that would otherwise have been lost. Overall, we believe the included studies are representative of current clinical practice within this population.

Obstetrics

One RCT of cell salvage use in Caesarean section was included. This demonstrated, with low-certainty evidence, that cell salvage use during these procedures is not associated with reduced risk of exposure to allogeneic transfusion, or reduced volume of transfusion (PPT and PPR) (low-, low-, and high-certainty evidence, respectively). This trial included people undergoing both emergency and elective Caesarean sections and so only a subgroup of participants from the study was eligible for inclusion. The trial itself is classified as low risk of bias in most categories. As only one trial was eligible for inclusion to date, albeit deemed low risk of bias with a large sample size, further research is indicated to determine the effectiveness of cell salvage in different obstetric patient groups. We have identified one ongoing study which may contribute further information in the future (NCT03429790). Further research is required in elective Caesarean section to determine the effectiveness of cell salvage during these planned procedures, as blood loss is anticipated to be lower when compared to emergency intervention.

Orthopaedic surgery

The majority of studies included in this review were of people undergoing orthopaedic surgery, with hip and knee surgery most common. We included three studies assessing cell salvage use in people undergoing spinal surgery and a further 11 studies of a mixed orthopaedic population. For the most part, it was unclear whether trial participants undergoing hip or knee surgery were undergoing primary or revision arthroplasty procedures. In UK hospitals, 94% of hip and knee replacements are primary procedures and just 6% are revision procedures (Reed 2022). Primary procedures are associated with lower blood loss (Goel 2018; Lloyd 2020). Previous studies have demonstrated greater utility of cell salvage in revision procedures (Palmer 2020a). Cell salvage may be less effective in primary procedures due to lower blood loss where reduced collection volumes are available for reinfusion.

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Given the uncertainty about whether the majority of hip and knee procedures were primary or revision arthroplasty, we have not performed any further analysis of these populations. We recommend future reviews specifically address the utility of cell salvage in primary and revision arthroplasty surgeries to better guide resource allocation.

The three trials of cell salvage in people undergoing spinal surgery that report exposure to allogeneic transfusion suggest, with moderate-certainty evidence, that intraoperative cell salvage use probably reduces the risk of allogeneic transfusion in this population. Trials were conducted in people undergoing lumbar fusion procedures, adult correction of deformity, or major spinal surgery. Our review did not include any trials of spinal surgical procedures of the cervical spine. Despite the heterogenous nature of spinal procedures, including different surgical approaches, there is moderate-certainty evidence that cell salvage reduces allogeneic blood transfusion in this population.

Transfusion thresholds

Where studies reported a transfusion threshold, we classified this as representative of either a restrictive or liberal policy based on the values described within the study and in comparison with current national guidance and accepted definitions within clinical practice (Carson 2021; NICE 2015). We opted for a threshold of a haemoglobin concentration of 80 g/L to represent a liberal transfusion policy. This was a pragmatic choice based on existing guidance and perceived clinical acceptability. Where studies reported a haemoglobin threshold for transfusion, it was unclear how strictly this was adhered to. Many studies gave a threshold based on haemoglobin or haematocrit level, alongside "any clinical signs or symptoms of anaemia". It is therefore likely that many clinicians transfused before reaching the threshold, or perhaps delayed transfusion for longer. One study noted that an analysis of those who received a transfusion found that transfusion was unnecessary in 37% of those who were transfused (Thomassen 2014).

Cell salvage may be more beneficial in the context of liberal transfusion policies, in which allogeneic transfusion is more readily prescribed and a greater reduction in allogeneic transfusion may be achieved. In patients undergoing total hip replacement with a restrictive transfusion threshold employed, cell salvage reduced the risk of exposure to allogeneic transfusion (moderate-certainty evidence) but, in comparison to liberal transfusion policies, was not effective at reducing the volume of allogeneic blood transfused when analysed PPR or PPT (moderate- and very low-certainty evidence, respectively).

Very low-certainty evidence of this effect in people undergoing cardiac surgery with bypass (PPT) was also demonstrated. Results therefore suggest that, in the context of a restrictive transfusion policy, use of cell salvage may reduce the risk of exposure to allogeneic transfusion but, should allogeneic transfusion be required, it may have little benefit in reducing the volume of allogeneic blood transfused. While restrictive transfusion policies have been demonstrated as both effective and safe across a number of surgical groups, both their adherence and impact with regard to the effect of cell salvage remain unclear (Carson 2021). Further research is warranted to examine this question specifically.

Use of tranexamic acid and other patient blood management (PBM) techniques

Pre-, intra-, and postoperative interventions can be implemented as part of a broader PBM strategy, which aims to optimise erythropoiesis, minimise blood loss, and optimise the physiological reserve of anaemia (Palmer 2020b). Tranexamic acid use perioperatively is recommended for reducing blood loss in people undergoing surgery with moderate anticipated blood loss (> 500 mL) and routinely in people undergoing hip and knee replacement (NICE 2015; NICE 2020). Its use is now commonplace in clinical practice (Lloyd 2020; Mueller 2018; Murphy 2021). Increased uptake and implementation of PBM interventions will reduce exposure to allogeneic blood transfusion. We did not assess the use of such measures as part of this review, and so we are unable to determine whether the effect of cell salvage in reducing allogeneic transfusion has or should be modified by increasing implementation of other PBM interventions. Further research is required to delineate this, as well as determine the optimal combination of perioperative interventions for reducing allogeneic blood transfusion within different surgical populations.

Volume of blood transfused

Our evidence may be limited by the lack of analysable data regarding the volume of blood (mean red blood cell (RBC) units) transfused due to the reporting, interpretation, and analysis of skewed data (presented as median and range or interquartile range (IQR)): some studies reported the total number of RBC units transfused, to the whole group, or the number of participants who required more than a specific number of RBC units (e.g. the number of people requiring more than one, two, three, or four units of blood), though this was reported inconsistently across trials. We were unable to convert these data for this review, as we had specified a continuous outcome using the mean and standard deviation (SD), and instead presented them in a table of non-analysable data. Consequently, less than half of the included studies contributed analysable data for volume transfused. Due to the variability in the need for RBC units – as the expectation is that most people require very few units and one or two people may require upwards of 20 units in cases of extreme blood loss – a significant portion of the data is skewed, and so is presented as median and IQR, or median and range. Consequently, in future updates of this review, we will consider introducing an additional dichotomous variable to assess the number of participants who required more than a specific number of units to be transfused, to highlight where there is greater need for further intervention.

We also encountered issues in interpreting the mean and SD reported, as it could not be confirmed whether these data were for all participants randomised, or for only those who had been transfused. Where we could ascertain this information, we could analyse the data by calculating the required data from information provided.

Adverse events

We were only able to analyse infection data where they were clearly reported as the number of people experiencing an infection. Mostly, infection data were reported as number of events, where an individual could have multiple events. We have presented data reported this way separately. Our analysis suggests no increased risk of infection associated with cell salvage use (very low- and low-certainty evidence). However, as we were not able to analyse all

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infection data reported across the included studies, the true effect may be different to that demonstrated.

We included major adverse cardiovascular events (MACE) as an outcome measure. This is a commonly-reported composite outcome measure within cardiovascular research, which typically includes death, non-fatal stroke, and non-fatal myocardial infarction events, though has been expanded to include hospitalisation because of heart failure and revascularisation, including percutaneous coronary intervention and coronary artery bypass graft (Bosco 2021; Hicks 2018; Poudel 2019). We have accepted any definition reported by the study. Within most of our included studies, these components were reported individually; only two studies reported MACE, and there were zero cases in both (Gäbel 2013a; Šarkanoviü 2013). We were unable to include studies that reported MI, stroke, and mortality within the MACE outcome as this would risk double counting of events. MACE, as a composite outcome, has been considered a useful measure of the safety and effectiveness of interventions for cardiovascular disease. However, due to its variability, the separate reporting of the component parts of MACE may more accurately reflect the safety and effectiveness of an intervention than the composite measure (Kip 2008). Use of MACE as an outcome measure in future trials of cell salvage is likely to have limited benefit. Whilst less concise, reporting of MI, stroke, and mortality separately provides more data and greater clinical relevance.

Certainty of the evidence

Certainty of the evidence varied from very low certainty to high certainty. Reasons for downgrading included imprecision (small sample sizes below the optimal information size (OIS) required to detect a difference, and wide confidence intervals), inconsistency (high statistical heterogeneity), and risk of bias (high risk from lack of blinding, poorly reported randomisation, and baseline imbalances). We were able to assess publication bias in a limited number of outcomes for some comparisons where there were at least 10 studies contributing. There was some suggestion that a few smaller studies that favour the control group may be missing, but not enough to impact the overall summary statistic (see Figure 4), and so we did not downgrade for publication bias where it could be assessed.

Despite the high statistical heterogeneity, we continued to pool the results (with downgrading of the certainty as a result), though we suggest future updates (where this review is separated into types of surgery) will be able to investigate reasons for this high heterogeneity further. We were unable to investigate the reason for the heterogeneity due to the breadth of this review. We recommend that any future reviews (that focus on a single population/type of surgery) perform further subgroup analyses to assess potential influencers of between-study heterogeneity, such as the impact of the use of other blood-sparing protocols as standard care (used in both arms), such as tranexamic acid; and the impact of whether a surgery was a primary or revision surgery (in orthopaedics, in particular).

Potential biases in the review process

We have attempted to minimise bias in the review process. We conducted a comprehensive search, searching multiple data sources (including multiple databases and clinical trial registries) to ensure that we captured all relevant studies. We imposed no language restrictions on study reports. We carefully assessed the relevance of each publication, and we performed all screening and data extractions in duplicate. We prespecified all outcomes and subgroups prior to analysis. We carefully considered the guideline of the Cochrane Injuries Group (Broughton 2021; Cochrane Policy 2020), but did not exclude unregistered or retrospectively registered trials as cell salvage is not considered to be a medicinal product under the 2001 EU Clinical Trials Directive (EU Clinical Trial Directive 2001; EU Regulations 2014). We therefore have confidence that we have included all relevant trials, and our sensitivity analysis assessing the impact of including these trials showing no noticeable difference supports this (Effects of interventions; Analysis 1.2).

For consistency across all included and excluded studies from the previous versions and this update, we re-assessed previously included and excluded studies, and applied our definitions of outcomes to all studies. This included checking all extracted data for all outcomes, extracting additional information, and performing more in-depth risk of bias assessments.

We pooled data that appear to have high statistical heterogeneity without investigating the causes beyond the subgroups and sensitivity analyses we have mentioned above (see: Certainty of the evidence). However, we do not think this has biased the results as the certainty of the evidence for all outcomes has been downgraded accordingly.

Agreements and disagreements with other studies or reviews

Aggregate analysis

This review is an update of a previous systematic review published in 2010 (Carless 2010). The aggregate analysis in that review demonstrated that use of cell salvage was associated with 38% relative reduction in the risk of allogeneic blood transfusion with no adverse impact on patient outcomes; however, the certainty of this evidence was not assessed. This updated review, following the addition of 39 RCTs, has demonstrated a similar effect of cell salvage in reducing the risk of allogeneic transfusion (very low-certainty evidence) in the aggregate analysis of the primary outcome, but with an increase in the precision of the estimate (narrower confidence interval around the summary statistic), and we can therefore expect to have greater confidence in the data than previously. Despite this, we do not believe an assessment of whether cell salvage should be performed should depend on the aggregate data, and so we have also disaggregated the effect estimates by surgical type.

Only seven of the 20 studies that we assessed as low risk of bias (ROB) in the relevant domains for our sensitivity analysis were published since 2010. Sensitivity analysis of prospectively registered studies had little to no effect on the summary statistic. On the other hand, sensitivity analysis including only those studies with low ROB in the majority of domains removed the clear effect of the intervention in cardiovascular (no bypass), orthopaedic (hip), orthopaedic (knee), and orthopaedic (mixed populations). Due to poor historical reporting standards, it is difficult to interpret the true impact of the results of this sensitivity analysis. Inadequate reporting may account for some assessments of unclear risk of bias in studies that were actually well-conducted and employed sound methodology.

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The principal difference between this update and the previous version of this review is our analysis of data according to surgical groups. Due to the high number of included studies and in order to address the high heterogeneity associated with this population, we have performed all analyses within these defined surgical groups.

Cancer

Previous concerns regarding the risk of cancer dissemination in people undergoing cancer surgery had contraindicated the use of cell salvage in this population. Leucocyte depletion filters are effective at reducing the number of malignant cells within salvaged blood and are recommended for routine use in cell salvage when performed in the context of malignancy (Klein 2018). A recent systematic review of non-randomised studies has suggested that leucocyte depletion filters are effective at removing 99.6% to 99.9% of malignant cells from salvaged blood (Frietsch 2020). Ex vivo data also suggest that remaining tumour cells are likely not viable (Kumar 2016). The risk of cancer recurrence when cell salvage is used, with or without leucocyte depletion filters, was reduced compared to people that were not transfused, received allogeneic transfusion, or underwent preoperative autologous donation (Frietsch 2020). These findings are consistent with findings in our review, which has demonstrated no increased risk of mortality with cell salvage use in cancer surgery (very low-certainty evidence). Very few randomised trials have been published to date. We have identified a further three ongoing trials which we hope will expand the evidence base for cell salvage use in this population in future. When available, further systematic reviews and meta-analysis should be performed to assess findings across available RCTs. At present, results suggest that cell salvage use within some cancer surgery is safe and not associated with tumour dissemination (Frietsch 2020), or increased risk of death (very low-certainty evidence). However, we are unable to comment on its effectiveness in reducing allogeneic blood exposure due to lack of analysable data.

Cardiovascular (vascular)

Two previous reviews have assessed the use of intraoperative cell salvage within vascular surgery (Meybohm 2016; Takagi 2007). Takagi 2007 assessed its use in abdominal aortic aneurysm surgery and included four RCTs (Clagett 1999; Mercer 2004; Spark 1997; Wong 2002), one of which was not eligible for inclusion in our review due to use of a complex intervention (Wong 2002). Meybohm 2016 assessed the use of washed cell salvage within vascular surgery and purported to include six RCTs (Clagett 1999; Farrer 1997; Kelley-Patteson 1993; Mercer 2004; Spark 1997; Thompson 1990). However, we established that Farrer 1997 is a duplicate report of Spark 1997, a study included in our review. Both reviews demonstrated a beneficial effect of cell salvage use during vascular surgery in reducing exposure to allogeneic blood transfusion, which is not consistent with our findings (very low-certainty evidence). Both reviews only included studies if they reported on transfusion outcomes, amongst other criteria. By contrast, we did not consider outcome reporting in our study selection. We identified no more recent studies in the updated search performed for this review. The existing included trials are mostly of high or unclear risk of bias regarding randomisation and allocation concealment. Further large, well-conducted randomised controlled trials are needed to assess the benefit of cell salvage use in vascular surgery.

Cardiovascular (with or without bypass)

We assessed the benefit of cell salvage use in people undergoing cardiac surgery both on and off cardiopulmonary bypass. Cell salvage was effective at reducing the risk of exposure to allogeneic transfusion in cardiac surgery performed on- and off-bypass (low- and moderate-certainty evidence, respectively). These findings are consistent with that reported in previous systematic reviews (Meybohm 2016; Wang 2009). Wang 2009 also assessed the effectiveness of different uses of cell salvage during on-bypass cardiac surgery. Wang and colleagues demonstrated no benefit if used to process cardiotomy suction blood while on bypass, whereas there was a 55% reduction in risk of allogeneic red cell transfusion when used to salvage blood lost and/or residual blood pre- and post-bypass. We did not examine for a differential effect of cell salvage used at different times in on-bypass cardiac surgery and so are unable to contribute to this finding. We have identified three ongoing RCTs which may provide additional information in future (DRKS00021914; NCT02595385 (CONSERVE); NCT04574128). Further systematic reviews of cell salvage use in people undergoing cardiac surgery should aim to determine how and when cell salvage may be used during these procedures for maximum benefit (including at what point in the bypass process blood is salvaged, and also when it is reinfused).

Obstetrics

We identified one randomised controlled trial assessing the use of cell salvage in Caesarean section (Khan 2017 (SALVO)). This study included women undergoing Caesarean section for both emergency and elective indications and provided subgroup transfusion data for some outcomes. We identified no other trials of cell salvage in obstetrics, and no other systematic reviews have been published. We found that intraoperative cell salvage did not reduce the relative risk of allogeneic transfusion, nor the volume of allogeneic transfusion. Adverse events were not reported for each subgroup and so these data were not analysable. There are concerns regarding the safety of cell salvage use in obstetrics due to the risk of amniotic fluid embolism (Fong 2007). Leucocyte depletion filters may be used to reduce this risk but have mixed effectiveness and do not protect against alloimmunisation (Campbell 2012; Klein 2018). Currently, there is no substantial evidence to support the use of intraoperative cell salvage in women undergoing elective Caesarean section, and there is an absence of evidence regarding harms.

Orthopaedic

A systematic review of cell salvage use in orthopaedic surgery was published in 2015 (Van Bodegom-Vos 2015). This demonstrated cell salvage use was associated with a 34% reduction in relative risk of allogeneic blood transfusion in people undergoing hip arthroplasty and a 49% reduction in relative risk of allogeneic transfusion in people undergoing knee arthoplasty. Our review has demonstrated that cell salvage use is associated with a 48% reduction in risk of allogeneic blood transfusion in people undergoing hip arthroplasty, and a 51% reduction in relative risk of allogeneic transfusion in people undergoing knee arthroplasty. The Van Bodegom-Vos 2015 review used all the orthopaedic studies included in the previous version of our review (Carless 2010), as well as those identified as meeting inclusion criteria from their updated search to 2012. The beneficial effect of cell salvage was lost when studies identified from the updated search were analysed in isolation. We did not perform separate analysis of studies

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newly included in our review; however, our sensitivity analysis of prospectively registered studies showed no difference in effect to the summary statistic.

The Van Bodegom-Vos 2015 review authors performed subgroup analyses to explore the difference in effect identified in the 2015 review.

They subgrouped, as we did, by whether a liberal or restrictive transfusion threshold was used. A threshold of Hb 80 g/L was used to define whether a threshold was liberal or restrictive to reflect the increasing use of the restrictive transfusion thresholds (Hb < 80 g/L) observed in clinical practice. Using a liberal transfusion threshold (defined as Hb > 80 g/L) demonstrated a beneficial effect of cell salvage in risk of exposure to allogeneic blood transfusion and volume of allogeneic blood transfused (Van Bodegom-Vos 2015). In contrast, studies using a restrictive transfusion threshold (defined as Hb < 80 g/L) demonstrated no beneficial effect of cell salvage in risk of exposure or volume of allogeneic blood transfused (Van Bodegom-Vos 2015). All studies included in these analyses were also included in our analyses.

We witnessed a similar effect in our orthopaedic (hip) group of a beneficial effect of cell salvage in reducing volume of blood transfused when a liberal transfusion policy was in place (PPR, moderate-certainty evidence); however, this effect was lost when a restrictive transfusion policy was used (PPR, moderate-certainty evidence). In contrast, there was no difference in the direction of the effect for the risk of exposure to allogeneic transfusion comparing results of studies using liberal and restrictive transfusion policies, though the effect appears to be greater with a restrictive threshold (restrictive: moderate certainty, and liberal: very low-certainty evidence). Further systematic reviews of specific surgical populations that analyse the concomitant use of other PBM interventions are required to assess this.

Our findings regarding postoperative cell salvage in people undergoing hip or knee surgery were consistent with previously published systematic reviews (Haien 2013; Van Bodegom-Vos 2015). Each review demonstrates reduced risk of exposure to allogeneic blood transfusion with cell salvage use, but the effect on volume of blood transfused is inconsistent. There was no association between use of postoperative cell salvage and perioperative adverse events in any of the reviews. It is unclear whether the benefit of postoperative cell salvage demonstrated justifies the increased cost of postoperative autotransfusion devices.

Our review has also not assessed for any difference in the effect of cell salvage in primary and revision procedures, nor has it been assessed in other systematic reviews of cell salvage use in orthopaedic surgery. Revision surgery is associated with increased blood loss and increased risk of transfusion (Goel 2018). Cell salvage therefore may be more effective in this population, particularly in the context of revision for infection, fracture, and when both components are revised (Palmer 2020a). Economic analysis is required to determine whether the increased cost of postoperative autotransfusion devices justifies the associated benefit, and the difference in benefit of cell salvage use in primary and revision procedures in order to guide optimal resource allocation.

AUTHORS' CONCLUSIONS

Implications for practice

Evidence within this review suggests the use of cell salvage is not associated with an increased risk of adverse events, over and above those experienced with standard care in most surgical groups (there is an absence of evidence regarding harms for obstetrics). However, we rated the evidence as very low to low certainty for all adverse event outcomes.

There is some evidence to suggest that cell salvage is effective at reducing the risk of exposure to allogeneic transfusion and the volume of allogeneic blood transfused in people undergoing planned surgical procedures; however, the certainty of this evidence varied according to surgery type. Our findings reflect current guidance for the use of cell salvage in elective surgery, though this is likely due to the use of the same evidence base (Klein 2018; NICE 2015).

Implications for research

We have identified a number of areas where additional research (either new primary research or secondary analysis) will expand the knowledge base, and inform decision-making in the future.

Population (type of surgery)

Future updates of this review should focus on specific surgical groups, in separate reviews, to allow for greater depth of analysis. There is a significant volume of published literature on cell salvage use within cardiovascular (with bypass) and orthopaedic surgery. Further primary research is indicated in cardiovascular (vascular), cancer, and obstetric surgery in order to delineate the true risks and benefits associated with cell salvage in these patients, as existing evidence is limited in volume, at high risk of bias, or both. Systematic reviews assessing both randomised and non-randomised studies may be useful to further investigate the safety of cell salvage in cancer surgery, which may encourage further randomised controlled trials (RCTs) to be performed in future. We have identified a limited number of currently ongoing RCTs within cancer and obstetric surgery (NCT03429790ChiCTR1800018118; NCT04922307 (RESTRICT); NCT05612477).

Further primary research in orthopaedic surgery should address specific procedures and indications, such as prosthetic joint infection or malignancy. Future reviews in each surgical speciality may be able to determine whether there is a difference in the effect of cell salvage use when used for primary or revision surgeries, and high and low blood-loss settings and procedures. Revision surgery is associated with increased blood loss and allogeneic transfusion rates. As a result, we would anticipate there to be a greater effect of cell salvage in this population. We have not been able to perform this analysis within this current review and recommend that (1) future systematic reviews aim to address this, and (2) future trials consider stratifying recruitment according to risk of haemorrhage. Similarly, future reviews of cell salvage use in cardiac surgery with bypass should aim to provide greater detail in how and when cell salvage should be used during these procedures for maximum effectiveness.

It remains unclear whether the cost of cell salvage (used intraoperatively, postoperatively, or both) is justified by its beneficial effect. Economic analysis assessing the cost-benefit of

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cell salvage use within individual surgical groups is required to help determine optimal resource allocation.

Intervention and comparators

As we found high statistical heterogeneity across a number of outcomes and populations, we suggest that future updates investigate the possible cause of this (additional subgrouping): assessing the impact of using other blood-sparing protocols as standard care (such as tranexamic acid or other pharmacological interventions to reduce blood loss, used in both groups), impact of baseline anaemia, impact of transfusion thresholds, the type of surgery being performed, and the haematocrit of the salvaged blood transfused. This was not possible in this review due to the breadth of the evidence, encompassing any elective surgery. There will be greater scope for additional data extraction and analyses in future reviews focused on specific surgical groups.

In cardiovascular surgery studies that included the use of bypass, we were often unable to ascertain whether bypass blood was treated the same in both groups. Thus, we marked these studies as awaiting classification. If bypass blood was treated differently between study groups in the same study, the study had to be excluded (e.g. one group received processed bypass blood, and another unprocessed). Should this be a feature of future RCTs, we recommend that researchers explain the rationale for the different treatment of groups, as this difference may confound the effect reported.

Transfusion protocols and thresholds were reported for most of the included studies. The compliance with these protocols remains unclear and few studies reported post hoc analysis of whether transfusions were necessary and, moreover, in line with the trial protocol. One study noted that, of those who received a transfusion, 37% were unnecessary (Thomassen 2014). Greater understanding of whether transfusions are being administered according to current guidelines and the trial protocols is required to fully determine the effect of cell salvage use alongside different transfusion thresholds. The combination of cell salvage, haemoglobin thresholds for transfusion, and other patient blood management (PBM) blood-sparing interventions, such as the use of tranexamic acid, need to be explored in future studies and reviews.

Outcome reporting

In the results, we have described the evidence for all of our listed outcomes. We presented the seven outcomes deemed most important for this review in the summary of findings tables (risk of transfusion of allogeneic blood, volume of allogeneic blood transfused, all-cause mortality, deep vein thrombosis (DVT), infection, myocardial infarction (MI), and cerebrovascular accident (CVA)/stroke). Of these outcomes, there was limited information for: all-cause mortality (37 studies), DVT (20 studies), MI (17 studies), and CVA/stroke (10 studies). None of the included studies were powered for these outcomes.

Data for infections were reported in such a way that much of the data could not be formally analysed: reporting number of infectious events (where an individual could experience multiple events), as opposed to number of people who experienced an infectious event. Whilst we appreciate the importance of knowing how many separate events there were, we encourage researchers to also report the number of people who had an infection, in order to have a fuller data set for analysis.

Likewise, whilst we had planned to perform an overall analysis of thromboembolic events, we have presented the various diagnoses separately (pulmonary embolism (PE), myocardial infarction (MI), cerebrovascular accident (CVA)/stroke, deep vein thrombosis (DVT)), as they were not consistently reported: some studies only reported one or the other, but did not state they had zero cases of other thromboembolic events, and we could not make this assumption. Moving forward, we encourage researchers to report any and all thromboembolic events, both individually (as PE, MI, stroke, DVT, etc.), and as the number of people experiencing any thromboembolic event (in case some people had multiple events).

As mentioned in Overall completeness and applicability of evidence, we encountered a number of issues surrounding the reporting, interpretation, and analysis of the average (mean) volume of red blood cell (RBC) units due to lack of clarity on what was being reported (where we had to make assumptions based on the data whether studies were reporting number of people randomised, or the number of people transfused, or where a mean was reported but not how many people were transfused, so we were unable to calculate the required data). We therefore encourage researchers to be clear with regard to their analysis (mean and standard deviation – or median and interquartile range, depending on skewness – of RBC units per participant randomised, or per participant transfused), and also present categories of the number of RBC units transfused (e.g. number of participants requiring one, two, three, four, or five or more units) to aid future analyses.

Trial registration

Whilst prospectively registering a trial of non-medicinal products is not compulsory, we encourage researchers to do so, or publish their protocol prior to study commencement, as this allows complete transparency in the design, and an audit trail for any changes that may have been made (with a rationale for those changes) during the various study phases (active recruitment, through data analysis, to publication, dissemination, or both).

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The following people conducted the editorial process for this article:

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• Editorial Assistant (conducted editorial policy checks, collated peer-reviewer comments and supported editorial team): Leticia Rodrigues, Cochrane Central Editorial Service

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Abuzakuk 2007

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre trial **Setting:** specialist orthopaedic hospital, Stanmore, London, UK **Recruitment:** recruitment and study dates are not specified **Maximum follow-up:** duration of hospital stay
Participants	104 consecutive participants undergoing primary cemented total knee arthroplasty were randomised to one of two groups: **Autotransfusion drain** (Cell salvage/intervention group): n = 52 **Standard drain** (Control/no cell salvage group): n = 52 Demographic characteristics were matched between the two arms of the study. NB: of the 104 randomised participants, 43 were male and 61 were female. The mean age of randomised participants was 68.5 years.
Interventions	**Autotransfusion drain:** the cell salvage group (Bellovac autotransfusion system) had one deep drain inserted at the end of the operation. The drain was opened in the recovery room 20 minutes after the tourniquet was released. If blood collected in the reinfusion drain was > 150 mL, it was transfused back into the participant unwashed and a new bag was then attached to the drain. The process was repeated if the amount of blood collected again exceeded 150 mL. **Standard drain:** control group (Redivac standard suction drain) had their collected blood discarded.
Outcomes	**Outcomes reported**:number of participants transfused allogeneic blood, amount of allogeneic blood transfused, blood loss, hospital length of stay, Hb and Hct levels, wound problems, knee range of motion
Notes	**Transfusion protocol:** allogeneic blood transfusion was given if the haemoglobin level was < 9.0 g/dL when measured on days 2 and 5 postoperatively. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** study approval by institutional review board or ethics committee is not reported **Language of publication:** English **Trial funding:** not reported

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Abuzakuk 2007 *(Continued)*

Conflicts of interest: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	The software program MINIM was used to randomise participants to intervention or control.
Allocation concealment (selection bias)	Low risk	Randomisation performed using computer programme
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	**Transfusion protocol:** allogeneic blood transfusion was given if the haemoglobin level was < 9.0 g/dL when measured on days 2 and 5 postoperatively.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	All outcomes lack clear guidelines
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	All outcomes lack clear guidelines
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Unclear whether all participants randomised are accounted for in the analysis: appears to be ITT based on N in table 2, but unclear
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No mention of funding or conflicts. Used minimisation so unlikely to be baseline imbalance (demographics reported show balance)

Adalberth 1998

Study characteristics

Methods	**Deisgn:** RCT, parallel three-arm, single-centre study **Setting:** university teaching hospital, Uppsala, Sweden

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Adalberth 1998 *(Continued)*

	Recrutiment: recruitment and study dates are not reported **Maximum follow-up:** duration of hospital stay
Participants	90 participants undergoing primary total knee arthroplasty were randomised to one of three groups: **No drain group:** N = 30. M:F 11:13. Mean (95% CI) age 70 (67 to 74) **Solcotrans drain group** (Cell salvage/intervention group): N = 30. M:F 4:20. Mean (95% CI) age 71 (69 to 74) **Standard (Redon) drain group** (Control/no cell salvage group): N = 30. M:F 9:16. Mean (95% CI) age 72 (69 to 75) Of the 90 participants included in the study, 73 remained for analysis. Patients with DVT, drainage failure, lost study values, or those given NSAIDs were excluded. For the purpose of our analysis, we included data from the Solcotrans drain group as the intervention group and the Standard (Redon) drain group as the control group.
Interventions	**No drain group:** no drain was used. **Solcotrans drain group:** Solcotrans autotransfusion system collected blood for 6 hours or until the unit was full. Acid citrate dextrose-anticoagulant (ACD-A) was not added to the collection unit. Continuous suction was applied at 20 cm H_2O. Drains were maintained for 24 hours postoperatively. **Standard (Redon) drain group:** a standard disposable closed suction drainage system (Redon) was used with two standard drains maintained for 24 hours postoperatively.
Outcomes	**Outcomes reported:** number of participants transfused allogeneic blood, blood loss, hospital length of stay, Hb and Hct levels
Notes	**Transfusion protocol:** allogeneic blood transfusion was given if the haemoglobin level was < 9.0 g/dL. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study was approved by the Ethics Committee at Uppsala University Hospital. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Randomisation process not described
Allocation concealment (selection bias)	Unclear risk	Sealed envelopes were used to conceal treatment allocation, but doesn't mention opaqueness of envelopes
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)

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Adalberth 1998 *(Continued)*

Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	**Transfusion protocol:** allogeneic blood transfusion was given if the haemoglobin level was < 9.0 g/dL.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	All outcomes lack clear guidelines
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	All outcomes lack clear guidelines
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	20% attrition rate, even across the three groups; those excluded were due to adverse events (unclear if AEs due to intervention or if DVT etc. noted at baseline and were incorrectly included)
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No mention of funding or conflicts

Adan 1988

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** non-academic training hospital, Nieuwegein, the Netherlands **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** duration of hospital stay
Participants	50 participants undergoing routine coronary artery revascularisation were randomised to one of the following two groups: **ATS group** (Cell salvage/intervention group): N = 25 **C group** (Control/no cell salvage group): N = 25 The study reports that participants in both groups were comparable for ages and sex.
Interventions	**ATS group** (Cell salvage/intervention group): cell salvage was performed using the Sorenson system. Blood from the mediastinal space and lost via the chest tubes was collected into the uppermost bag of the two bags, attached in series. Blood from the upper bag passes through two 170 µm filters into the lower bag. The capacity of the lower bag is 800 mL. When it is filled, or within four hours of use, the lower bag is detached, and its contents are reinfused to the patient using a 40 µm Pall-filter. When the amount of blood lost within the period of four hours was < 200 mL, autotransfusion was not performed.

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Adan 1988 *(Continued)*

	C group (Control/no cell salvage group): in the control group, only stored blood was used
Outcomes	**Outcomes reported:** amount of stored blood required, haemoglobin, haematocrit, blood loss, bacterial contamination
Notes	**Transfusion protocol:** indications for the infusion of blood in the direct postoperative period were determined by systemic arterial blood pressure, pulmonary artery pressure, cardiac output, blood loss, and haemoglobin level. Blood loss exceeding 500 mL in 12 hours and Hb < 5 mmol/L within the first 24 hours postoperatively necessitated the infusion of blood. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the protocol was approved by the local medical-ethical committee. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information provided – 'patients randomised according to chart number'. No detail on how randomisation sequence generated
Allocation concealment (selection bias)	Unclear risk	Insufficient information – no comment on allocation concealment
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	No transfusion protocol - subjective transfusion protocol in place
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	Unlikely to be blinded
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	Only subjective outcome reported is transfusions (low risk for detection)
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Although authors do not provide explicit statement on dropouts/exclusions, one of the results tables shows n = 25, suggesting that there were no dropouts/exclusions.

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Adan 1988 *(Continued)*

Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	Authors do not provide baseline characteristics so cannot verify their claim that there were no important differences between groups at baseline. Also, no funding or conflict of interest declaration

Altinel 2007

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Afyon, Turkey **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** duration of hospital stay
Participants	32 participants undergoing total knee arthroplasty were randomised to one of two groups: **Study group** (Cell salvage/intervention group): N = 16. M:F 0:16. Mean (SD) age 66.9 (9.1). Mean (SD) BMI 32.6 (4.3) kg/m^2. **Control group** (Control/no cell salvage group): N = 16. M:F 2:14. Mean (SD) age 66.2 (7.1). Mean (SD) BMI 34.3 (8.3) kg/m^2. There was no baseline imbalance between groups with regard to demographic data.
Interventions	**Study group** (Cell salvage/intervention group): cell salvage group (ConstaVac CBCII autotransfusion system) had wound drain connected at the end of the operation. The drain fluid was collected during the first 6 hours. Collected blood was transfused at the end of the 6th hour. Reinfusion was performed using a standard 40 µm blood filter between the collection bag and the intravenous site. After the 6 hours, any blood collected from the reinfusion drain was discarded. **Control group**: control group received standard care without autotransfusion.
Outcomes	**Outcomes reported:** number of participants transfused allogeneic blood, blood loss, hospital length of stay, adverse events
Notes	**Transfusion protocol*:*** allogeneic blood transfusion was given if the haemoglobin level was < 9.0 g/dL. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study was approved by the Ethics Committee of the Faculty of Medicine, Afyon Kocatepe, Turkey. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**

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Altinel 2007 *(Continued)*

Random sequence generation (selection bias)	Low risk	Lots drawn
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was not described
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: if the blood haemoglobin level was below 9 g/dL and there were evident clinical signs of anaemia, patients were given additional homologous blood.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	Blinding status of participants and personnel is not described
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	One outcome (chest x-ray evaluation) noted as blinded assessment; suggests the remaining outcomes were not blinded, but not clear
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Unclear patient flow - baseline characteristics suggest 16 per group, but whether this is number randomised, or if all were analysed, is not clear
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No mention of funding or conflicts

Amin 2008

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** District General Hospital, Colchester, Essex, UK **Recruitment:** May 2005 to December 2005 **Maximum follow-up:** duration of hospital stay
Participants	178 participants undergoing total knee replacement were randomised to one of two groups:

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Amin 2008 *(Continued)*

	Autologous retransfusion drain group (Cell salvage/intervention group): N = 92. M:F 43:49. Mean (range) age 70.3 (55.2 to 88.5) **Standard vacuum drain group** (Control/no cell salvage group): N = 86, M:F 39:47. Mean (range) age 70.4 (57.9 to 87.1) No formal test of baseline imbalance was performed to compare the groups and the authors do not comment on whether they were similar.
Interventions	**Autologous retransfusion drain group:** cell salvage group (Bellovac ABT autotransfusion sytem) had the blood collection suction bellows connected to an autologous transfusion bag with a 200 mm filter and a one-way valve. The transfusion bag was connected to a transfusion set with a 40 µm filter. The drain was opened 20 minutes after tourniquet release. The shed blood was returned to the participant after collecting up to 500 mL and no later than 6 hours after surgery. A maximum of 1200 mL was re-transfused. **Standard vacuum drain group:** control group (standard vacuum drain) had blood collected in the vacuum drains discarded.
Outcomes	**Outcomes reported:** number of participants transfused allogeneic blood, hospital length of stay, adverse events
Notes	**Transfusion protocol:** allogeneic blood was transfused if the haemoglobin level fell below 80 g/L, or if the participant developed clinical signs of anaemia, such as tachycardia and postural hypotension, in the presence of a haemoglobin level of 80 g/L to 100 g/L. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study was approved by the local ethics committee. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Sealed envelopes were used to conceal treatment allocation, but doesn't mention if they were opaque.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: allogenic blood was transfused if the haemoglobin level fell below 8 g/dL, or if the participant developed clinical signs of anaemia, such as tachycardia and postural hypotension, in the presence of a haemoglobin level of 8 g/dL to 10 g/dL.
Blinding of participants and personnel (performance bias)	Unclear risk	No mention of blinding of participants or personnel

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Amin 2008 *(Continued)*

Subjective: all other outcomes		
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	No mention of blinding in manuscript
Incomplete outcome data (attrition bias) All outcomes	Low risk	Unclear patient flow; however, results state they analysed ITT
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No mention of funding or conflicts

Atay 2010

Study characteristics	
Methods	**Design:** RCT, parallel two-arm study **Setting:** Istanbul, Turkey; Bolu, Turkey **Recruitment:** December 2008 to April 2009 **Maximum follow-up:** 7 days postoperatively
Participants	74 participants (77 surgeries) undergoing primary, unilateral hip or knee arthroplasty were randomised to one of the following groups: **Study group** (Cell salvage/intervention group): N = 37. Knee group: Mean (SD) age 65.25 (12.57). M:F 2:18. Hip group: Mean (SD) age 59.76 (15.43). M:F 6:11. **Control group**: N = 40. Knee group: Mean (SD) age 68.19 (6.62). M:F 7:14. Hip group: Mean (SD) age 58.95 (13.6). M:F 6:13. There were no differences in age, gender, or preoperative haemoglobin concentration between groups.
Interventions	**Study group** (Cell salvage/intervention group): autotransfusion set (Transolog, Heim Medizintechnik, Germany) was used to salvage blood immediately postoperatively for four hours. At the end of the 4th hour postoperatively, any salvaged blood was filtered and autotransfused. The drain remained in situ for 48 hours postoperatively. **Control group**: Received a standard haemovac drain, which remained in situ for 48 hours postoperatively.

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Atay 2010 *(Continued)*

Outcomes	**Outcomes reported:** haemoglobin concentrations immediately after the operation, haematocrit concentrations immediately after the operation, amount of autotransfusion, number of participants receiving allogeneic blood transfusion, amount of allogeneic blood transfused (units), transfusion reactions and adverse events
Notes	**Transfusion protocol:** autotransfusion was performed at the end of the 4th hour postoperatively in the study group. Allogeneic transfusion was administered to any participant with Hb < 8 g/dL or Hct < 25% and clinical signs of anaemia, such as tachycardia, dyspnoea or hypotension. **Prospective registration status:** study published prior to 2010 **Ethical approval:** it is unclear whether the trial received approval from a Research Ethics Committee or Institutional Review Board prior to the start of recruitment. The authors were contacted to request this information but no response has been received. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Participants were randomised using a block randomisation method; however, no further details are available.
Allocation concealment (selection bias)	Unclear risk	The method used to conceal treatment allocation is unclear
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	Blinding of study participants and personnel was not performed - different drains were used between the study and control groups.
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	The blinding status of outcome assessors is not described
Incomplete outcome data (attrition bias)	Unclear risk	Insufficient information on patient flow

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Atay 2010 *(Continued)*
All outcomes

Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	Conflicts and funding not reported

Axford 1994

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** Veterans Medical Centre, Boston, MA, USA **Recruitment:** June 1988 to August 1989 **Maximum follow-up:** 30 days postoperatively
Participants	32 participants undergoing cardiac surgery requiring cardiopulmonary bypass were randomised to one of two groups: **Shed blood group** (Group 1) (Cell salvage/intervention group): N = 16. Mean (SD) age 60 (8.0). **Banked blood group** (Group 2) (Control/no cell salvage group): N = 16. Mean (SD) age 61 (8.0). There were no differences between groups at baseline.
Interventions	**Shed blood group** (Group 1): cell salvage group (Pleur-evac Autotransfusion System - A-5005-ATS) had their mediastinal shed blood collected in a polyvinyl chloride blood bag containing an inline 200 µm nylon mesh filter by means of a closed system with -20 cm H_2O suction applied. This collection system contained no anticoagulant and none was added. Mediastinal shed blood was transfused without washing by detaching the autotransfusion replacement bag and reinfusing the blood through a standard 40 µm screen blood filter (Pall SQ40S) via a peripheral intravenous line. **Banked blood group** (Group 2): control group received either autologous packed cells if available or allogeneic packed red blood cells (standard citrate-phosphate-dextrose ADSOL-preserved cross-matched packed RBCs units stored at 4 °C for up to 42 days).
Outcomes	**Outcomes reported:** amount of allogeneic blood transfused, amount of autologous blood transfused, number of participants transfused autologous and/or allogeneic blood, complications, bleeding times, post-transfusion febrile reactions
Notes	**Transfusion protocol:** the decision to transfuse a participant postoperatively was made by the clinician who was responsible for the participant's postoperative care, and who was not involved in the study. The clinical criteria used to determine the need for transfusion consisted of the following: systolic BP < 80 mmHg; mean arterial pressure < 50 mmHg; central venous pressure (CVP) < 5 mmHg; pulmonary capillary wedge pressure (PCWP) < 5 mmHg; cardiac index (CI) < 2.0L/min/m2; evidence of inadequate end-organ perfusion (i.e.: urine output < 20 mL/h), or anaemia (Hct < 25%). Any participant who bled > 400 mL in the first 4 hours postoperatively and who met any of these criteria underwent transfusion. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the experimental protocol for the study was performed by the local institutional human research committee. **Language of publication:** English

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Axford 1994 *(Continued)*

Trial funding: US Naval Medical Research and Development Command; Richard Warren Surgical Research and Education Fund

Conflicts of interest: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to concealment treatment allocation was unclear.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: systolic blood pressure, < 80 mmHg; mean arterial pressure, < 50 mmHg; central venous pressure, < 5 mmHg; pulmonary capillary wedge pressure, < 5 mmHg, cardiac index, < 2.0 L/min/m^2; evidence of inadequate end-organ perfusion (i.e., urine output, < 20 mL/h); or anaemia (hematocrit, < 25 ~01%). Any patient who bled > 400 mL in the first 4 hours after operation and who met any of these criteria
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	The blinding status of participants and personnel is not described
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	The blinding status of outcome assessors was not described
Incomplete outcome data (attrition bias) All outcomes	High risk	Significant number of participants lost to follow-up: of the initial 103 participants, 71 were excluded (for reasons such as re-operation, not bleeding enough, etc). Only 32 included in the analysis (16 per group)
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Low risk	Funding reported (non pharma). No apparent baseline imbalance.

Ayers 1995

Study characteristics

Methods	**Design:** RCT, parallel two-arm, multicentre study

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Ayers 1995 *(Continued)*

	Setting: regional hospital and university teaching hospital, Syracuse, NY, USA **Recruitment:** October 1991 to January 1993 **Maximum follow-up:** duration of hospital stay
Participants	232 participants undergoing total hip arthroplasty were randomly assigned to one of two groups: **Postoperative Blood Salvage group** (Cell Salvage/intervention group): N = 103. N primary procedure = 67 (65%). N revision procedure = 36 (35%). **Closed suction (Haemovac) drain group** (Control/no cell salvage group): N = 129. N primary procedure = 89 (69%). N revision procedure = 40 (31%). No demographic data were reported, but the study reports that the two groups were similar in all respects.
Interventions	**Postoperative Blood Salvage group** (Cell Salvage/intervention group): cell salvage group (Autovac Post-operative Orthopaedic Autotransfusion Canister) had blood loss collected for 4 hours postoperatively. The autotransfusion canister was injected with 40 mL of acid-citrate-dextrose anticoagulant (ACD-A) before activation. The autotransfusion canister was connected to wall suction with use of an Autovac Autotranfusion Regulator that limited maximum collection pressure to 100 mmHg. If at least 300 mL of blood was collected within 4 hours, the unwashed blood was reinfused through a microaggregate filter; if < 300 mL of blood was collected, the blood was discarded. Any blood that had not been reinfused within 6 hours after the beginning of collection was discarded. **Closed suction (Haemovac) drain group** (Control/no cell salvage group): control group had a closed suction drainage system used (Hemovac system). All participants were advised to donate blood pre-operatively. The 156 participants (67%) who were scheduled to have a primary procedure were advised to donate 2 units of autologous blood, and the 76 participants (33%) who were scheduled to have a revision procedure were advised to donate 4 units of autologous blood.
Outcomes	**Outcomes reported:** number of participants transfused allogeneic and/or autologous blood, blood loss, Hb levels
Notes	**Transfusion protocol:** use of a transfusion protocol is not reported. All revision participants were exposed to cell salvage intraoperatively. 85% of Group 1 participants pre-deposited blood pre-operatively (PAD). 77% of Group 2 participants pre-deposited blood pre-operatively (PAD). **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** it is unclear whether the study was approved by an institutional review board or ethics committee. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Randomly assigned on the basis of their hospital number – possibly quasi-RCT – but unclear how the hospital number was used (may be properly randomised). All those who had revision procedure had cell salvage

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Ayers 1995 *(Continued)*

Allocation concealment (selection bias)	High risk	Inadequate allocation concealment. No info on most, but all who had a revision (not primary) procedure had cell salvage
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	Protocol in reference to how patients are monitored not indication for transfusion
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	A large number definitely knew their allocation to cell salvage
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	A large number definitely knew their allocation to cell salvage
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	The number of participants analysed is not reported: unclear patient flow, and unclear how many were used for each analysis as there appears to be sub-grouping by those who had pre-donated autologous blood
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No mention of funding or conflicts

Blatsoukas 2010

Study characteristics	
Methods	**Design:** quasi-RCT, parallel three-arm, single-centre study **Setting:** university teaching hospital, Alexandroupolis, Greece **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** 3 months postoperatively
Participants	248 participants undergoing primary, unilateral total knee replacement for osteoarthritis were randomised to one of the following three groups: **Group 0** (Control/no cell salvage): N = 85. Median (SD) age 68.5 (7.38). M:F 12:73. Mean (SD) BMI 31.68 (3.06) kg/m^2.

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Blatsoukas 2010 *(Continued)*

	Group 1 (Cell salvage/intervention group): N = 92. Median (SD) age 69.41 (6.54). M:F 17:75. Mean (SD) BMI 32.04 (3.76) kg/m^2. **Group 2** (Cell salvage/intervention): N = 71. Median (SD) age 69.11 (7.21). M:F 14:57. Mean (SD) BMI 32.05 (4.83) kg/m^2.
Interventions	**Group 0** (Control/no cell salvage group): received allogeneic blood transfusion only **Group 1** (Cell salvage/intervention group): received intraoperative cell salvage using Dideco Compact Advanced, Dideco, 41037 Mirandola, Italy. Autotransfusion of salvaged blood from this device was performed intraoperatively. Postoperative cell salvage was performed using a suction drain (ConstaVac CBC II, Stryker, Kalamazoo, MI) and autotransfusion was performed within 6 hours of collection. The drain was removed at 48 hours postoperatively. **Group 2** (Cell salvage/intervention group): postoperative cell salvage only was used via a suction drain (ConstaVac CBC II, Stryker, Kalamazoo, MI) and autotransfusion was performed within 6 hours of collection. The drain was removed at 48 hours postoperatively.
Outcomes	**Outcomes reported:** adverse events, need for allogeneic blood transfusion, volume of autologous blood reinfusion from intraoperative and postoperative cell salvage devices, blood loss, postoperative haemoglobin levels recorded on days 1, 2, 3 and 7 postoperatively
Notes	**Transfusion protocol:** allogeneic blood transfusion was given to any participant experiencing signs and symptoms of severe anaemia due to blood loss on the day of the operation. During the following 2 days, allogeneic transfusion was performed according to the following haemoglobin concentrations: Hb 9-10 g/dL: 1 unit Hb 8-9 g/dL: 2 units Hb 7-8 g/dL: 3 units **Prospective registration status:** the trial was not prospectively registered in a trials registry. **Ethical approval:** ethics committee approval was received from the hospital ethics committee of University General Hospital of Alexandroupolis, Dragana, Alexandroupolis, Greece **Language of publication:** English **Study groups and subgrouping:** the cell salvage/intervention group data are combined from Groups 1 (intraoperative auto-transfusion (IAT) and postoperative auto-transfusion (PAT)) and 2 (PAT only). Data from Group 1 (IAT and PAT) contributed to the subgroup analysis of intra- and postoperative cell salvage. Data from Group 2 (PAT only) contributed to the subgroup analysis of postoperative cell salvage. **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Quasi-randomisation methodology used, whereby participants were randomised according to the week upon which their operation fell.
Allocation concealment (selection bias)	High risk	Based on the method used to randomise participants, allocation concealment will not have been possible.

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Blatsoukas 2010 *(Continued)*

Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place but day 1 is based on "symptoms or signs of severe anaemia"
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	The presence of a drain in Groups 1 and 2 versus no drain in Group 0 would alert study participants to their treatment allocation. It is not clear whether participants and clinicians were blinded to the use of intraoperative cell salvage.
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No clear defining criteria for some infection and wound complication outcomes Strict adverse event criteria not given so high risk of subjectivity and bias from unblinding
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No breakdown of exclusion or dropouts provided, only exclusion criteria is stated: 15 participants initially randomised were subsequently excluded after re-checking of the exclusion criteria. As a result, only 48 participants were in the no drain group, < the 50-participant target to account for the a priori sample size and loss-to-follow-up.
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare. Inconsistent reporting of results compared to outcomes stated in methodology.
Other bias	Unclear risk	Unclear what the effect of using two different cell saver devices could be i.e. for intraoperative autotransfusion in the IAT+PAT group vs the PAT device used in the PAT only group. I.e. could there be a difference in processing of blood / blood collection between these different devices etc? Authors have not addressed this clearly. Could not find a clear statement on conflicts of interest. Unsure how authors calculated 'blood saved' from values in Table 1

Breakwell 2000

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Sheffield, Yorkshire, UK **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** 4 days postoperatively

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Breakwell 2000 *(Continued)*

Participants	33 participants undergoing simultaneous bilateral total knee arthroplasty were randomly allocated to one of two groups: **Study group** (Cell salvage/intervention group): N = 14. Mean age 66.8. M:F 8:6. **Control group** (No cell salvage group): N = 19. Mean age 73.7. M:F 8:11. There was no difference between groups in preoperative haemoglobin concentrations.
Interventions	**Study group** (Cell salvage/intervention group): all participants had four suction drains positioned at the end of surgery, two deep and two superficial. In the study group, the two deep drains were connected to a Stryker CBCII ConstaVac blood retrieval device in which the blood was filtered before being re-infused. Only the blood collected in the initial eight postoperative hours was re-infused. **Control group** (No cell salvage group): all participants had four suction drains positioned at the end of surgery, two deep and two superficial. In the control group, the drains were allowed to empty into suction bottle containers and their contents then discarded.
Outcomes	**Outcomes reported:** volume of blood collected, volume of blood reinfused, allogeneic blood requirements, adverse events and complications, length of hospital stay
Notes	**Transfusion protocol:** participants with haemoglobin values below the preset trigger value of 9 g/dL were rescued with allogenic transfusion. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Randomisation method not clear
Allocation concealment (selection bias)	Unclear risk	Allocation concealment method unclear
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: participants with haemoglobin values below the preset trigger value of 9 g/dL were rescued with allogeneic transfusion.
Blinding of participants and personnel (performance bias)	Low risk	Authors state standard care for all participants in sufficient detail.

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Breakwell 2000 *(Continued)*

Subjective: all other outcomes		
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Blood loss measurement unclear
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Authors do not provide breakdown of dropouts and do not make a statement to confirm that there were no dropouts.
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No conflict of interest declaration or funding statement is made. No baseline imbalance

Cheng 2005

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** District General Hospital, Hong Kong **Recruitment:** June 2002 to May 2004 **Maximum follow-up:** 3 days postoperatively
Participants	60 participants undergoing unilateral total knee arthroplasty (TKA) were randomly allocated to one of two groups: **Group 1** (Cell salvage/intervention group): N = 26. M:F 6:20. Mean (range) age 72 (57 to 84) **Group 2** (Control/no cell salvage group): N = 34. M:F 12:22. Mean (range) age 69.4 (55 to 78) There were no differences between groups at baseline.
Interventions	**Group 1**: cell salvage group (DONOR system) had their blood reinfused from drains using a 40 µm blood filter between the collection bag and the intravenous site within 6 hours of surgery. All participants had their drains removed on postoperative day 2 or 3. The DONOR system is an integrated, closed system designed for the collection and reinfusion of drained wound blood. It consists of an 800 mL chlorine-free, pre-evacuated collection vessel, a vacuum regulator, and a 40 µm integrated filter for salvaged blood. **Group 2**: control group received no postoperative autotransfusion.
Outcomes	**Outcomes reported:** amount of allogeneic blood transfused, number of participants transfused allogeneic blood, febrile complications, adverse events, blood loss
Notes	**Transfusion protocol:** allogeneic blood transfusion was given if the haemoglobin level was < 9.0 g/dL, or on the authority of the lead physician if the participant experienced severe anaemic symptoms. Transfusions were given according to the following criteria:

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Cheng 2005 *(Continued)*

Hb 81-90 g/L = 1 unit

Hb 71-80 g/L = 2 units

Hb 61-70 g/L = 3 units

Hb 50-60 g/L = 4 units

Prospective registration status: the study was published prior to 2010.

Ethical approval: the study was approved by the ethics board of the Hong Kong Hospital's Authority Kowloon West Cluster.

Language of publication: English

Trial funding: Tung Wah Group of Hospitals Research Fund

Conflicts of interest: none reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Allocated into a reinfusion group and a control group. Randomisation was by sealed opaque envelopes, which were well mixed by independent personnel and consecutively assigned a case number from 1 to 60.
Allocation concealment (selection bias)	Low risk	Randomisation was by sealed opaque envelopes, which were well mixed by independent personnel and consecutively assigned a case number from 1 to 60
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	Transfusion protocol based on Hb level, or on the authority of the lead physician if the participant experienced severe anaemic symptoms. Group allocation revealed at end of procedure. Transfusion decisions made in unblinded fashion.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Low risk	Near the end of each operation, the corresponding envelope was opened, and the surgeon was informed at the time of drain insertion to achieve a single-blind effect.
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	Described as single blind only (outcome assessors unblinded), though all outcomes deemed low risk of bias
Incomplete outcome data (attrition bias) All outcomes	Low risk	States 60 participants were enroled, and both pre-op and post-op data suggest 60 participants (26 and 34) analysed. No other info regarding patient flow. One participant mentioned in reinfusion group (blood discarded), does not appear to have been excluded

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Cheng 2005 *(Continued)*

Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Low risk	Funding reported (non pharma). No apparent baseline imbalance

Cheung 2010

Study characteristics	
Methods	**Design:** RCT, parallel three-arm, single-centre study **Setting:** Specialist Orthopaedic Hospital, Oswestry, Shropshire, UK **Recruitment:** July 2005 to August 2006 **Maximum follow-up:** 12 months postoperatively
Participants	168 participants undergoing primary total hip replacement for osteoarthritis were randomised to one of the following three groups: **Group 1** (Cell salvage/intervention group): N = 53. Median (IQR) age 65 (61 to 73). M:F 22:39. Median (IQR) BMI 29 (26 to 33). **Group 2** (Control/no cell salvage group): N = 52. Median (IQR) age 70.5 (63 to 76). M:F 24:30. Median (IQR) BMI 26.3 (24.3 to 29.5). **Group 3** (Control/no cell salvage group): N = 48. Median (IQR) age 69 (62.3 to 76). M:F 23:30. Median (IQR) BMI 27 (25 to 29).
Interventions	**Group 1** (Cell salvage/intervention group): autologous blood transfusion group (ABT) received a Bellovac ABT drain (Astra Tech Ltd., Gloucestershire, UK) (size 12). If deemed necessary, autologous transfusion was performed within 6 hours of collection. The drain was removed at 24 hours post-surgery. **Group 2** (Control/no cell salvage group): the standard drain group received a standard suction drain (size 12). The drain used was a High Vaccuum Medinorm drain (Van Straten, Quiershield, Germany). The drain was removed at 24 hours postsurgery. **Group 3** (Control/no cell salvage group): the no drain group did not have a drain inserted
Outcomes	**Primary outcome:** transfusion rate (proportion of participants), volume of blood administered **Secondary outcomes:** blood loss (intraoperative), postoperative haemoglobin concentration, wound infection rate, time for wound to become dry, length of hospital stay, investigation and treatment for thromboembolic events
Notes	**Transfusion protocol:** the decision about whether to transfuse was made by the ward doctors or anaesthetist. No criteria were set to trigger a transfusion, although all doctors at the trust had attended a transfusion awareness lecture, outlining broad guidelines. **Prospective registration status:** the study was retrospectively registered on a trials registry, 18 months after study commencement. **Ethical approval:** the study received ethics approval from the local research ethics committee for Robert Jones and Agnes Hunt Orthopaedic and District Hospital, Oswestry, Shropshire, UK **Language of publication:** English **Study groups:** for the purpose of our review, Group 2 and Group 3 were used as the "control/no cell salvage" group in the comparison against Group 1, the "cell salvage/intervention" group.

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Cheung 2010 *(Continued)*

Trial funding: no benefits of funds were received in support of the study

Conflicts of interest: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Patients undergoing primary total hip replacement were randomised to one of three groups using stratified randomisation software (StratOs, Cooked Bits, Oswestry, UK) to balance the groups according to potentially confounding factors. The software used the Pocock and Simon implementation of the minimisation method. Prognostication was based on four prognostic factors: body mass index (BMI), age, gender and the use of aspirin and non-steroidal anti-inflammatory drugs (NSAIDs).
Allocation concealment (selection bias)	Low risk	It is unlikely that sequence allocation could be anticipated given the randomisation methodology used
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	No transfusion protocol in place: the decision about whether to transfuse was made by the ward doctors or anaesthetist. No criteria were set to trigger a transfusion, although all doctors at the trust had attended a transfusion awareness lecture, outlining broad guidelines.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	No blinding, no strict guidelines for subjective outcomes
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding, no strict guidelines for subjective outcomes
Incomplete outcome data (attrition bias) All outcomes	Low risk	15 of 163 participants initially randomised were subsequently excluded after re-checking of the exclusion criteria. Groups remained broadly even in size, no other loss to follow-up
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	Conflicts not reported. Baseline imbalance in BMI between groups. Funding was reported.

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Cip 2013

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Innsbruck, Austria **Recruitment:** December 2007 to January 2009 **Maximum follow-up:** 5 days postoperatively
Participants	151 participants being treated with primary elective total knee replacement for osteoarthritis were randomised to one of the following groups: **Group A** (Cell salvage/intervention group): N = 76. Mean (SD) age 70 (8). M:F 29:49. Mean (SD) BMI 31 (6) kg/m^2. **Group B** (Control/no cell salvage group): N = 75. Mean (SD) age 69 (8). M:F 29:49. Mean (SD) BMI 32 (6) kg/m^2.
Interventions	**Group A** (Cell salvage/intervention group): the cell salvage group received the Orthopaedic Perioperative Autotransfusion System (OrthoPAT, Haemonetics Corp, Braintree, MA, USA) for both intraoperative and postoperative cell salvage and autotransfusion. The drain remained in situ until 48 hours postoperatively. **Group B** (Control/no cell salvage group): the control group received a standard drain without suction. The drain remained in situ until 48 hours postoperatively.
Outcomes	**Outcomes reported:** number of participants receiving allogeneic blood transfusion, postoperative haemoglobin concentrations, postoperative blood loss, wound infection, allergic reaction, deep vein thrombosis, minor bleeding, major bleeding, neural deficiencies, arterial embolism, number of red blood cell units used
Notes	**Transfusion protocol:** transfusion was indicated in any participant with signs of anaemia, defined as vertigo, nausea, vomiting, hypotension (systolic blood pressure < 100 mmHg), tachycardia (heart rate > 100 beats per minute) or haemoglobin concentration < 8 g/dL. **Prospective registration status:** the study was not prospectively registered on a trials registry. **Ethical approval:** the study was approved by the Institutional Review Board for the Department of Orthopaedic Surgery, Academic Teaching Hospital, Medical University of Innsbruck, Feldkirch, Austria. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** each author certifies that he or she, or a member of his or her immediate family, has no funding or commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licencing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article.

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Participants were randomised using sealed envelopes, each given an assigned code. Even number codes were allocated to Group A and odd-numbered codes were allocated to Group B. Envelopes were opened in the operating room shortly before the start of surgery.

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Cip 2013 *(Continued)*

Allocation concealment (selection bias)	Low risk	Allocation was performed by a single, blinded, independent individual using anonymous codes
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: signs of anaemia (vertigo, nausea, vomiting, hypotension (systolic blood pressure < 100 mmHg, tachycardia > 100 beats/minute) or a haemoglobin level < 8 g/dL).
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Low risk	Participants were not blinded to treatment postoperatively. Personnel were not blinded to treatment allocation.
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Intraoperative staff unblinded – may affect outcomes such as blood loss. Not clear if postop staff responsible for recording also unblinded, but presumably they were – may affect recording of adverse events which are not well described or defined
Incomplete outcome data (attrition bias) All outcomes	Low risk	Low dropout rate (< 10%) and balanced between groups. Although reason for missing data not provided, there were only 140/151 participants with results, but roughly equal loss in both arms – 6 lost from intervention arm and 5 lost from control arm, so this proportion may not introduce significant bias. Reasons given for exclusion of randomised participants: (1) lack of data (six participants), (2) technical problems with the retransfusion system (four participants), and (3) acute intraoperative renal failure (one participants).
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare. Specific primary / secondary outcomes are not clear from text. No clear data presented for whether there was a decreased postoperative infection rate with the use of an autologous transfusion system. Data clearly presented for ABT requirement and Hb levels after salvaged blood administration. Authors also provide a P value for blood loss but these data are not presented anywhere in the paper.
Other bias	Low risk	Each author certifies that he or she, or a member of his or her immediate family, has no funding or commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licencing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article.

Clagett 1999

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, multi-centre study. Each participating hospital was part of a single university teaching hospital.

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Clagett 1999 *(Continued)*

	Setting: three sites of a single university teaching hospital, Dallas, TX, USA **Recruitment:** September 1996 to December 1997 **Maximum follow-up:** duration of hospital stay
Participants	100 participants undergoing aortic surgery were randomly allocated to one of two groups: **Intraoperative autotransfusion group** (Cell salvage/intervention group): N = 50. M:F 41:9. Mean (SD) age 63 (11.0). Mean (SD) weight 77 (15) kg. **Control group** (Control/no cell salvage group): N = 50. M:F 43:7. Mean (SD) age 65 (9.0). Mean (SD) weight 79 (15) kg. There was a between-group difference in renal insufficiency, measured by serum creatinine level, preoperatively.
Interventions	**Intraoperative autotransfusion group** (Cell salvage/intervention group): intraoperative autotransfusion group had their blood processed by either a Cell Saver 3 Plus or Cell Saver 5 device. Both systems consist of polyvinyl aspiration tubing with a separate channel for introducing small amounts of heparinised saline solution to anticoagulate aspirated blood, a plastic cardiotomy reservoir with microaggregate filter, a continuous flow, disposable washing bowl driven by a centrifuge, and a transfusion setup that consists of a plastic transfer pack passed to the anaesthesiologist for administration. The maximum allowable amount of IAT-PRBCs [intraoperative autotransfusion packed red blood cells] administered to a single patient was 1500 mL. **Control group** (Control/no cell salvage group): control group did not receive autotransfusion.
Outcomes	**Primary outcomes:** total amount of allogeneic blood transfusion per participant during the period of hospitalisation, and the proportion of participants in whom allogeneic blood was not transfused **Secondary outcomes:** blood loss, hospital length of stay, intensive care unit (ICU) length of stay, morbidity and mortality
Notes	**Transfusion protocol:** intraoperative transfusion for haemodynamic instability and/or Hb < 10 g/dL (Hct < 30%), and postoperative transfusion for Hb < 8 g/dL (Hct < 25%), or Hb between 8 and 10 g/dL (Hct, 25% to 30%) for those with compromised cardiopulmonary status. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the protocol was approved by the University of Texas Southwestern Medical Center Institutional Review Board and the Human Studies Committee of the Dallas Department of Veterans Affairs (VA) Medical Center. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomised by means of a drawing of sealed envelopes that contained prescriptions for either intraoperative autotransfusion (IAT) or control therapy.
Allocation concealment (selection bias)	Unclear risk	Randomised by means of a drawing of sealed envelopes that contained prescriptions for either IAT or control therapy; not known whether envelopes opaque

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Clagett 1999 *(Continued)*

Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: intraoperative transfusion for haemodynamic instability and/or Hb < 10 g/dL (Hct < 30%), and postoperative transfusion for Hb < 8 g/dL (Hct < 25%), or Hb between 8 and 10 g/dL (Hct, 25% to 30%) for those with compromised cardiopulmonary status.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	Unblinded study: high risk for some outcomes (blood loss and wound complication). Authors note that it "is possible that there were sources of bias that may have influenced outcomes. If so, it is likely to have favored the use of IAT. Surgeons and anesthesiologists were accustomed to using IAT during aortic surgery at our institution, and some were initially reluctant to randomize patients. An early concern was that anesthesiologists would be more likely to administer allogeneic blood to control patients simply because the IAT device was absent."
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	Unblinded study: high risk for some outcomes (blood loss and wound complication). Authors note that it "is possible that there were sources of bias that may have influenced outcomes. If so, it is likely to have favored the use of IAT. Surgeons and anesthesiologists were accustomed to using IAT during aortic surgery at our institution, and some were initially reluctant to randomize patients. An early concern was that anesthesiologists would be more likely to administer allogeneic blood to control patients simply because the IAT device was absent."
Incomplete outcome data (attrition bias) All outcomes	Low risk	All participants randomised are accounted for in the reported outcomes: 100 enroled, 100 analysed. Unclear if this was total randomised, but suspect so due to the reporting of exclusions.
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	Some baseline imbalance (renal insufficiency), unclear how that may impact outcomes. Funding and conflicts not reported

Dalrymple-Hay 1999

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Southampton, Hampshire, UK **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** duration of hospital stay

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Dalrymple-Hay 1999 *(Continued)*

Participants	112 participants undergoing cardiac surgery were randomised to one of two groups: **Group A** (Cell salvage/intervention group): N = 56. M:F 36:20. Mean (SD) age 67.4 (9.0) **Group C** (Control/no cell salvage group): N = 56. M:F 41:15. Mean (SD) age 65.3 (10.5)
Interventions	**Group A** (Cell salvage/intervention group): cell salvage group were transfused with washed postoperative drained blood processed by a Fresenius Continuous Autotransfusion System (C.A.T.S). **Group C** (Control/no cell salvage group): control group received usual care management without autotransfusion.
Outcomes	**Outcomes reported:** amount of allogeneic blood transfused, number of participants transfused allogeneic blood, mortality, re-operation for bleeding, blood loss, coagulopathy, Hb levels
Notes	**Transfusion protocol:** participants were transfused allogeneic RBCs intraoperatively if the haemoglobin level was < 7.0g/dL. Postoperatively participants were transfused allogeneic RBCs if the haemoglobin level was < 10.0 g/dL. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study was approved by an ethics committee. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Participants were randomised using a binary random number table
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was not described.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place; < 0.2 during cardiopulmonary bypass, banked blood was transfused in both groups if the Hb fell to < 7 g/dL
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	No info on blinding. Re-operation and length of stay not clearly defined
Blinding of outcome assessment (detection bias)	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding

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Dalrymple-Hay 1999 *(Continued)*

Objective outcomes: mortality and transfusions		
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	No info on blinding. Re-operation and length of stay not clearly defined
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	The number analysed is not reported: 112 randomised; unclear analysis N - appears to be calculated based on the number who received blood (for volume transfused). But very unclear
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No baseline imbalance noted. Funding and conflicts not reported

Damgaard 2006

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Copenhagen, Denmark **Recruitment:** September 2003 to October 2004 (study dates) **Maximum follow-up:** 31 days postoperatively
Participants	60 participants undergoing 'off-pump' coronary artery bypass surgery were randomly allocated to one of two groups: **Cell saver group** (cell salvage/intervention group): N = 30. M:F 11:19. Mean (IQR) age 77 (74 to 79) **Control group** (control/no cell salvage): N = 30. M:F 14:16. Mean (IQR) age 76 (70 to 79) There was no difference in baseline characteristics.
Interventions	**Cell saver group** (cell salvage/intervention group): cell salvage group (Medtronic Autolog system) received intraoperative autotransfusion. Immediately after surgery, the suctioned blood was processed by the cell saver device and autotransfused before the participant was transferred to the intensive care unit (ICU). **Control group** (control/no cell salvage group): control group had their intraoperative suctioned blood discarded. NB: the cell saver reservoir with a 40 µm filter was used in the ICU for mediastinal drained blood collection and for postoperative autotransfusion in both groups. A maximum of 12 hours of postoperative unwashed autotransfusion from the drains was routine practice.
Outcomes	**Outcomes reported:** amount of allogeneic blood transfused, number of patients transfused allogeneic blood, blood loss, Hb levels, adverse events, costs
Notes	**Transfusion protocol:** both groups received allogeneic blood transfusion when indicated and when drain blood volumes in the reservoir were inadequate for autotransfusion. Indication for RBC transfusion was the usual guidelines of the department: haemoglobin below 6.0 mmol/L and/or haematocrit below 30%. **Prospective registration status:** the study was published prior to 2010.

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Damgaard 2006 *(Continued)*

Ethical approval: the study was approved by an ethics committee.

Language of publication: English

Trial funding: H:S Copenhagen Hospital Corporation

Conflicts of interest: none reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described: randomly allocated 1:1
Allocation concealment (selection bias)	Low risk	60 sealed and opaque envelopes numbered in sequence randomly allocating 1:1, 30 participants to the study (cell saver) group and 30 to the control group
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: both groups received allogeneic blood transfusion when indicated and when drain blood volumes in the reservoir were inadequate for autotransfusion. Indication for RBC transfusion was the usual guidelines of the department: haemoglobin below 6.0 mmol/L and/or haematocrit below 30%.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Low risk	The surgical and anaesthetic team were blinded during the operation, but not after. However, the ICU and ward personnel were not informed about which procedure had been performed. Wouldn't affect clinical decision-making during the operation
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	The surgical and anaesthetic team were blinded during the operation, but not after. However, the ICU and ward personnel were not informed about which procedure had been performed. Wouldn't affect clinical decision-making during the operation
Incomplete outcome data (attrition bias) All outcomes	Low risk	All participants randomised are accounted for in the reported intention-to-treat analysis. According to intention-to-treat principles, they were kept in the study analysis.
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Low risk	No baseline imbalance noted. Funding and conflicts reported

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Davies 1987

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** private hospital, Melbourne, Victoria, Australia **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** 35 days postoperatively
Participants	50 participants undergoing aortic surgery were randomly allocated to one of two groups: **Group A** (Cell salvage/intervention group): N = 25. M:F 21:4. Mean (SD) age 68 (8.0). Mean (SD) weight 69 (11) kg. **Group H** (Control/no cell salvage): N = 25. M:F 22:3. Mean (SD) age 70(8.0). Mean (SD) weight 69 (12) kg. There were no differences reported between groups at baseline.
Interventions	**Group A** (Cell salvage/intervention group): cell salvage group (Sorenson autotransfusion system) had their blood loss from the surgical site suctioned into the Sorenson receptacle device and then retransfused at the time of surgery. Additional blood loss which could not be collected was replaced according to haematocrit levels, 3.5% polygeline being given if the haematocrit was above 30% and allogeneic blood if the haematocrit was below 30%. The collected blood was anticoagulated with an acid citrate dextrose solution and administered via a burette at a rate of 70 mL for every 430 mL of autologous blood collected. The scavenged blood was collected in a 1900 mL sterile disposable Sorenson receptal ATS trauma liner contained within the rigid reusable receptal canister. When approximately 1 litre of autologous blood had been scavenged, the liner was removed and this blood then administered to the participants after being filtered through a Pall 40 µm filter. **Group H** (Control/no cell salvage): intraoperative blood loss was replaced with either 3.5% polygeline or allogeneic blood according to the measured Hct. If the Hct was above 30%, polygeline was used; if the Hct was below 30%, allogeneic blood was administered.
Outcomes	**Outcomes reported:** amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of participants transfused allogeneic blood, mortality, re-operation for bleeding, haemodialysis, blood loss, coagulopathy, Hb levels, organisms cultured from autologous versus allogeneic blood
Notes	**Transfusion protocol:** participants received allogeneic RBC transfusion if the haematocrit level fell below 30%. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study was approved by the research ethics committee of St. Vincent's Hospital. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.

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Davies 1987 *(Continued)*

Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	**Transfusion protocol:** Participants received allogeneic RBC transfusion if the haematocrit level fell below 30%.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	No info on blinding - may impact clinical decision-making related to blood loss and decision to re-operate
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	The blinding status of outcome assessors was not described. No info on blinding - may impact clinical decision-making related to blood loss and decision to re-operate, and when to transfuse
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	The total number of participants contributing to the outcome measures is not reported; no info on patient flow
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No baseline imbalance noted. Funding and conflicts not reported

Djurasovic 2018

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** specialist spinal surgery hospital, Louisville, KY, USA **Recruitment:** October 2011 to October 2013 (study dates) **Maximum follow-up:** 7 days postoperatively
Participants	115 participants over 18 years of age undergoing 2- or 3-level lumbar decompression and fusion between L1-S1 through a posterior-only approach were randomised to either cell saver or no cell saver groups: **Cell Saver group:** N = 58 following randomisation; however, 10 were subsequently lost to follow-up and so 48 were available for analysis. Mean (SD) age was 62.9 (10.6). M:F 20:28. Mean (SD) BMI 32.1 (6.7). **No cell saver group**: N = 57 following randomisation; however, 10 were lost to follow-up and so 47 were available for analysis. Mean (SD) age was 61.8 (11.4). M:F 17:30. Mean (SD) BMI 32.4 (8.3).

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Djurasovic 2018 *(Continued)*

	The reasons for loss to follow-up following randomisation are due to participant withdrawal from the study (n = 2 per arm), a change in surgical approach from posterior-only (n = 3 per arm) and single level decompression and fusion only (n = 5 per arm). There were no differences between groups at baseline.
Interventions	**Cell Saver group:** Cell Saver group received cell salvage intraoperatively and had salvaged blood processed and returned to them intraoperatively. **No cell saver group**: the no Cell Saver group received standard care without the use of a cell saver or autotransfusion.
Outcomes	**Outcomes reported:** postoperative haemoglobin concentration, postoperative haematocrit concentration, need for allogeneic transfusion, cost difference between the groups
Notes	**Transfusion protocol:** transfusion was at the discretion of the treating clinician but was generally triggered at Hb < 8 g/dL associated with hypotension, tachycardia, or existing cardiac disease. **Prospective registration status:** the study was prospectively registered on a trial registry (NCT01453309). **Ethical approval:** the study was approved by the institutional review board for Norton Leatherman Spine Centre, Louisville, Kentucky, USA. **Language of publication:** English **Trial funding:** authors report multiple funding sources (OREF, Norton Healthcare, Scoliosis Research Society (SRS), Pfizer, Integra, and IntelliRod, Nuvasive, Medtronic) **Conflicts of interest:** authors consult for Nuvasive and Medtronic

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Participants were randomised to one of two groups using stratified block randomisation in blocks of 6 to account for the varying number of lumbar levels being operated on. Randomisation was performed using sealed envelopes.
Allocation concealment (selection bias)	Low risk	There is low risk that allocation sequence was revealed or could be anticipated using the randomisation method described: sealed envelopes used to conceal allocation – whoever was responsible for allocating (authors do not state whether it was done centrally or not) could not foresee what the next allocation would be using this method. Envelopes not described as opaque, but not an issue in this case
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	Transfusion 'protocol' outlined; however, significant possibility of between-subject variability: "Need for allogeneic blood transfusion was left to the discretion of the treating surgeon, but was generally triggered by a Hb of < 8.0 g/L." Potential for variability of transfusion threshold in this study, which will affect measurement of this outcome.
Blinding of participants and personnel (performance bias)	High risk	Remaining outcomes at high risk of bias, surgeons not blinded to treatment

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Djurasovic 2018 *(Continued)*

Subjective: all other outcomes		
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Authors state that postoperative allogeneic transfusion requirement was left to discretion of treating surgeon but generally triggered if < 8.0 g/dL. It is not clear whether the surgeon was responsible for administering ABT several days post-procedure, or if patient care would have been handed over to a different team.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Authors provide a breakdown (CONSORT chart) of exclusions and number analysed so all participants initially randomised are accounted for. Following randomisation, 10 participants were lost from each arm of the trial due to participant withdrawal or surgical factors that subsequently met the exclusion criteria. Overall, the number of participants in each arm remained sufficient according to the a priori sample size calculation.
Selective reporting (reporting bias)	Low risk	A prospectively registered trial protocol is available with the planned primary and secondary outcomes listed. All primary and secondary outcomes are reported.
Other bias	Unclear risk	Authors work with Medtronic – one holds patent with Medtronic who sell Cell Saver device. Authors do not clearly state the brand / manufacturer of the Cell Saver used in this study. Possible conflict of interest.

Dramis 2006

Study characteristics	
Methods	**Design:** RCT, parallel two-arm design **Setting:** speciality orthopaedic hospital, Birmingham, West Midlands, UK **Recruitment:** consecutive 30-day period, dates not specified **Maximum follow-up:** 4 days postoperatively
Participants	49 participants undergoing primary unilateral total knee arthroplasty were randomly allocated to one of two groups: **Group A** (Cell salvage/intervention group): N = 32. M:F 11:21. Mean (range) age 69 (49 to 83) **Group B** (Control/no cell salvage group): N = 17. M:F 4:13. Mean (range) age 72 (62 to 91) There was no difference in preoperative haemoglobin concentrations between groups.
Interventions	**Group A** (Cell salvage/intervention): cell salvage group (CellTrans system) had their drained blood filtered through a 40 µm filter before being reinfused. Before closure of the wound, two drainage tubes were inserted. The tubes were connected through a Y-connector to the CellTrans assembly which contains two transfusion bags. The clamps remained closed for 20 minutes after the wound had been closed off. The drainage was started in the recovery room and collected for 6 hours or until 600 mL of blood had accumulated at which point reinfusion took place. Collection up to a maximum of 12 hours - thereafter the blood collected in the drains was discarded.

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Dramis 2006 *(Continued)*

	Group B (Control/no cell salvage group): control group received a standard vacuum drain (Redivac high vacuum drainage system). Drains were removed routinely at 48 hours. Contents were discarded.
Outcomes	**Outcomes reported:** number of participants transfused allogeneic blood, amount of allogeneic blood transfused, Hb levels, cost
Notes	**Transfusion protocol:** the trigger for transfusing allogeneic blood was a postoperative haemoglobin level of < 9.0 g/dL or clinical symptoms of anaemia. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: "The trigger for transfusing allogeneic blood was a postoperative Hb of < 9.0 g/dL or clinical symptoms of anaemia."
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Low risk	No info on blinding - may impact clinical decision-making but not for our outcomes (low risk related to transfusion protocol)
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No info on blinding - may impact clinical decision-making but not for our outcomes (low risk related to transfusion protocol)
Incomplete outcome data (attrition bias) All outcomes	High risk	Cross-over of participants within trial without ITT analysis: 7 participants initially allocated to group B received autotransfusion drain and were included in group B

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Dramis 2006 *(Continued)*

Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	Funding and conflicts of interest not reported

Dutton 2012

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre feasibility study **Setting:** university teaching hospital, Coventry, Warwickshire, UK **Recruitment:** January 2009 to July 2009 **Maximum follow-up:** 48 hours postoperatively
Participants	48 participants scheduled for elective total knee replacement were randomised to one of two treatment arms: **Retransfusion drain group** (Cell salvage/intervention group)N = 23. Mean (range) age 68.7 (56 to 84). M:F 10:13. **No drain group** (Control/no cell salvage group): N = 25. Mean (range) age 70.5 (56 to 95). M:F 10:15. The study does not report whether there were any differences between groups at baseline.
Interventions	**Retransfusion drain group** (Cell salvage/intervention group): participants in the retransfusion drain group received a Bellovac Autologous Blood Transfusion ((ABT) Astra Tech, Molndal, Sweden) drain at the time of wound closure. The drain collects blood from the operative site postoperatively. Salvaged blood is transferred to a transfusion bag via a 200 mm filter prior to retransfusion. Drains were opened 20 minutes after tourniquet release and allowed to drain for 6 hours. Salvaged blood was retransfused if > 80 mL was collected. Drains were removed after 6 hours. **No drain group** (Control/no cell salvage group): participants in the control group did not receive a drain.
Outcomes	**Outcomes reported:** postoperative haemoglobin concentration at 48 hours, complications and adverse events, number of participants requiring allogeneic transfusion, number of allogeneic units transfused
Notes	**Transfusion protocol:** a transfusion threshold was not used. The decision to transfuse allogenic blood was left to the independent clinical teams as per their normal practice. **Prospective registration status:** the study was not prospectively registered on a trials registry. The study was performed as a pilot study, for which registration is not required. **Ethical approval:** the study was approved by the local research ethics committee for University Hospitals Coventry and Warwickshire. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** no competing interests declared

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**

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Dutton 2012 *(Continued)*

Random sequence generation (selection bias)	Low risk	Participants were randomised to the Retransfusion Drain or No Drain groups by means of a computer-generated random sequence generated prior to commencement of the study
Allocation concealment (selection bias)	Low risk	Sequentially-numbered, sealed, opaque envelopes used during the randomisation process and allocation to study arm was only revealed at the point in the operation at which a drain would be inserted.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding.
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	No transfusion protocol in place: decision to transfuse allogenic blood was left to the independent clinical teams as per their normal practice.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	Each surgeon followed their normal clinical practice and were unblinded to group allocation
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	Each surgeon followed their normal clinical practice and were unblinded to group allocation; no other statement regarding outcome assessors
Incomplete outcome data (attrition bias) All outcomes	Low risk	All participants recruited to the study and randomised were accounted for at follow-up and within the outcomes reported, no apparent loss to follow-up, but no breakdown presented
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	High risk	Significant protocol deviations with regard to re-transfusion of blood. Raises suspicion of trial conduct. Declared no competing interests

Ekback 1995

Study characteristics	
Methods	**Design:** RCT, parallel three-arm, single-centre study **Setting:** university teaching hospital, Örebro, Sweden **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** 7 days postoperatively

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Ekback 1995 *(Continued)*

Participants	45 participants undergoing total hip arthroplasty were randomly allocated to one of three groups: **Group 1** (Control/no cell salvage group): n = 15 **Group 2** (Cell salvage/intervention group): n = 15 **Group 3** (Autologous pre-donation plus cell salvage group): n = 15 Demographic data were not reported; however, the authors state that there were no differences between groups with regard to demographic data. Participants in Groups 2 and 3 had significantly higher blood volume than those in Group 1.
Interventions	**Group 1** (Control group/no cell salvage): blood loss was replaced with heterologous erythrocyte concentrate (SAGM-ERC) and 3% dextran 60 in a ratio of 1:1. If necessary, additional SAGM-ERC was transfused to correct erythrocyte volume fraction (EVF) > 27%. **Group 2** (Cell salvage/intervention group): blood loss was replaced with 3% dextran and by autotransfusion of washed and haemoconcentrated blood salvaged by intraoperative suction and from wound drains up to 4 hours postoperatively. Haemonetic Cell Saver 4, Althin model AT 1000, or Shiley/Dideco STAT were used. Blood was retrieved from the operation site by suction through a double lumen catheter and was then anticoagulated with heparin (30,000 IU heparin in 1000 mL of physiological saline). The blood was collected into a reservoir where a macrofilter removed debris. Thereafter, the blood was pumped into a spinning centrifuge bowl (125 mL of blood) and washed with 1500 mL of physiological saline. The erythrocytes were concentrated to an EVF of about 50% to 60% and pumped into an infusion bag. The effluent containing platelets, free haemoglobin, and anticoagulants was disposed. As in Group 1, additional SAGM-ERC was transfused to correct erythrocyte volume fraction (EVF) > 27%. **Group 3** (Autologous pre-donation plus cell saver group): blood loss was replaced with 3% dextran and by autotransfusion of washed and haemoconcentrated blood salvaged by intraoperative suction and from wound drains up to 4 hours postoperatively, as per the technique described for Group 2. Pre-donated autologous SAGM-ERC was used instead of heterologous blood to maintain erythrocyte volume fraction (EVF) > 27%. In 2 to 3 sessions within 6 weeks prior to the operation, 2 to 3 units of SAGM-ERC had been withdrawn. If necessary, heterologous SAGM-ERC was used if transfusion of all pre-donated autologous blood failed to maintain EVF > 27%.
Outcomes	**Outcomes reported:** amount of allogeneic blood transfused, amount of autologous blood transfused, number of participants transfused allogeneic blood, complications, adverse events
Notes	**Transfusion protocol:** participants were transfused allogeneic blood to maintain the erythrocyte volume fraction (EVF) > 27%. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study was approved by the local hospital ethics committee. **Language of publication:** English **Study groups:** for the purposes of our review, Group 2 was used as the cell salvage/intervention group, while Group 1 was used as the control/no cell salvage group. **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described

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Ekback 1995 *(Continued)*

Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol: "additional heterologous SAGM-ERC was transfused to maintain EVF > 27%"
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	No info on blinding - may impact clinical decision-making related to blood loss
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No info on blinding - may impact clinical decision-making related to blood loss
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No info on participant flow; 15 per group (45 total) at baseline, but unclear whether all were analysed
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	High risk	Funding and conflicts not reported. Some baseline imbalance: "Due to the small group sizes in our study, well balanced groups could not be achieved; a lower preoperative calculated blood volume in group I (Table 1); a higher preoperative APTT (within normal values) in group 2 (Table 2); a lower preoperative R 1 (within normal values) in group 2 (Fig. (3 patients had Rl < 15%/min) were found."

Elawad 1991

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Malmo, Sweden **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** 24 hours postoperatively

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Elawad 1991 *(Continued)*

Participants	40 participants undergoing primary total hip arthroplasty were randomly allocated to one of two groups: **Autologous group** (Cell salvage/intervention group): N = 20. M:F 9:11. Mean (range) age 68 (59 to 89) **Homologous group** (Control/no cell salvage group): N = 20. M:F 8:12. Mean (range) age 74 (48 to 89) The authors do not state whether there were any between-group differences at baseline.
Interventions	**Autologous group** (Cell salvage/intervention group): cell salvage group received autologous blood processed intraoperatively by a cell saver device (Electromedic Autotrans AT1000 autotransfusion system). Blood was retrieved from the operative field with a double lumen suction catheter. The blood was immediately anticoagulated with sodium citrate. Larger debris was removed by a 240 µm filter in the cardiotomy reservoir. The filtered blood was pumped into a bowl centrifuge and washed with 1500 mL of saline. The supernatant was discarded. The erythrocyte concentrate was pumped into a reinfusion bag and then reinfused into the patient. **Homologous group** (Control/no cell salvage group): control group received allogeneic blood and no autotransfusion.
Outcomes	**Outcomes reported:** amount of allogeneic units transfused, number of participants receiving allogeneic blood, complications, blood loss
Notes	**Transfusion protocol:** the indications for blood transfusion were the same in both groups. Intraoperatively, blood was given according to the anaesthetist's decision. Postoperatively, a transfusion was given if the haemoglobin was < 85 g/L or if there were symptoms of anaemia. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described
Allocation concealment (selection bias)	Unclear risk	Does not state whether sealed envelopes are also opaque
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	Transfusion protocol in place but intraoperative transfusion according to clinician decision: intra-op high ROB as decided by the clinician. Transfusion protocol post-op only: "The indications for blood transfusion were the same in both groups. Intraoperatively, blood was given according to the anesthetist's decision. Postoperatively, a transfusion was given if the hemoglobin was < 85 g/L or if there were symptoms of anemia (Grindon et al. 1985)"

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Elawad 1991 *(Continued)*

Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	Variable techniques for blood loss measurement; no description for other outcomes
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	The blinding status of participants and personnel was not described but transfusion decisions according to clinician preference intraoperatively
Incomplete outcome data (attrition bias) All outcomes	Low risk	One participant was excluded due to logistical failures
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	Baseline imbalance marginal (age range included younger patients in control group but mean was similar). Funding and conflicts not reported

Eng 1990

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Leeds, Yorkshire, UK **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** duration of hospital stay
Participants	40 participants (33 males and 7 females) undergoing elective coronary artery bypass surgery were randomised to one of two groups: **Study group** (Cell salvage/intervention group): N = 20 **Control group**: N = 20 Mean (range) age for both groups = 55.75 (33 to 69) years. The authors report no differences in demographic data or pre-operative variables between the groups at baseline.
Interventions	**Study group** (Cell salvage/intervention group): received postoperative autologous blood transfusion (AT) using the Shiley hardshell venous reservoir. At the end of the operation in theatre, the chest drains were connected to the Shiley hardshell venous reservoir using the Shiley drainage set. After the system was primed and specimens obtained for haematological, biochemical, and bacteriological analyses, transfusion of the shed blood was commenced, the rate depending on the amount of drainage, reinfusing the previous hour's blood loss over the subsequent hour. At the end of 6 hours, the AT was discontinued, and further specimens were obtained.

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Eng 1990 *(Continued)*

	Control group: participants were managed in the same manner without the use of autologous blood transfusion.
Outcomes	**Outcomes reported:** amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of participants transfused allogeneic blood, hospital length of stay, mortality, blood loss, adverse events
Notes	**Transfusion protocol*:*** allogeneic blood transfusion was used only when the haematocrit fell below 25%, haemoglobin below 9.0 g/dL or the blood loss exceeded 500 mL in the first 4 hours. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study was approved by the Hospital Ethics Committee. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: blood was used only when the haematocrit fell below 25%, haemoglobin below 9 g/dL or the blood loss exceeded 500 mL in the first 4 hours
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	No mention of blinding of participants or personnel; may impact clinical decision-making for blood loss and re-operation
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No mention of blinding of participants or personnel; may impact clinical decision-making for blood loss and re-operation
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No info on participant flow: 40 participants randomised, unclear how many were analysed. Likely that all 40 were, based on baseline characteristics mentioned in the text (33M, 7F), but this is not clear

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Eng 1990 *(Continued)*

Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No baseline imbalance noted, though there is no breakdown of baseline characteristics per group, so relying on their statement that groups were similar. Funding and conflicts not reported

Feiner 2015

Study characteristics	
Methods	**Design:** RCT, parallel three-arm, single-centre study **Setting:** university teaching hospital, San Francisco, CA, USA **Recruitment:** May 2006 to April 2010 **Maximum follow-up:** none reported
Participants	91 participants aged between 16 and 75 years scheduled to undergo elective major spinal surgery with surgical blood loss sufficient to require erythrocyte transfusion were randomised to one of three groups: **Group 1** (Cell salvage/intervention group): N = 36. Mean (SD) age 57 (11). M:F 11:25. Mean (SD) BMI 30.2 (7). **Group 2** (Control/no cell salvage group): N = 18. Mean (SD) age 62 (8). M:F 2:16. Mean (SD) BMI 28.2 (5.6). **Group 3** (Control/no cell salvage group): unwashed stored allogeneic transfusion. N = 23. Mean (SD) age 56 (12). M:F 9:14. Mean (SD) BMI 29.5 (7.1). Some participants required transfusion prior to either the salvaged blood or allogeneic stored blood being ready for transfusion. These participants either received fresh frozen plasma, whole blood, washed or unwashed autologous erythrocytes. 10 of the 91 participants enroled pre-donated blood. This was used in case transfusion was required prior to cell saved or allogeneic blood being available. There were between-group differences in age and current tobacco use at baseline.
Interventions	**Group 1** (Cell salvage/intervention group): cell salvage group had cell salvage performed intraoperatively using Fresnius-Kabi Continuous AutoTransfusion System, Germany. Blood was collected from the surgical field, processed and washed prior to autotransfusion. **Group 2** (Control/no cell salvage group): washed stored allogeneic transfusion **Group 3** (Control/no cell salvage group): unwashed stored allogeneic transfusion Allocation to the above groups dictated the nature of the first transfusion that would be administered to a participant.
Outcomes	**Outcomes reported:** change in PaO2/FiO2 (partial pressure of oxygen in the arterial blood/fraction of inspired oxygen (P/F)) ratio from before to after transfusion between groups, changes in the ratio of the dead space (Vd) ventilation to tidal volume (Vd/Vt) and PaO2 from before to after transfusion, rate of acute lung injury
Notes	**Transfusion protocol:** a transfusion protocol is not reported. Transfusion of stored erythrocytes was permitted at the discretion of the anaesthesiologist. **Prospective registration status:** the study was not prospectively registered with a trial registry.

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Feiner 2015 *(Continued)*

Ethical approval: the study was approved by the institutional review board of the University of California, San Francisco, CA, USA.

Language of publication: English

Study groups: for the purpose of our review, we considered Group 1 as the cell salvage/intervention group. Groups 2 and 3 were considered the control/no cell salvage group.

Trial funding: multiple funding sources reported (Masimo, Inc. (Irvine, California), Bluepoint Medical (Selmsdorf, Germany), Nonin Medical (Plymouth, Minnesota), CAS Medical Systems (Branford, Connecticut), Covidien (Minneapolis, Minnesota), Mespere LifeSciences (Waterloo, Ontario, Canada), Pacific Medico (Tokyo, Japan), Xhale Inc. (Gainesville, Florida), and Anamedical (Tel Aviv, Israel))

Conflicts of interest: potential conflict of interest reported - one author (RBW) consults for several organisations with an interest in red cell transfusion (U.S. Food and Drug Administration (Silver Spring, Maryland)); National Heart, Lung, and Blood Institute/National Institutes of Health (Bethesda, Maryland); U.S. Department of Defense (Frederick, Maryland); and TerumoBCT (Lakewood, Colorado). He has also consulted for Sangart (San Diego, California), OPK Biotech (Cambridge, Massachusetts), HbO2 Therapeutics (Souderton, Pennsylvania), and Octapharma USA (Hoboken, New Jersey).

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer-generated, sealed, opaque envelopes produced by the blinded study statistician
Allocation concealment (selection bias)	Low risk	Computer-generated, sealed, opaque envelopes produced by the blinded study statistician
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	No transfusion protocol in place: transfusion of stored erythrocytes was permitted at the discretion of the anaesthesiologist
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	No other clinical decisions were dictated by the research protocol
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Impact of trial protocols and status of outcome assessors unknown for outcomes relevant to this review as these aren't reported. This needs to be updated should these be reported subsequently
Incomplete outcome data (attrition bias) All outcomes	High risk	Per-protocol analysis performed: a substantial number of participants received an intervention different to the one assigned at randomisation. Following randomisation, study groups were amended to account for a proportion

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Feiner 2015 *(Continued)*

		of participants who required transfusion prior to either the cell saved or allogeneic blood being ready for transfusion (N = 14). As a result, analysis was unable to account for the 91 participants randomised to the initial three groups and the statistical analysis plan was changed from an ITT model to a per-protocol model.
Selective reporting (reporting bias)	High risk	A priori decisions stated in text are not supported by a published protocol. The initial trial was designed to test acute normovolaemic haemodilution. However, study authors report that due to a change in clinical practice, this was changed following study commencement to test intraoperative cell salvage versus allogeneic transfusion.
Other bias	Unclear risk	Funding reported (non-pharma), conflicts declared (related biotech companies and non-commercial organisations). Some baseline imbalance (age) according to as-treated population, unclear of the impact of this. No information on baseline imbalance according to initial randomisation

Galaal 2019 (TIC TOC)

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, multicentre feasibility study **Setting:** four UK NHS hospitals (3 university teaching hospitals, 1 district general hospital) **Recruitment:** July 2016 to June 2018 (study dates) **Maximum follow-up:** not reported
Participants	Adult women requiring primary or interval surgery for suspected ovarian cancer (Figo III/IV or primary peritoneal cancer) were randomised to one of the following two groups: **Intraoperative cell salvage** (Cell salvage/intervention group) **Donor blood transfusion** (Control/no cell salvage group) The authors do not report a between-group comparison at baseline and no demographic data are provided.
Interventions	**Intraoperative cell salvage** (Cell salvage/intervention group): intraoperative cell salvage was used to salvage intraoperative blood, which was subsequently processed prior to autotransfusion. As cell saver machines varied between participating sites, no specific device is named. **Donor blood transfusion** (Control/no cell salvage group): participants in the donor blood group were considered for transfusion according to clinical judgement and local hospital policy
Outcomes	**Outcomes reported:** mortality, cancer recurrence, inadvertent visceral injury (bladder, bowel, ureters, blood vessels, nerve), return to theatre within 48 hours, surgical site infection (see online supplementary appendix 4) within 30 days, thromboembolic complications (DVT, PE) within 30 days, number and nature of adverse events, amount of donor blood given (total and ≤ 24 hours postsurgery), length of hospital stay, resource use, generic quality of life (QOL) measure: EQ-5D-5L, cancer-specific QOL measure: EORTC QLQ-C30 (Version 3.0) (confirmed cancer only), ovarian cancer QOL measure: EORTC QLQ-OV28 (confirmed cancer only)
Notes	Full results for this study are not available. We extracted data from a conference abstract; we extracted methods from the published protocol and trial registration **Transfusion protocol:** all sites followed a common intraoperative cell salvage protocol and donor transfusion was considered during surgery in accordance with clinical judgement, guided by local hos-

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Galaal 2019 (TIC TOC) *(Continued)*

pital policy. No further details with regards to the study's transfusion protocol or local hospital policy are available.

Prospective registration status: the study was prospectively registered with a trials registry (ISRCTN19517317).

Ethical approval: ethical approval was granted by the South West Exeter Research Ethics Committee (ref: 16/SW/0256).

Language of publication: English

Trial funding: National Institute for Health Research (NIHR) Research for Patient Benefit (RfPB) programme grant (PB-PG-1014-35005).

Conflicts of interest: none declared

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Quote: "Patients will be randomised to either group using a web-based randomisation system. Randomisation will be performed using random permuted blocks of varying size in a 1:1 allocation ratio, stratified by study site. Randomisation will be performed as close as possible to the time of surgery."
Allocation concealment (selection bias)	Low risk	Quote: "Randomisation will be achieved by means of a web-based system created by the UK Clinical Research Collaboration-registered Peninsula Clinical Trials Unit (CTU) in conjunction with the trial statistician, using random permuted blocks of varying size."
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	Transfusion according to local protocol but guided by clinical judgement
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	Surgeons, other theatre staff, and the person recording details of intraoperative blood transfusion or re-infusion could not be blinded in this study.
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Quote: "The research nurse responsible for recording postoperative outcomes will aim to remain blinded to treatment allocation." Unclear if this remained the case
Incomplete outcome data (attrition bias)	Unclear risk	Protocol published and initial results presented as a conference abstract only with no information regarding patient flow.

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Galaal 2019 (TIC TOC) *(Continued)*
All outcomes

Selective reporting (reporting bias)	Unclear risk	Protocol published, initial results presented as a conference abstract only (limited results reported)
Other bias	Unclear risk	Conference abstract only - does not comment on baseline characteristics or funding. Authors state no conflicts of interest to disclose

Gannon 1991

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, multicentre study **Setting:** two university teaching hospitals, Columbus, OH, USA **Recruitment:** January 1989 to April 1989 **Maximum follow-up:** 48 hours postoperatively
Participants	239 consecutive participants undergoing total knee replacement procedures were randomly assigned to one of two groups: **Study group** (Cell salvage/intervention group): N = 124. M:F 59:65. Mean age 65 **Control group**: N = 115. M:F 46:69. Mean age 69 The study does not comment on whether any between-group differences were presented at baseline.
Interventions	**Study group** (Cell salvage/intervention group): the cell salvage group (Solcotrans autotransfusion system) had their wounds drained into postoperative blood salvage canisters. There was a 6-hour total time limit for collection and reinfusion of blood. Because 40 mL of citrate ACD-A was entered in each Solcotrans canister prior to use, a minimum of 320 mL of blood and citrate volume was necessary before reinfusion to prevent citrate toxicity. If wound drainage was slow and an adequate volume had not been collected before the 6-hour time limit, the canister and blood were discarded, and a standard collection canister was attached to the drainage tube for the duration. If wound drainage was rapid, the canister was allowed to fill completely (500 mL volume). The blood was then infused at an appropriate rate as long as the 6-hour pre-canister limit was not exceeded. Another Solcotrans canister could then be attached, beginning a new 6-hour time interval. Intraoperative blood salvage was not used. **Control group**: the control group had their wounds drained into standard 400 mL suction canisters. Autotransfusion was not performed.
Outcomes	**Outcomes reported:** amount of blood re-transfused from the cell saver, number of participants transfused allogeneic blood, adverse events
Notes	**Transfusion protocol:** all participants whose postoperative haemoglobin value was < 9.0 g/dL were transfused allogeneic blood. The decision to transfuse patients with haemoglobin values > 9.0 g/dL was made by the internist on the basis of each patient's medical condition. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board. **Language of publication:** English **Trial funding:** not reported

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Gannon 1991 *(Continued)*

Conflicts of interest: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	A computer-generated random number list was used pre-operatively to assign participants to either intervention or control.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	**Transfusion protocol:** all patients whose postoperative haemoglobin value was < 9.0 g/dL were transfused allogeneic blood. The decision to transfuse patients with haemoglobin values > 9.0 g/dL was made by the internist on the basis of each patient's medical condition
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	The blinding status of participants and personnel was not described.
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	The blinding status of participants and personnel was not described.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No information on participant flow. The total number of participants contributing to the outcome measures is not reported
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No baseline characteristics provided per group. Funding and conflicts not reported

Goel 2007

Study characteristics

Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** specialist cardiothoracic surgery hospital, Amritsar, Punjab, India

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Goel 2007 *(Continued)*

	Recruitment: March 2004 to June 2004 **Maximum follow-up:** 5 days postoperatively
Participants	50 participants undergoing 'off-pump' first-time CABG were randomised to one of two groups: **Group C** (Cell saver/intervention group): N = 24. M:F 21:3. Mean (SD) age 58.2 (8.7) **Group N** (Control/no cell saver group): N = 25. M:F 21:4. Mean (SD) age 61.9 (10.0) There were no between-group differences at baseline. NB: one participant in the autotransfusion group (intervention group) was excluded from the final analysis due to conversion to cardiopulmonary bypass ('on-pump').
Interventions	**Group C** (Cell saver/intervention group): the cell salvage group (Dideco autotransfusion system) had all intraoperative shed blood collected from the time of incision until skin closure. Blood was aspirated using a single lumen, high-pressure suction cannula flushed with heparinised saline and collected in the reservoir of the cell saver device. The collected blood was then subjected to washing and centrifugation. The processed red blood cells were collected in sterile blood bags and were made available to the anaesthetic staff for autotransfusion. **Group N** (Control/no cell saver group): the control group had their intraoperative shed blood discarded.
Outcomes	**Outcomes reported:** amount of allogeneic blood transfused, volume of blood re-transfused from the cell saver, blood loss, adverse events
Notes	**Transfusion protocol:** the indication for allogeneic blood transfusion in the intraoperative period was a haemoglobin level < 9.0 g/dL or a haematocrit level < 27%. In the autotransfusion group, all the processed red blood cells collected during surgery were re-transfused as required. Banked allogeneic blood was used only if the haemoglobin level remained < 9.0 g/dL despite autotransfusion. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study was approved by the hospital ethics committee. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Sealed envelopes were used to conceal treatment allocation. It is not known whether they were opaque.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias)	Low risk	Transfusion protocol in place: "The threshold for blood transfusion in both the groups was haemoglobin < 9 g d either during the procedure or at any time in the postoperative period"

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Goel 2007 *(Continued)*

Subjective: transfusion protocol		
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	The blinding status of participants and personnel was not well described.
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	The blinding status of participants and personnel was not well described.
Incomplete outcome data (attrition bias) All outcomes	Low risk	One participant was excluded for clinical reasons: "Of the 50 participants, 49 completed the study."
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No baseline imbalance noted. Funding and conflicts not reported

Gäbel 2013a

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Gothenburg, Sweden **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** 24 hours postoperatively
Participants	34 participants undergoing elective CABG for stable angina were randomised to one of two groups: **Retransfusion group** (Cell salvage/intervention group): N = 15. Mean (SD) age 66 years (8). M:F 11:4. Mean (SD) BMI 27 (4). **No retransfusion group** (Control/no cell salvage group): N = 15. Mean (SD) age 66 years (8). M:F 12:3. Mean (SD) BMI 27 (4). There was between-group difference in time spent on the Extracorporeal Circuit (ECC).
Interventions	**Retransfusion group** (Cell salvage/intervention group): all cardiotomy suction blood was collected in a separate closed uncoated cardiotomy reservoir. Participants in intervention group had re-transfusion of cardiotomy suction blood (no processing) prior to weaning from cardiopulmonary bypass (CPB). **No re-transfusion group** (Control/no cell salvage group): all cardiotomy suction blood was collected in a separate closed uncoated cardiotomy reservoir. Participants in the control group were randomised to no re-transfusion of cardiotomy suction blood prior to weaning from CPB.

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Gäbel 2013a *(Continued)*

Outcomes	**Outcomes reported:** postoperative bleeding, amount of transfused red cells, amount of transfused plasma, amount of transfused platelets, MACE as defined by myocardial infarction or any other evidence of thrombotic event
Notes	**Transfusion protocol:** red blood cell transfusions were given when blood haemoglobin levels decreased to < 80 g/L or if the patient had symptomatic anaemia. **Prospective Registration Status:** the study was not prospectively registered with a trial registry. **Ethical approval:** the study received ethical approval from the Research Ethics Committee of the Medical Faculty, University of Gothenburg, Gothenburg, Sweden. **Language of publication:** English **Trial funding:** Västra Götaland region (ALF/LUA grant 146281 to AJ), Gothenburg Medical Society (4201 to JG) and The Swedish Heart and Lung Foundation (20090488 to AJ) **Conflicts of interest:** none reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Randomisation methodology not described
Allocation concealment (selection bias)	Unclear risk	Not known whether envelopes are opaque and sealed
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: RBC transfusions were given when blood haemoglobin level decreased to < 80 g/L, or if the patient had symptomatic anaemia.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Low risk	All trial personnel other than the research coordinator and perfusionist were blinded to treatment allocation.
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	All trial personnel other than the research coordinator and perfusionist were blinded to treatment allocation.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	N used for analysis is unclear; 4 participants were excluded following randomisation (1 due to pericardial adhesions, 1 due to overseen treatment with clopidogrel, 1 due to < 100 mL cardiotomy suction blood, and 1 due to technical er-

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Gäbel 2013a *(Continued)*

		ror intraoperatively). A priori sample size calculation deemed that 30 participants were needed for the study, which was still achieved.
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Low risk	Funding reported and no conflicts reported. Baseline imbalance in ECC time present but unlikely to impact outcomes

Healy 1994

Study characteristics	
Methods	**Design:** RCT, parallel three-arm, multicentre study **Setting:** four US medical centres **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** duration of hospital stay
Participants	128 participants undergoing total hip arthroplasty, total knee arthroplasty, or spine fusion were randomly allocated to one of three groups: **Group 1** (Orth-Evac) (Cell salvage/intervention group): N = 44. M:F 18:26. Mean (range) age 67.9 (41 to 82) **Group 2** (Solcotrans) (Cell salvage/intervention group): N = 40; M:F 20:20. Mean (range) age 66.3 (54 to 82) **Group 3** (Banked blood) (Control/no cell salvage group): N = 44; M/F 23:21. Mean age 62.5. The three groups were similar with regard to age, height, weight, and gender.
Interventions	**Group 1** (Orth-Evac) (Cell salvage/intervention group): the cell salvage (Orth-Evac) group received autologous shed blood reinfusion collected from wound drainage by an Orth-evac device (Deknatal, Fall River, Massachusettes, USA). **Group 2** (Solcotrans) (Cell salvage/intervention group): the cell salvage (Solcotrans) group received autologous shed blood reinfusion collected from wound drainage by a Solcotrans device (Smith & Nephew, Memphis, Tennessee, USA). **Group 3** (Banked blood) (Control/no cell salvage group): the control group received either autologous pre-donated blood or allogeneic banked blood. In control participants, a standard wound drainage system (Hemovac) was used, and these participants received liquid-preserved autologous pre-donated blood or allogeneic blood filtered with a standard 170 µm screen filter. NB: participants randomised to the cell salvage groups (Group 1 and Group 2) were randomly assigned to one of two infusion filters (Pall 40 µm screen filter or Pall RC100 polyester filter) for the transfusion phase of the study. With the Solcotrans drainage system, 40 mL acid citrate dextrose (ACD) was used. No anticoagulant was added with the Ortho-evac drainage system.
Outcomes	**Outcomes reported:** amount of blood collected by the cell saver, amount of blood re-transfused from the cell saver, number of participants transfused allogeneic blood, amount of allogeneic blood transfused, adverse events
Notes	**Transfusion protocol:** use of a transfusion protocol is not reported. **Prospective registration status:** the study was published prior to 2010.

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Healy 1994 *(Continued)*

Ethical approval: it is not clear whether the study was approved by an ethics committee or institutional review board.

Language of publication: English

Study groups: for the purpose of our review, Group 1 (Orth-Evac) and Group 2 (Solcotrans) were used as the cell salvage/intervention group. Group 3 (banked blood) was used as the control/no cell salvage group.

Trial funding: not reported

Conflicts of interest: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	No clear transfusion protocol in place: homologous packed red cells were transfused intraoperatively or postoperatively when the haematocrit fell below 30%.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	The blinding status of participants and personnel was not described
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	The blinding status of outcome assessors was not described and there was no transfusion protocol in place
Incomplete outcome data (attrition bias) All outcomes	High risk	8/84 who had drainage of < 250 mL and one participant whose shed blood was stored at room temperature for longer than 6 hours were not reinfused and were excluded from the study. Unbalanced across groups
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No baseline imbalance noted. Funding and conflicts not reported

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Heddle 1992

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, multicentre study **Setting:** two hospitals (1 university teaching hospital, 1 regional hospital) in Ontario, Canada **Recruitment:** recruitment and study dates are not reported **Maximum follow-up:** duration of hospital stay
Participants	81 participants undergoing elective knee arthroplasty were randomly assigned to one of two groups: **Solcotrans group** (Cell salvage/intervention group): N = 39. M:F 14:25. Mean (SD) age 69.3 (6.9) **Control group**: N = 40. M:F 14:26. Mean (SD) age 71.0 (9.0) There was no between-group differences reported at baseline.
Interventions	**Solcotrans group** (Cell salvage/intervention group): the cell salvage group underwent drainage and autotransfusion using a Solcotrans system. The autologous blood collected into the drainage and transfusion device was transfused if specific transfusion guidelines were met. Participants were transfused the initial unit of Solcotrans blood if 350 mL or more had been collected within 3 hours of the patient's entry to the recovery room. The 3-hour collection time provided for collection and transfusion of the blood within the maximum interval of 6 hours. After successful collection and transfusion of the first autologous blood unit, a second autologous blood collection device was attached. For this and subsequent collections, autologous blood was transfused if 150 mL or more was collected within 3 hours. When the rate of drainage was < 250 mL of blood within a 3-hour period, a subsequent drainage and transfusion device was not attached. The first Solcotrans device attached to the drain contained 40 mL of ACD-A. **Control group**: the control group had their drained blood collected by a Davol suction unit and discarded. The Davol unit was the current standard practice in the two study centres. Participants assigned to the Davol suction group received 1 unit of allogeneic red cells if > 500 mL of blood drained from the surgical site within a 2-hour period. Subsequently, whenever drainage exceeded 500 mL within a 2-hour period, 1 unit of allogeneic blood was transfused.
Outcomes	**Outcomes reported*:*** amount of allogeneic blood transfused, number of participants transfused allogeneic blood, adverse events, blood loss, coagulation variables, venogram tests
Notes	**Transfusion protocol:** on postoperative Day 2 through to Day 5, the criteria for allogeneic red cell transfusions were identical for both groups. Participants were given one unit of red cell concentrate if their haemoglobin was within the range of 8.0 to 8.9 g/dL, two units when the value was from 7.0 to 7.9 g/dL, three units when the value was from 6.0 to 6.9 g/dL, and four units if the value was from 5.0 to 5.9 g/dL. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**

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Heddle 1992 *(Continued)*

Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	Transfusion protocol at high risk for inter-participant variability: "As the study could not be double-blind, strict transfusion criteria were developed for all study patients. The criteria by which allogeneic red cell transfusions were administered were established by the orthopedic surgeons participating in the study and reflected clinical practice in Canada.... Transfusion guidelines for Day 1 of the study had to be different for the two treatment groups because of the two interventions being studied."
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	The study was unblinded
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	The study was unblinded
Incomplete outcome data (attrition bias) All outcomes	Low risk	81 randomised, 79 analysed. 2 exclusions explained
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No baseline imbalance noted. Funding and conflicts not reported

Horstmann 2012

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** non-academic regional hospital, Zwolle, the Netherlands **Recruitment:** February 2007 to April 2008 **Maximum follow-up:** 3 months postoperatively

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Horstmann 2012 *(Continued)*

Participants	100 participants scheduled for primary total hip replacement were enroled and randomised to one of the following groups: **Autotransfusion group** (Cell salvage/intervention group): N = 50. Mean (SD) age 68.6 (9.1). M:F 13:37. Mean (SD) BMI 28.1 (4.5). **Control group:** N = 50. Mean (SD) age 69 (9.2). M:F 14:36. Mean (SD) BMI 27.6 (3.8). The groups were similar with regard to demographic data and baseline variables, other than mean operation time, which was longer in the no drainage group.
Interventions	**Autotransfusion group** (Cell salvage/intervention group): postoperative autotransfusion using the Bellovac ABT system (Astra Tech, Mölndal, Sweden). The drain was inserted at the end of the procedure and low suction (60 to 90 mmHg) was started. Re-transfusion was performed within 6 hours after surgery and was not allowed to exceed 1500 mL. Drains were removed after 24 hours. **Control group**: control group for whom no drain was inserted.
Outcomes	**Outcomes reported:** blood loss during surgery, homologous blood transfusion, incidence of haematomas, amount of drained and re-transfused wound blood, wound healing disturbances, postoperative pain, length of hospital stay, adverse events, Harris Hip Score, physical and mental SF-36 scores, total blood loss
Notes	**Transfusion protocol:** homologous transfusion was given based on Dutch guidelines, with a trigger of 6.4 g/dL in American Society of Anesthesiologists (ASA) 1 patients, 8 g/dL in ASA 2/3 patients, and 9.6 g/dL in ASA 4 patients and in patients that failed to increase cardiac output to compensate for dilution **Prospective registration status:** the study was not prospectively registered with a trial registry. **Ethical approval:** the study received approval from the Institutional Medical Ethics Committee, Isala Clinics, Zwolle, the Netherlands. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** none reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Randomisation methodology not provided
Allocation concealment (selection bias)	Low risk	Participants were randomised to intervention or control using numbered, concealed envelopes containing pre-randomised cards
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: additional homologous blood transfusions were given based on the Dutch homologous blood transfusion guidelines. The trigger for homologous transfusions was an Hb level of 6.4 g/dL in American Society of Anesthesiologists (ASA) 1 patients, 8.0 g/dL in ASA 2/3 patients, and 9.6 g/dL in ASA 4 patients and in patients that failed to increase their cardiac output to compensate for dilution

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Horstmann 2012 *(Continued)*

Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Low risk	Clear method for measuring blood loss described. Outpatient caregivers blinded to group allocation.
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	Doctors reviewing participants at follow-up in the outpatient clinic were blinded to their treatment allocation; however, it is unclear whether outcome assessment of outcomes reported during the admission was blinded
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No information provided for patient flow, or N analysed
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Low risk	Conflicts declared, no baseline imbalance

Horstmann 2013

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** non-academic regional hospital, Zwolle, the Netherlands **Recruitment:** August 2009 to April 2011 (study dates) **Maximum follow-up:** 3 months postoperatively
Participants	204 participants undergoing primary total hip replacement were randomised to one of two groups: **Autologous blood transfusion (ABT) group** (Cell salvage/intervention group): N = 102. Mean (SD) age 67.3 (9.3). M:F 28:74. Mean (SD) BMI 28.3 (4.1). **No drainage group** (Control/no cell salvage): N = 102. Mean (SD) age 67.6 (9.4). M:F 29:73. Mean (SD) BMI 27.9 (4.7). There were no between-group differences at baseline.
Interventions	**Autologous blood transfusion (ABT) group** (Cell salvage/intervention group): ABT group (Cell Salvage group) used the Sangvia, autologous blood salvage machine (low vacuum, 100 to 150 mmHg; Astratech, Mölndal, Sweden) to collect blood intraoperatively and from the drainage bottle postoperatively. Blood was sequentially filtered by the device prior to re-transfusion. Blood salvaged intraoperatively was re-transfused within 6 hours postoperatively. Transfusion of intraoperative collected blood did not exceed 1500 mL, and of postoperative blood, did not exceed 1000 mL. The drain was removed 24 hours after surgery. **No drainage group** (Control/no cell salvage): the control group did not receive a drain and intraoperative blood was not salvaged.

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Horstmann 2013 *(Continued)*

Outcomes	**Outcomes reported:** homologous blood transfusion requirement, adverse events, total blood loss, volume of intraoperatively collected and re-transfused blood, volume of re-transfused blood collected in the drain
Notes	**Transfusion protocol:** allogeneic transfusions given according to Dutch guidelines. The trigger was 6.4 g/dL for American Society of Anesthesiologists (ASA) 1 patients, 8 g/dL for ASA2/3 patients, and 9.6 g/dL for ASA 4 patients and in patients who failed to increase cardiac output to compensate for dilution. **Prospective Registration Status:** the study was not prospectively registered with a trials registry. **Ethical approval:** the study was approved by the Institutional Medical Ethics Committee, Isala Clinics, Zwolle, the Netherlands. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** "Benefits from a commercial party related directly or indirectly to the subject of this article were received but directed solely to a research fund, foundation, educational institution, or other non-profit organisation with which one or more of the authors are associated."

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No randomisation methodology provided
Allocation concealment (selection bias)	Low risk	Numbered sealed opaque envelopes containing pre-randomised cards placed in operating theatre. But unclear who was responsible for allocation.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: additional homologous blood transfusions (HBTs) were given according to the Dutch HBT guidelines. The trigger for HBT was an Hb 6.4 g/dL for American Society of Anesthesiologists (ASA) grade 1 patients, 8.0 g/dL for ASA 2/3 patients, and 9.6 g/dL for ASA 4 patients (and in patients who failed to increase their cardiac output to compensate for dilution).
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Low risk	Surgeons were blinded to group allocation until the end of surgery, at which point allocation was revealed. Blinding of participants is not described.
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	Postoperative care team blinded to group allocation
Incomplete outcome data (attrition bias)	Low risk	No loss to follow-up; all participants are accounted for in outcome data

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Horstmann 2013 *(Continued)*
All outcomes

Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	Conflicts of interest: "Although none of the authors has received or will receive benefits for personal or professional use from a commercial party related directly or indirectly to the subject of this article, benefits have been or will be received but will be directed solely to a research fund, foundation, educational institution, or other non-profit organisation with which one or more of the authors are associated."

Horstmann 2014a

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** non-academic regional hospital, Zwolle, the Netherlands **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** 3 months postoperatively
Participants	118 participants undergoing primary elective total hip replacement were randomised to one of two groups. **Autologous blood transfusion (ABT) drain group** (Cell salvage/intervention group): N = 56. Mean (SD) age 67.6 (9.1). M:F 20:36. Mean (SD) BMI 27.8 (4.4). **Drain group** (Control/no cell salvage group): N = 62. Mean (SD) age 69.3 (9.5). M:F 20:42. Mean (SD) BMI 28.1 (4.4). The groups were similar with regard to demographic and baseline data, except for operation time, which was longer in the drainage (control) group.
Interventions	**Autologous blood transfusion (ABT) drain group** (Cell salvage/intervention group): participants in the ABT (Cell Salvage) group had intraoperative and postoperative cell salvage and autotransfusion performed using the Sangvia ABT system (intraoperative and postoperative autologous blood salvage unit, low vacuum, 100 to 150 mmHg, Astratech, Mölndal, Sweden). Blood salvaged during the operation was re-transfused and a drain for postoperative salvage was inserted at the end of the procedure. Postoperatively drained blood was re-transfused within 6 hours after surgery. **Drain group** (Control/no cell salvage group): participants in the drain group (control group) received a standard high suction drain (Redon, Medinorm AG, Quierschied, Germany). No autotransfusion was performed. The drains were removed 24 hours after surgery in both groups.
Outcomes	**Outcomes reported:** blood loss during surgery, volume of intraoperatively suctioned and re-transfused blood, volume of re-transfused drained wound blood, allogeneic blood transfusions, postoperative pain, hospital stay, adverse events, total blood loss
Notes	**Transfusion protocol:** allogeneic transfusions were given according to Dutch guidelines. The trigger was 6.4 g/dL in American Society of Anesthesiologists (ASA) 1 patients, 8 g/dL in ASA 2/3 patients, and 9.6 g/dL in ASA 4 patients or those whose cardiac output failed to increase to compensate for dilution. **Prospective registration status:** the study was not prospectively registered with a trial registry. **Ethical approval:** the study was approved by the Institutional Medical Ethics Committee, Isala Clinics, Zwolle, the Netherlands.

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Horstmann 2014a *(Continued)*

Language of publication: English

Trial funding: not reported

Conflicts of interest: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Authors do not state how the randomisation sequence was generated e.g. computer-generated sequence?
Allocation concealment (selection bias)	Low risk	Participants were randomised to one of two groups using sealed and numbered, opaque enveloped containing pre-randomised cards.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: additional allogeneic blood transfusions were given based on the Dutch allogeneic blood transfusion guidelines. The trigger for allogeneic transfusions was an Hb level of 6.4 g/dL in patients with American Society of Anaesthesiologists (ASA) physical classification 1, 8.0 g/dL in ASA classifications 2 and 3, and 9.6 g/dL in ASA classification 4, as well as in those whose cardiac output failed to increase to compensate for dilution.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	Insufficient information about postoperative care received and blinding status. Surgeons were blinded during the operation until the last available opportunity, which would help to mitigate performance bias during the operation.
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	Insufficient information about postoperative care received and blinding status. Surgeons were blinded during the operation until the last available opportunity, which would help to mitigate performance bias during the operation.
Incomplete outcome data (attrition bias) All outcomes	Low risk	All participants are accounted for at 3-month outcome measurements. ITT, all participants accounted for in analysis, although authors do not make a definitive statement on whether there were any dropouts or losses to follow-up.
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	Only significant difference between groups at baseline (prior to autotranfusion) was operation time ($P < 0.04$). No information provided regarding conflicts of interest or funding

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Horstmann 2014b

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, multicentre study **Setting:** two hospitals in the Netherlands (non-academic regional hospital, Zwolle; district hospital, Haarlem) **Recruitment:** February 2007 to February 2009 **Maximum follow-up:** 3 months postoperatively
Participants	115 participants undergoing primary total knee arthroplasty were randomised to one of the following groups: **Autologous blood transfusion (ABT) group** (Cell salvage/intervention group): N = 59. Mean (SD) age 68 (9). M:F 17:42. Mean (SD) BMI 28.8 (5.1). **No drainage group** (Control/no cell salvage group): N = 56. Mean (SD) age 69 (8). M:F 17:39. Mean (SD) BMI 29.3 (5.2). The groups were balanced with regard to demographic and preoperative variables.
Interventions	**Autologous blood re-transfusion (ABT) group** (Cell salvage/intervention group):participants in the cell salvage group received postoperative autologous blood salvage and re-transfusion using the Bellovac Autologous Blood Transfusion drain (Astratech, Mölndal, Sweden). The drain was inserted at the end of the operative procedure and low-suction drainage was commenced 30 minutes later. Drained blood was re-transfused within 6 hours after surgery. No more than 1500 mL of drained blood could be re-transfused and the drain was removed at 24 hours postoperatively. **No drainage group** (Control/no cell salvage group): the control group did not receive a drain.
Outcomes	**Outcomes reported:** intraoperative blood loss, postoperatively drained blood loss, amount of re-transfused drained blood, allogeneic blood transfusions, incidence of haematomas, wound-healing problems, postoperative pain, duration of hospital admission, adverse events, total blood loss
Notes	**Transfusion protocol:** allogeneic transfusion given according to Dutch guidelines. The transfusion trigger was 6.4 g/dL for American Society of Anesthesiologists (ASA) 1 patients, 8 g/dL for ASA 2/3 patients, and 9.6 g/dL for ASA 4 patients. **Prospective registration status:** the study was not prospectively registered with a trials registry. **Ethical approval:** the study was approved by the Institutional Medical Ethics Committee, Isala Clinics, Zwolle, the Netherlands. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Authors do not state how the randomisation sequence was generated e.g. computer-generated sequence
Allocation concealment (selection bias)	Low risk	Sealed, opaque envelopes used to conceal allocation

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Horstmann 2014b *(Continued)*

Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: additional allogeneic blood transfusions were given based on the Dutch allogeneic blood transfusion guidelines. The trigger for allogeneic transfusions was an Hb level of 6.4 g/dL in patients with American Society of Anesthesiologists (ASA) physical classification 1, 8.0 g/ dl in ASA classifications 2 and 3, and 9.6 g/dL in ASA classification 4, as well as in those whose cardiac output failed to increase to compensate for dilution
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Low risk	Surgeons were blinded to allocation until the end of surgery, at which point the allocation was revealed. Participant blinding is not described.
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Doctors reviewing participants at follow-up in the outpatient clinic were blinded to their treatment allocation; however, it is unclear whether outcome assessment of outcomes reported during the admission was blinded
Incomplete outcome data (attrition bias) All outcomes	Low risk	All participants enroled and randomised in the study are accounted for in the outcome data
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Low risk	Authors declare no conflicts of interest. Funding source not disclosed.

Jacobi 1997

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Erlangen, Germany **Recruitment:** March 1993 to October 1993 **Maximum follow-up:** duration of hospital stay
Participants	24 participants undergoing radical prostatectomy were randomly allocated to one of two groups: **Autotransfusion group** (Cell salvage/intervention group): N = 12. Median age 64.6. Median weight 80.6 kg. **Homologous blood transfusion group** (Control/no cell salvage group): N = 12. Median age 65.8. Median weight 79.8 kg.

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Jacobi 1997 *(Continued)*

	The two groups were similar in their demographics. No formal assessment of this was performed.
Interventions	**Autotransfusion group** (Cell salvage/intervention group): participants in the cell salvage group had shed blood collected intraoperatively using the Cell Saver 3+ (Haemonetics, Munich). Following collection, salvaged blood was processed, including centrifugation and washing, prior to re-transfusion to the participant. **Homologous blood transfusion group** (Control/no cell salvage group): participants received homologous blood transfusion as needed.
Outcomes	**Outcomes reported:** serum haematology assessment, serum coagulation assessment, serum creatinine assessment, osmotic erythrocyte resistance, cytological assessment, bacteriological assessment, blood loss, allogeneic blood requirement, length of hospital stay, postoperative complications
Notes	**Transfusion protocol:** the indication for blood transfusion was a drop in Hb below 8 g/dL. All patients received 10 mL/kg body weight/hour intraoperatively and 2 mL/kg body weight/hour crystalloid infusion solutions in the recovery room. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board. **Language of publication:** German **Trial funding:** unclear **Conflicts of interest:** unclear

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient information about randomisation methods
Allocation concealment (selection bias)	Unclear risk	Insufficient information about allocation concealment
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: the indication for blood transfusion was a drop in Hb below 8 g/dL. All patients received 10 mL/kg body weight/hour intraoperatively and 2 mL/kg body weight/hour crystalloid infusion solutions in the recovery room.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	Lack of detail about postoperative care
Blinding of outcome assessment (detection bias)	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding

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Jacobi 1997 *(Continued)*

Objective outcomes: mortality and transfusions		
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Lack of information on how outcomes measured
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Number analysed not clear
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	Balanced group characteristics, although conflicts of interest unclear

Kelley-Patteson 1993

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Wichita, KA, USA **Recruitment:** January 1989 to January 1990 **Maximum follow-up:** duration of hospital stay
Participants	36 participants undergoing aortobifemoral or aortobi-iliac bypass for occlusive disease were randomised to one of two groups: **AFB/CS group** (Cell salvage/intervention group): N = 18 **AFB/No CS group** (Control/no cell salvage group): N = 18 Demographic data were not reported.
Interventions	**AFB/CS group** (Cell salvage/intervention group): autotransfusion group (Haemonetics Cell Saver) was monitored and operated by a technician-member of the perfusion team. The Haemonetics Cell Saver delivers washed red blood cells at an average haematocrit level of 55% to 60%. **AFB/No CS group** (Control/no cell salvage group): control group did not receive autotransfusion.
Outcomes	**Outcomes reported:** amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, adverse events, hospital length of stay, blood loss, haemoglobin levels
Notes	**Transfusion protocol:** after the operation, allogeneic red cell transfusions were not given to patients who were haemodynamically stable, and had haemoglobin values > 8.0 g/dL. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

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Kelley-Patteson 1993 *(Continued)*

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	The method for randomising participants was inadequate: randomised on an alternating basis to either the Cell Saver (AFB/CS) or the No Cell Saver (AFB/no CS) group.
Allocation concealment (selection bias)	High risk	Randomised on an alternating basis to either the Cell Saver (AFB/CS) or the No Cell Saver (AFB/no CS) group.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	Transfusion protocol in place but scope for between-subject variability: High ROB for intra-op transfusion (clinician decision), low ROB post-op (clearer guidelines): "Intraoperative homologous red cell transfusions were given at the discretion of the anesthesiologist and surgeon and were used to treat hypotension unresponsive to crystalloid and colloid fluid loading... After operation homologous red cell transfusions were not given to patients who were hemodynamically stable, and had hemoglobin values > 8.0 gm/dl. Patients who were not hemodynamically stable, having hypotension unresponsive to crystalloid or colloid fluids, acute myocardial ischemia, severe pulmonary insufficiency, and severely symptomatic anemia, were given transfusiLons at higher hemoglobin levels, as needed".
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	No blinding mentioned. Blood loss, hospital LOS have no guidelines mentioned (high ROB).
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding mentioned. Blood loss, hospital LOS have no guidelines mentioned (high ROB).
Incomplete outcome data (attrition bias) All outcomes	Low risk	All participants randomised are accounted for in the reported outcomes: 36 randomised, 36 analysed
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No baseline characteristics provided per group (table 1 is postoperative day 1 and 4, not baseline). Funding and conflicts not reported

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Khan 2017 (SALVO)

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, multicentre study **Setting:** 26 UK obstetric units in NHS hospitals **Recruitment:** June 2013 to April 2016 (study dates) **Maximum follow-up:** duration of hospital stay
Participants	Participants were women admitted to labour ward for either emergency or elective Caesarean section with an identifiable increased risk of haemorrhage. Each was randomised to one of two treatment arms: **Cell salvage group**: N = 1517. Mean (SD) age 31.6 (5.7). **Control group**: N = 1511. Mean (SD) age 31.8 (5.8). Baseline data were comparable between the two groups.
Interventions	**Cell salvage group*:*** for these participants, full cell saver set up of both collection and processing was mandated as part of the study protocol, as was the return of any processed blood. **Control group*:*** the control group underwent Caesarean section without routine use of cell salvage. In life-threatening acute haemorrhage, women were managed as per standard care for the institution, which occasionally included cell saver use.
Outcomes	**Primary outcome:** rate of women receiving donor blood transfusion **Secondary outcomes:** units of blood transfused, time to first mobilisation, length of hospital stay, maternal fatigue, safety outcomes, costs of resources and provisions, process outcomes (e.g. volume of blood processed)
Notes	**Transfusion protocol:** the need for donor blood transfusions was according to the policies of each participating hospital, and donor blood transfusion rates and thresholds were monitored for compliance with those. **Prospective registration status:** the study was registered prospectively with a trials registry (ISRCTN 66118656). **Ethical approval:** the study was approved by the UK National Research Ethics Committee (North West – Haydock. Approval number 12/NW/0513). **Language of publication:** English **Trial funding:** UK National Institute for Health Research (NIHR) Health Technology Assessment grant (10/57/32) **Conflicts of interest:** none reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Participating women were randomised by entry into a bespoke online system using random permuted blocks of variable sizes to maintain allocation concealment at a ration of 1:1. Randomisation was stratified by centre, indication, placentation, and multiple birth.

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Khan 2017 (SALVO) *(Continued)*

Allocation concealment (selection bias)	Low risk	Quote: "The randomisation will use random permuted blocks of variable sizes to ensure that trial staff conducting randomisation cannot reliably predict the next allocation." Allocation and randomisation carried out by third party
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Use of transfusion protocol unclear: “use local protocols”. However, “[we] will minimise this risk by ensuring that each centre has an intraoperative transfusion protocol for use in theatre and recovery to standardise operative transfusion triggers across both study groups in each centre."
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	Participants blinded, personnel unblinded. Protocols reviewed by research team prior to study commencement. LOS not defined
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Participants blinded, personnel unblinded. Protocols reviewed by research team prior to study commencement. LOS not defined
Incomplete outcome data (attrition bias) All outcomes	Low risk	All participants had complete data for the primary outcome and < 5% did not have data for the secondary outcomes. ITT where random data missing. Low dropout, all reasons given. But imbalance in number missing (higher in cell salvage group, and no return for “other reasons”)
Selective reporting (reporting bias)	Low risk	A study protocol is available and all outcome measures planned were measured and reported.
Other bias	Low risk	No other concerning features of this study were identified: primary NIHR grant supporting the roles of KK, PM, RH, IW, LB, TR, CM, JDa, SR, DL and JDo. PM also declares having been a co-applicant for two other NIHR-funded grants over within the last five years. Other than this, all authors declare no support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

Kirkos 2006

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, multicentre study **Setting:** two hospitals in Greece (one university teaching hospital (Thessaloniki, Greece) and 1 district general hospital (Kilkis, Greece))

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Kirkos 2006 *(Continued)*

	Recruitment: during 2002. Recruitment and study dates not specified. **Maximum follow-up:** 5 days postoperatively
Participants	155 participants undergoing total knee arthroplasty were randomly allocated to one of two groups: **Group B (Autotransfusion group)** (Cell salvage/intervention group): N = 78. M:F 18:60. Mean (SD) age 69.08 (5.45) **Group A (Standard vacuum drain)** (Control/no cell salvage group): N = 77. M:F 10:67. Mean (SD) age 68.88 (5.11) The study suggests groups were comparable at baseline; however, there was a higher percentage of males in Group B than in Group A.
Interventions	**Group B1 (Autotransfusion group)** (Cell salvage/intervention group): autotransfusion group had their drained blood that was collected within the first 6 hours postoperatively transfused through a standard blood transfusion set with 40 µm microaggregate filter. A standard 1000 mL blood transfer bag was connected to the system in order to collect and re-transfuse the blood by gravity. **Group A2 (Standard vacuum drain)** (Control/no cell salvage group): control group received standard vacuum drains without autotransfusion.
Outcomes	**Outcomes reported:** amount of allogeneic blood transfused, days with fever, fever, volume of blood re-transfused, haemoglobin levels
Notes	**Transfusion protocol*:*** participants were transfused allogeneic blood if haemoglobin level fell to < 10.0 g/dL. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study was approved by the hospital's Scientific Research Board. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Study allocated participants to intervention or control on an alternating basis. The first patient to participate in the study was classified in Group B, the second patient in Group A, and so on. If a Group B patient was withdrawn from the study during the operation, the next patient to participate in the study was again classified in Group B.
Allocation concealment (selection bias)	High risk	Study allocated participants to intervention or control on an alternating basis. The first patient to participate in the study was classified in Group B, the second patient in Group A, and so on. If a Group B patient was withdrawn from the study during the operation, the next patient to participate in the study was again classified in Group B.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)

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Kirkos 2006 *(Continued)*

Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: "Patients with Hb level < 10 g/dL were transfused with allogeneic blood"
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	Differential management of wound closure and bleeding between groups
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	Differential management of wound closure and bleeding between groups
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	The total number of patients contributing to the outcome measures is not reported: states that 78 and 77 were per group. Unclear if this was the number randomised and/or number analysed. Would assume analysed, but therefore unclear whether this is ITT, or general info on patient flow
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	High risk	Funding and conflicts of interest not reported. Also states that "the patients in both groups were comparable with respect to their age and gender", but higher % of male in group B than group A (18/78 versus 10/77). Pre-op Hb and platelet count similar. In discussion, they note differences/correlations due to gender, but do not comment that they actually had a gender imbalance.

Klein 2008

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** specialist cardiothoracic hospital, Papworth, Cambridgeshire, UK **Recruitment:** recruitment and study dates not specified **Maximum follow-up:** 5 days postoperatively
Participants	213 participants undergoing first-time CABG and/or cardiac valve surgery were randomised to one of two groups: **Cell salvage group:** N = 102. M:F 78:24. Mean (SD) age 68.6 (9.6) **Control group:** N = 111. M:F 84:27. Mean (SD) age 67.4 (10.2). There were no differences between the groups with regard to demographic and preoperative variables.
Interventions	**Cell salvage group:** the cell salvage group (C.A.T.S. Fresenius Hemocare system) had their suctioned blood processed before and after CPB with the cell salvage apparatus. After weaning from CPB, blood

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Klein 2008 *(Continued)*

	remaining in the CPB circuit was processed by the cell saver device. All recovered blood, with no minimum volume due to the design of the cell salvage device, was transfused to the patient. Postoperatively, the cell saver was transferred with the patient to the intensive care unit (ICU) and connected to the chest tubes. All blood lost during the first 6 hours was processed and autotransfused. Cell salvage was disconnected after 6 hours. **Control group:** in the control group, blood suctioned before and after CPB discarded. After CPB, any remaining blood in the bypass machine tubing and reservoir was collected in the bag and transfused directly to the patient.
Outcomes	**Primary outcome:** number of participants transfused allogeneic blood **Secondary outcomes:** amount of allogeneic blood transfused, number of participants transfused fresh frozen plasma, number of participants transfused platelets, blood loss, adverse events, re-operation for bleeding
Notes	**Transfusion protocol:** during surgery, allogeneic RBCs were transfused for a haemoglobin 7.0 g/dL. Postoperatively, allogeneic RBCs were transfused for haemoglobin 8.0 g/dL. In the cell salvage group, allogeneic blood was only transfused if there were no available RBCs from the cell salvage processing. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study was approved by a research ethics committee (05/Q0106/19). **Language of publication:** English **Trial funding:** funded in part by autotransfusion device manufacturer (Fresenius, C.A.T.S. manufacturer) via unrestricted educational grant and in part by anaesthetic research unit at Papworth Hospital. **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Participants were allocated to intervention or control by simple randomisation generated by an independent statistician using a computer random number function, stratified by type of surgery.
Allocation concealment (selection bias)	Low risk	The randomised allocation was performed on admission to hospital the day before surgery and held in the hospital research unit until the participant had consented and was registered.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: during surgery, allogeneic RBCs were transfused for haemoglobin 7 g/dL. Postoperatively, allogeneic RBCs were transfused for haemoglobin 8.0 g/dL. In the cell salvage group (see below), allogeneic blood was only transfused if there were no available RBCs from the cell salvage processing.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	No blinding: due to the nature of the intervention, group allocations were necessarily made available to operating room and intensive care unit (ICU) staff managing the participants.

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Klein 2008 *(Continued)*

Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding: due to the nature of the intervention, group allocations were necessarily made available to operating room and intensive care unit (ICU) staff managing the participants.
Incomplete outcome data (attrition bias) All outcomes	Low risk	The total number of participants contributing to the outcome measures is not reported, but an intention-to-treat analysis was performed.
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	Funded in part by autotransfusion device manufacturer via unrestricted educational grant. No baseline imbalance

Kleinert 2012

Study characteristics	
Methods	**Design:** RCT, parallel three-arm, single-centre study **Setting:** university teaching hospital, Zurich, Switzerland **Recruitment:** October 2008 to May 2009 **Maximum follow-up:** duration of hospital stay
Participants	120 participants were randomised to one of three groups. **Group A (no drain)** (Control/no cell salvage group): N = 40. Mean (SD) age 66 (10). M:F 17:23. Mean (SD) BMI 26 (10). **Group B (standardsuction drain**) (Control/no cell salvage group): N = 40. Mean (SD) age 64 (11). M:F 21:19. Mean (SD) BMI 26 (5). **Group C (reinfusion drain)** (Cell salvage/intervention group): N = 40. Mean (SD) age 66 (10). M:F 21:19. Mean (SD) BMI 28 (5). The three groups did not differ in terms of demographic and preoperative variables.
Interventions	**Group A (no drain)** (Control/no cell salvage group): received no drain postoperatively (control group) **Group B (standard suction drain)** (Control/no cell salvage group): received a closed suction drain connected to a vacuumed drainage bottle (Redon, B/Braun). The drain was removed at 48 hours postoperatively. **Group C (reinfusion drain)** (Cell salvage/intervention group): received a Bellovac-ABT (Astratec) ABTrans autologous retransfusion system. Autologous drainage was performed when 250 mL of blood was collected within 6 hours of surgery. The drain was removed at 48 hours postoperatively.
Outcomes	**Outcomes reported:** total number of transfusions, operating time, intraoperative blood loss, total blood loss, pain (visual analogue scale (VAS)), thigh swelling, haematoma formation, hospital stay, pyrexia, transfusion reactions, wound complications, other complications, Harris Hip Score at 3 months

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Kleinert 2012 *(Continued)*

Notes

Transfusion protocol: homologous (allogeneic) blood transfusion was performed if postoperative haemoglobin was < 80 g/L or if patients were symptomatic with Hb values between 80 and 100 g/L. Symptoms included breathlessness, heart palpitations, dizziness, headache, or if weakness impaired them from starting to walk during the first 2 days.

Prospective registration status: the study was not prospectively registered with a trials registry.

Ethical approval: the study was approved by the Institutional Review Board of Dept. of Orthopaedics, University of Zurich, Balgrist Hospital, Forchstrasse 340, 80008, Zurich, Switzerland.

Language of publication: English

Study groups: for the purpose of our review, we have combined groups A and B as controls. Group C is the intervention.

Trial funding: not reported

Conflicts of interest: none reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Randomisation was performed at the end of the procedure by the anaesthetist. Participants block-randomised to one of three groups using sealed envelopes; computer randomisation not performed. Method of randomisation not described
Allocation concealment (selection bias)	Unclear risk	Allocation concealment is not described. Block size not described. Mentions sealed envelopes, but not whether they were opaque
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: homologous blood transfusions were given if the postoperative Hb was less than 80 g/L or if patients were symptomatic with Hb values in the range 80 to 100 g/L according to in-house guidelines. Patients were considered symptomatic if they complained of breathlessness, heart palpitations, dizziness or headache, and if weakness impaired them from starting walking during the first 2 days.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	The blinding of study participants and personnel is not described. Poorly defined outcomes relevant to this review
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	Blinding of outcome assessors is not described. Poorly defined outcomes relevant to this review

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Kleinert 2012 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Low risk	Of the 181 participants initially enroled, 61 were excluded for the following reasons: denied informed consent (n = 21); history of coagulation disorder (n = 5); medications affecting coagulation status up to 10 days prior to surgery (n = 21); preoperative anaemia (n = 5); and avascular necrosis (N = 9). Breakdown of dropouts provided, and before randomisation which was postoperatively
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	Authors declare no conflicts of interest. Could not find information on funding

Koopman-van Gemert 1993a

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single centre study **Setting:** university teaching hospital, Nijmegen, the Netherlands **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** perioperative
Participants	40 participants undergoing elective coronary artery bypass graft surgery (CABG) were randomised to one of two groups: **Group 1 (Perioperative autotransfusion)** (Cell salvage/intervention group): N = 20. M:F 14:3. Mean (SD) age 64 (7.0) **Group 2 (Homologous transfusion only)** (Control/no cell salvage group): N = 20. M:F 17:3. Mean (SD) age 62 (10.0) There were no between-group differences at baseline with regard to demographic data and preoperative variables.
Interventions	**Group 1 (Perioperative autotransfusion)** (Cell salvage/intervention group): cell salvage group received perioperative autotransfusion of blood processed by means of the Cell-Saver III-plus system. The blood collected before going on cardiopulmonary bypass (CPB) and the remnant from the CPB machine were transferred into the cardiotomy reservoir through a 170 µm filter. Drain blood was collected during the first 6 hours postoperatively. Blood cell processing was performed by personnel in the Red Cross Blood Bank. Before transport to the blood bank, the blood was transferred into labelled sterile one-litre bottles. After processing, the washed erythrocyte suspension was collected into labelled sterile bags and returned to the operating theatre (OT) or intensive care unit (ICU) for re-infusion through a 40 µm blood filter. Blood was transfused up to 10 hours after the end of the operation. This allowed a maximum of 6 hours for collection, and an extra 4 hours for transport, processing, and re-infusion to the patient. **Group 2 (Homologous transfusion only)** (Control/no cell salvage group): control group did not receive autotransfusion.
Outcomes	**Outcomes reported:** amount of blood collected by the cell saver, amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of participants transfused allogeneic blood, adverse events, blood loss
Notes	**Transfusion protocol*:*** allogeneic packed cells were transfused to maintain an Hct at 30%. **Prospective registration status:** the study was published prior to 2010.

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Koopman-van Gemert 1993a *(Continued)*

Ethical approval: it is not clear whether the study was approved by an ethics committee or institutional review board

Language of publication: English

Trial funding: not reported

Conflicts of interest: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	"Alternatingly allocated to group I or II at the moment of blood processing"
Allocation concealment (selection bias)	High risk	Based on the method of randomisation, group allocation is unlikely to be concealed: "Alternatingly allocated to group I or II at the moment of blood processing"
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: "homologous packed cells were transfused to maintain their haematocrit at 0.30 l/l (if needed)."
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Low risk	No mention of blinding but clear description of how blood loss was calculated
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No mention of blinding but clear description of how blood loss was calculated
Incomplete outcome data (attrition bias) All outcomes	Low risk	Three participants from Group 1 were excluded from the study because they did not receive their autologous blood due to logistical problems. Trialists also planned to fully disclose issues: "If definite errors have and can be as occurred, identified such, the results are excluded from the calculations. This will be mentioned in the text and/or tables. The data remaining are then reexamined without these suspect resulls [sic]. All extreme data for which no reason can be found for exclusion are included in the final analysis."
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No baseline imbalance noted. Funding and conflicts not reported

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Koopman-van Gemert 1993b

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single centre study **Setting:** specialist orthopaedic hospital, Nijmegen, the Netherlands **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** perioperative
Participants	60 patients undergoing total hip arthroplasty or dorsal lumbo-sacral fusion surgery were randomised to one of two groups: **Group 1 (Perioperative autotransfusion group)** (Cell salvage/intervention group): N = 30. M:F 6:23. Mean (SD) age 51 (18) **Group 2 (Homologous transfusion only)** (Control/no cell salvage group): N = 30. M:F 7:23. Mean (SD) age 53 (18) There were no between-group differences at baseline with regard to demographic data or preoperative variables.
Interventions	**Group 1 (Perioperative autotransfusion group)** (Cell salvage/intervention group): the cell salvage group received perioperative autotransfusion by means of the Haemonetics Haemolite-2 system. The blood shed intraoperatively and during the first six postoperative hours was collected and heparinised. The blood was processed in the Haemolite-2 by personnel of the intensive care unit (ICU). The erythrocyte suspension produced was transfused to the patient within 4 hours after collection through a 40 µm blood filter. Blood cultures were taken before re-transfusion to the patient. **Group 2 (Homologous transfusion only)**(Control/no cell salvage group): the control group did not receive autotransfusion.
Outcomes	**Outcomes reported:** amount of blood collected by the cell saver, amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of participants transfused allogeneic blood, adverse events, blood loss
Notes	**Transfusion protocol:** allogeneic packed red cells were transfused to maintain an Hct at 30%. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	High risk	"Each was alternatingly allocated to one of two groups in the evening before surgery"
Allocation concealment (selection bias)	High risk	Based on the method of randomisation, group allocation is unlikely to be concealed: "Each was alternatingly allocated to one of two groups in the evening before surgery"

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Koopman-van Gemert 1993b *(Continued)*

Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: "homologous packed cells were transfused to maintain their haematocrit at 0.30 l/l (if needed)."
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Low risk	No mention of blinding but clear description of how blood loss was calculated
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No mention of blinding but clear description of how blood loss was calculated
Incomplete outcome data (attrition bias) All outcomes	Low risk	One participant was excluded from Group 1 because insufficient information was available. Quote from section 5.1 (Koopman 1993a): "If definite errors have and can be as occurred, identified such, the results are excluded from the calculations. This will be mentioned in the text and/or tables. The data remaining are then reexamined without these suspect resulls [sic]. All extreme data for which no reason can be found for exclusion are included in the final analysis."
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No baseline imbalance noted. Funding and conflicts not reported

Kristensen 1992

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** regional hospital, Vejle, Denmark **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** 4 days postoperatively
Participants	56 participants undergoing total hip or knee arthroplasty were randomised into 2 groups, with subgrouped data available for hip and knee surgery patients for some information: **Autologous hip** (Cell salvage/intervention group): N = 18. Mean (range) age: 68 (18 to 84). **Autologous knee** (Cell salvage/intervention group): N = 13. Mean (range) age: 65 (6 to 86)

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Kristensen 1992 *(Continued)*

	Homologous hip (Control/no cell salvage group): N = 16. Mean (range) age: 66 (50 to 81) **Homologous knee** (Control/no cell salvage group): N = 9. Mean (range) age: 71 (61 to 81) Groups were similar with regard to baseline characteristics, although few details were provided.
Interventions	**Autologous group** (Cell salvage/intervention group): Solcotrans Orthopaedic drainage system was used to collect blood postoperatively. Reinfusion was performed either when the drainage bag was full, or after 6 hours of collection time if a minimum of 300 mL of blood was present in the drainage bag. Homologous blood was given if required. **Homologous group** (Control/no cell salvage group): drainage blood discarded instead of retransfused.
Outcomes	**Outcomes reported:** Homologous blood requirement, blood loss
Notes	**Transfusion protocol:** The criterion for giving homologous blood transfusion was clinical judgement, taking into account the haemodiluting effect of parenteral solutions given intraoperatively to maintain normovolaemia. The critical haemoglobin level for administering homologous blood was 8.5 g/dL. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board. **Language of publication:** English **Study groups:** for the purpose of our review, we have included the autologous hip and autologous knee groups as the cell salvage/intervention group. Homologous hip and homologous knee groups have been included as the control/no cell salvage group. **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Methods poorly described
Allocation concealment (selection bias)	Unclear risk	Methods poorly described
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	Transfusion protocol given. Although it does also state 'clinical judgement', risk of deviation from protocol as 8.5 g/dL is 'critical' transfusion threshold, so patients may receive transfusions at Hb above this. Quote: "The criterion for giving homologous blood transfusion was clinical judgement, taking into account the haemodiluting effect of parenteral solutions given intraoperatively to maintain normovolemia. The critical hemoglobin level for administering homologous blood was 8.5 g/dL".
Blinding of participants and personnel (performance bias)	High risk	Unclear if blinded but unlikely, and volume of blood loss measurement poorly described

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Kristensen 1992 *(Continued)*

Subjective: all other outcomes		
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	Unclear if blinded but unlikely, and volume of blood loss measurement poorly described
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Unclear if number analysed = number randomised.
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	Lack of baseline characteristics provided – only age and operation (hip or knee). No conflict of interest statement provided

Laszczyca 2015

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Katowice, Poland **Recruitment:** January 2013 to February 2014 **Maximum follow-up:** duration of hospital stay
Participants	101 patients undergoing total knee replacement were randomised to one of two groups: **Re-transfusion group (RTF and RTF2 group)** (Cell salvage/intervention group): N = 44. Mean age 70.9 **Drainage group (DRN and DRN2 group)** (Control/no cell salvage group): N = 57. Mean age 70.5 There was a higher proportion of males < 60 years old but does not state in which group. Groups were otherwise reported as balanced.
Interventions	**Re-transfusion group (RTF and RTF2 group)** (Cell salvage/intervention group): RTF group (cell salvage group) were scheduled to receive postoperative autotransfusion of salvaged blood via a HandyVac ATS (Unomedical) retransfusion set. Blood was collected and re-infused in-line with the manufacturers instructions. RTF2 represents those participants that received their drainage blood. **Drainage group (DRN and DRN2 group)** (Control/no cell salvage group): DRN group (control group) received a standard drain. DRN2 represents all participants that did not receive drainage blood.
Outcomes	**Outcomes reported:** intraoperative blood loss, postoperative blood loss, amount of blood re-transfused, amount of fresh frozen plasma (FFP) transfused, amount of packed red blood cells transfused, duration of hospital stay
Notes	**Transfusion protocol:** the postoperative indication to transfuse was the onset of hypovolaemic shock symptoms, general weakness and increasing symptoms of ischaemic disease. The trigger for trans-

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Laszczyca 2015 *(Continued)*

fusion was a haemoglobin < 8 g/dL, a decrement > 5 g/dL or < 9.5 g/dL with symptomatic anaemia or bleeding.

Prospective registration status: the study was not prospectively registered with a trials registry.

Ethical approval: the study was not approved by a Research Ethics Committee or Institutional Review Board.

Language of publication: English and Polish

Trial funding: not reported

Conflicts of interest: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Randomisation methods not stated
Allocation concealment (selection bias)	Unclear risk	The method of allocation concealment is not described and so there is insufficient information to make a judgement.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	Authors state indications for transfusion in the methods section, but also state that decision to give allogeneic blood was made on 'individual basis' so it is not clear how robust / rigid the transfusion protocol was.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	Blinding of study personnel and participants is not described and so there is insufficient information to make a judgement. No attempt suggested in terms of intraoperative blinding of surgeons until end of procedure, as has been done in other studies
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	Blinding of study personnel and participants is not described and so there is insufficient information to make a judgement. No attempt suggested in terms of intraoperative blinding of surgeons until end of procedure, as has been done in other studies. Outcomes measures not adequately defined
Incomplete outcome data (attrition bias) All outcomes	High risk	Six participants from intervention group were moved to control group because they did not receive an autotransfusion
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare

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Laszczyca 2015 *(Continued)*

Other bias	Unclear risk	Difference in group sizes included in analysis e.g. 38 RTF group versus 55 in drainage only group. Baseline characteristics table has not been provided - difficult to assess whether the groups were truly homogenous at baseline. Conflicts of interest statement / funding sources have not been provided.

Lepore 1989

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Gothenburg, Sweden **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** 5 days postoperatively
Participants	135 participants undergoing cardiac surgery were randomised to one of two groups: **Autotransfusion group** (Cell salvage/intervention group): N = 67. M:F 52:15. Mean (SD) age 60 (12) **Control group**: N = 68. M:F 51:17. Mean (SD) age 61 (10) Participants in the autotransfusion group were comparable to those in the control group at baseline.
Interventions	**Autotransfusion group** (Cell salvage/intervention group): cell salvage group had the cardiotomy reservoir (Dideco 742), after use in extracorporeal circulation, reconfigured to serve as a receptacle for postoperative mediastinal drainage. One of the inlet ports was connected to the tubes draining the mediastinum. In this way, the drainage from the chest passed through the 20 µm filter of the cardiotomy reservoir. The cardiotomy outlet tubing was replaced with an adaptor connecting with standard intravenous tubing. A standard infusion pump was used to reinfuse the collected blood. The filtered blood collecting in the reservoir was reinfused at hourly intervals. No blood was reinfused after the 6th postoperative hour. Thereafter, the reservoir served only as a receptacle for shed mediastinal blood. Reservoir blood was sampled at 6 hours for bacteriologic study. **Control group**: control group received no autotransfusion.
Outcomes	**Outcomes reported:** amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of participants transfused allogeneic blood, adverse events, mortality, blood loss
Notes	**Transfusion protocol:** the use of a transfusion protocol was not reported. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study was approved by the hospital Ethic's Committee. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.

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Lepore 1989 *(Continued)*

Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	No transfusion protocol in place
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	No blinding possible for personnel
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding possible for personnel
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No info on participant flow. Baseline characteristics as mentioned in methods as number who were allocated to each group. Unclear if this is the number used in analyses (1 participant died, unclear if they were excluded - no mention). Likely ITT, but not sure
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No baseline imbalance noted. Funding and conflicts not reported

Lorentz 1991

Study characteristics	
Methods	**Design:** RCT, parallel four-arm, single-centre study **Setting:** university teaching hospital, Mannheim, Germany **Recruitment:** 16-month period. Precise recruitment and study dates not reported **Maximum follow-up:** postoperatively
Participants	64 participants scheduled for total hip arthroplasty were randomly divided into one of four groups: **Group 1** (Preoperative autologous donation group): N = 16 **Group 2** (Preoperative haemodilution group): N = 16

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Lorentz 1991 *(Continued)*

	Group 3 (Autotransfusion group) (Cell salvage/intervention group): N = 16 **Group 4** (Control/no cell salvage group): N = 15 Demographic data were not reported.
Interventions	**Group 1**: preoperative autologous donation group had their preoperative blood donations stored in citrate-phosphate-dextrose solution with adenine (CPDA-1) buffer. Three units of 450 mL were requested. A pre-donation haemoglobin (Hb) concentration of 11.0 g/dL was required. Surgery was carried out in the 5th week after the first donation. **Group 2**: preoperative haemodilution group had their blood collected to a haemoglobin of 9.0 g/dL after the induction of anaesthesia and initial circulatory stabilisation. **Group 3** (Cell salvage/intervention group): autotransfusion group had a cell separator used for intraoperative and postoperative autotransfusion. Postoperative autotransfusion of drainage blood was continued until 6 hours after the beginning of the operation. Autologous blood collected with the cell separator was re-transfused at the end of the operation and after the autotransfusion period irrespective of the actual Hb concentration. **Group 4** (Control/no cell salvage group): control group received standard care.
Outcomes	**Outcomes reported:** amount of allogeneic blood transfused, number of patients transfused allogeneic blood, blood loss
Notes	**Transfusion protocol*:*** polygeline was used for volume resuscitation. If the Hb concentration fell below 9.0 g/dL in the operating room and the intensive care unit or below 10.0 g/dL in the general ward, autologous or allogeneic packed red cells were transfused. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board. **Language of publication:** German **Study groups:** for the purpose of our review, we have included Group 3 as the cell salvage/intervention group and Group 4 as the control/no cell salvage group. **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described: the participants were randomly selected into four groups: group 2 - preoperative haemodilution, group 3 - intra- and postoperative autotransfusion, group 4 - control group. (Only groups 3 and 4 are relevant.)
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation is unclear. The participants were randomly selected into four groups: group 2 - preoperative haemodilution, group 3 - intra- and postoperative autotransfusion, group 4 - control group. (Only groups 3 and 4 are relevant.)
Blinding of participants and personnel (performance bias)	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)

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Lorentz 1991 *(Continued)*

Objective outcome: mortality		
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: a haemoglobin concentration of 9 g/dL was set as the intervention value for a transfusion intraoperatively and during the stay at the watch station, and a haemoglobin concentration of 10 g/dL after the day of the operation
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	The blinding status of outcome assessors is not described. Transfusion protocol in place but method for measuring blood loss is not defined
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	The blinding status of outcome assessors is not described. Transfusion protocol in place but method for measuring blood loss is not defined
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Unclear - 1 participant in the control group was discharged from the study because - with an unremarkable medical history - stenocardia occurred postoperatively in the recovery room and the admission criteria for the study were no longer met
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	(Only groups 3 and 4 are relevant.) No apparent baseline imbalance. Funding and conflicts not reported

Luo 2016

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, multicentre study **Setting:** 2 hospitals in Guangzhou, China (1 university teaching hospital, 1 regional district hospital) **Recruitment:** October 2014 to October 2015 **Maximum follow-up:** 7 days postoperatively
Participants	A total of 91 participants undergoing total hip arthroplasty (THA) were randomised to one of the following two groups: **ABT Group** (Cell salvage/intervention group): N = 49. Mean (SD) age 58 (5.7). M:F 27:22. Mean BMI 22.1 **Standard drainage group** (Control/no cell salvage group): N = 42. Mean (SD) age 61 (6.3). M:F 22:20. Mean BMI 21.8 There was no difference in baseline data between the two groups.

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Luo 2016 *(Continued)*

Interventions	**ABT Group** (Cell salvage/intervention group): the ABT group received a ConstaVac Blood Conservation II (CBCII, Stryker Instruments, Kalamazoo, Michigan, USA) autologous blood transfusion device. Autologous blood collected within the first 6 hours after surgery was collected and reinfused. Blood collected after 6 hours was collected and discarded. The drain was removed when the daily drainage blood level was < 50 mL. **Standard drainage group** (Control/no cell salvage group): the drain group (control group) received a conventional postoperative vacuum drain, connected to an ordinary drainage bottle. Drainage blood was not re-transfused and the drain was removed when daily drainage blood level was < 50 mL.
Outcomes	**Outcomes reported:** intraoperative blood loss, postoperative drainage blood, amount of ABT blood retransfused, adverse events (including fever, chills, dyspnoea, redness, DVT, wound healing)
Notes	**Transfusion protocol:** use of a transfusion protocol is not reported for this study. **Prospective registration status:** the study was not prospectively registered on a trials registry. **Ethical approval:** there is no information available regarding ethical approval of the study. We contacted authors to enquire about this, but received no response. **Langauge:** English **Trial funding:** funded by the Panyu Central Hospital of Guangzhou (2014-Q-06) and the Technology and Information Department of Panyu (2014-Z03-30). **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	There is insufficient information provided to make a judgement
Allocation concealment (selection bias)	Unclear risk	There is insufficient information provided to make a judgement
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	No transfusion protocol stated, and excluded those who received allogeneic transfusion, without providing data on those excluded
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	There is no description of blinding of study participants or personnel: DVT, confirmed diagnostically by ultrasound Doppler carried out on postop day 7. Blood loss – unclear how this was measured. Unclear how lack of blinding may have influenced this outcome.
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)

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Luo 2016 *(Continued)*

Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	There is no description of blinding of study participants or personnel: DVT, confirmed diagnostically by ultrasound Doppler carried out on postop day 7. Blood loss – unclear how this was measured. Unclear how lack of blinding may have influenced this outcome.
Incomplete outcome data (attrition bias) All outcomes	High risk	Patients who received an allogeneic blood transfusion were excluded from the study
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	Funding reported (non-pharma): this study was funded by the Panyu Central Hospital of Guangzhou (2014-Q-06) and the Technology and Information Department of Panyu (2014-Z03-30). Conflicts of interest not stated. No apparent baseline imbalance. However, as those who were transfused were excluded, it is unclear whether they were included in the baseline characteristics.

Mac 1993

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** private, non-profit tertiary care hospital **Recruitment:** August 1990 to February 1991 **Maximum follow-up:** 1 year postoperatively
Participants	**Group 1 (Constavac)** (Cell salvage/intervention)**:** N = 56. Mean age 66.4. M:F (%) 50:50 **Group 2 (Haemovac)** (Control/no cell salvage)**:** N = 35. Mean age 63.9. M:F (%) 37:63 There was baseline imbalance in ASA score between the groups.
Interventions	**Group 1 (Constavac)** (Cell salvage/intervention): postoperative autoreinfusion device **Group 2 (Haemovac)** (Control/no cell salvage): standard drain used postoperatively
Outcomes	**Outcomes reported:** blood loss, blood replacement, length of hospital stay
Notes	**Transfusion protocol:** on the day of surgery, blood was transfused at the discretion of the surgeon. On postoperative days 1 and 2, blood was transfused for a haemoglobin below "10 vols/100 mL". **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported
Risk of bias	

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Mac 1993 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Original randomisation methods unclear. Randomisation was broken as 15 participants were reassigned after randomisation to ConstaVac group by operating surgeon
Allocation concealment (selection bias)	Unclear risk	Operating staff not aware of allocation until procedure but explicit method of concealment not reported e.g. sealed opaque envelopes
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	Decisions on blood transfusion varied depending on the day. Quote: "On the day of surgery, blood was transfused at the discretion of the surgeon. On postoperative days 1 and 2, blood was transfused for a haemoglobin below 10 vols/100ml."
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Low risk	Intraoperative allocation only shared at end of operation. Postoperative transfusion threshold in place and standard care described as consistent. Physician blinded for most of the procedure until drain inserted.
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	Undefined protocol for LOS and blood loss measurement, once blinding was broken
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Poorly described
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	High risk	No conflict of interest or funding declaration. Baseline imbalance of groups (ASA grade) and uneven group size

Mah 1995

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** district general hospital, Adelaide, Australia **Recruitment:** January 1986 to June 1990

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Mah 1995 *(Continued)*

	Maximum follow-up: not reported
Participants	99 participants undergoing elective primary total knee or hip replacement surgery were randomly allocated to one of two groups: **Autologous blood salvage (ABS)** (Cell salvage/intervention group): N = 91 **No autologous blood salvage (No-ABS)** (Control/no cell salvage group): N = 114 Demographic data are not reported.
Interventions	**Autologous blood salvage (ABS)** (Cell salvage/intervention group): cell salvage group had blood salvage performed using a semi-automated autotransfuser (Electromedics BT-795) according to the manufacturer's instructions. Intraoperative blood salvage was performed by a nurse in conjunction with an anaesthetist. Postoperative blood salvage was a continuation of the intraoperative salvage for a duration not exceeding 6 hours after the tourniquet was released. On completion of salvage, the wound drains were connected to two vacuum-charged Redivac bottles and the drains were removed at 48 hours after surgery. The average volume of blood salvaged in each participant was calculated after adjusting the haematocrit to 40%. **No autologous blood salvage (No-ABS)** (Control/no cell salvage group): control group received no autotransfusion.
Outcomes	**Outcomes reported:** number of participants transfused allogeneic blood, blood loss
Notes	**Transfusion protocol:** allogeneic blood transfusions were used intra/postoperatively to maintain a safe blood volume and a haemoglobin level around 10.0 g/dL. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study was approved by the Clinical Investigations Committee at the Repatriations General Hospital. **Language of publication:** English **Extraction:** only data from total knee replacement participants are available, as total hip replacement group was divided into uncemented and cemented subgroups. Total knee replacement group data have been reported across Tables 4 and 6 within the publication; the numbers did not add up for us. We contacted authors for clarification but received no response. We therefore marked the study as 'not reported' (NR) for all outcomes. **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Participants were randomised using a computer-generated randomisation table: 2 tables, one for knee replacement and one for hip replacement
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)

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Mah 1995 *(Continued)*

Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	No transfusion protocol
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	Poorly-defined processes for outcomes and blinding
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	Poorly-defined processes for outcomes and blinding
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	The total number of participants contributing to the outcome measures is not reported, no info on participant flow
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	Only the prospective study is relevant. Baseline data not reported. Funding and conflicts not reported

Majkowski 1991

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** specialist orthopaedic hospital, Bristol, Avon, UK **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** 48 hours postoperatively
Participants	40 participants undergoing primary unilateral total knee arthroplasty were randomised to one of two groups: **Study group (Autotransfusion**) (Cell salvage/intervention group): N = 20. M:F 6:14. Mean age 71.3 **Control group (Standard drain)**: N = 20. M:F 6:14. Mean age 70.3 There was no baseline imbalance between groups.
Interventions	**Study group (Autotransfusion)** (Cell salvage/intervention group): autotransfusion group (Solcotrans orthopaedic reinfusion system) had the two deep intra-articular drains connected to a Solcotrans reservoir and a suction pressure of 80 mmHg applied for an initial period of 10 minutes, after which the wound was allowed to drain by gravity alone. Two Solcotrans reservoirs were attached sequentially to each participant regardless of the volume drained. Blood was reinfused if a sufficient volume had been collected. Drains were removed at 48 hours.

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Majkowski 1991 *(Continued)*

	Control group (Standard drain): control group had all drains attached to Redivac bottles. Autotransfusion was not used.
Outcomes	**Outcomes reported:** amount of blood collected by the cell saver, amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, adverse events
Notes	**Transfusion protocol:** allogeneic blood was given to patients if the haemoglobin level fell below 9.5 g/dL or if indicated haemodynamically. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	**Transfusion protocol*:*** Allogeneic blood was given to patients if the haemoglobin level fell below 9.5 g/dL or if indicated haemodynamically.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Low risk	Clear diagnostic guidelines for outcomes, unlikely to be largely affected by blinding
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	Clear diagnostic guidelines for outcomes, unlikely to be largely affected by blinding
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	The number of participants analysed is unclear; no info on participant flow

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Majkowski 1991 *(Continued)*

Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No baseline imbalance noted. Funding and conflicts not reported

Marberg 2010

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Gothenburg, Sweden **Recruitment:** September 2006 to May 2007 **Maximum follow-up:** duration of hospital stay
Participants	80 consecutive participants with stable angina pectoris, scheduled for CABG were randomised to either autotransfusion or no-autotransfusion of mediastinal shed blood. **Autotransfusion group** (Cell salvage/intervention group): N = 39. Mean (SD) age 66 (10). M:F 30:9. Mean (SD) BMI 27 (4). **No autotransfusion group** (Control/no cell salvage group): N = 38. Mean (SD) age 68(8). M:F 29:9. Mean (SD) BMI 28 (3). There was a between-group difference in left ventricular ejection fraction (LVEF) at baseline.
Interventions	**Autotransfusion group** (Cell salvage/intervention group): participants received autotransfusion of all mediastinal shed blood in the first 12 hours postoperatively. Cardiotomy suction blood was continuously re-transfused without cell salvage during CPB. **No autotransfusion group** (Control/no cell salvage group): participants avoided all autotransfusion (mediastinal shed blood was discarded). Cardiotomy suction blood was continuously re-transfused without cell salvage during CPB.
Outcomes	**Outcomes reported:** postoperative bleeding volume during the first 12 postoperative hours, transfusion requirements
Notes	**Transfusion protocol:** "Transfusion triggers were predefined in the local clinical protocol. RBC transfusions were given when blood haemoglobin level decreased to < 80 g/L. Platelets were transfused in patients with ongoing bleeding > 300 mL/hr and platelet count < 50 x 10^9/L, or suspected or confirmed platelet dysfunction. Plasma was transfused in patients with ongoing bleeding > 200 mL/hr and signs of impaired coagulation on thrombo-elastometry. The final decision regarding transfusion was always made by the attending physician." **Prospective registration status:** the study was not prospectively registered with a trials registry. **Ethical approval:** the study was approved by the Regional Research Ethics Committee for Sahlgrenska University Hospital, Gothenberg, Sweden. **Language of publication:** English **Trial funding:** the study was supported by the Swedish Heart and Lung Foundation and Sahlgrenska University Hospital **Conflicts of interest:** not reported
Risk of bias	

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Marberg 2010 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Randomisation sequence method not stated
Allocation concealment (selection bias)	Unclear risk	While the envelopes used were unmarked, it is not described whether allocation concealment was achieved by using opaque envelopes.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	Authors provide transfusion protocol but state that in all cases, the final decision to transfuse was made by attending physician, which indicates scope for deviation from protocol.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	Lack of blinding of participants/personnel during procedure/postoperative care could affect outcomes such as blood loss/reoperation for rebleed (this trigger has not been defined by authors).
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Blinding status unclear
Incomplete outcome data (attrition bias) All outcomes	Low risk	All participants randomised within the study are accounted for in the outcome data.
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Low risk	No obvious baseline imbalance. Funding reported (no pharmaceutical funding: the study was supported by the Swedish Heart and Lung Foundation and Sahlgrenska University Hospital). Conflicts of interest not reported

Martin 2000

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Montreal, Québec, Canada **Recruitment:** September 1998 to January 1999

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Martin 2000 *(Continued)*

	Maximum follow-up: duration of hospital stay
Participants	198 patients undergoing cardiac surgery were randomised to one of two groups: **Reinfusion group** (Cell salvage/intervention group): N = 98. M:F 75:23. Mean (SD) age 62 (19.8) **Control group:** N = 100. M:F 70:30. Mean (SD) age 66 (20.0) Preoperative Hb, age, weight, body surface area, and red cell mass were all imbalanced between groups at baseline.
Interventions	**Reinfusion group** (Cell salvage/intervention group): cell salvage group were treated with an autotransfusion system (Atrium Medical Corporation) consisting of 28F thoracic tubes connected to a three-chamber system. All collected blood was filtered and autotransfused until no drainage was present or for a maximum period of 12 hours. Transfusion began one hour after the patient arrived in the intensive care unit (ICU). **Control group**: control group had their postoperative mediastinal drainage discarded.
Outcomes	**Outcomes reported:** number of participants transfused allogeneic blood, amount of allogeneic blood transfused, blood loss, adverse events
Notes	**Transfusion protocol:** during CPB, allogeneic red blood cells were transfused for haemoglobin concentrations below 6.0 g/dL. In the postoperative period, the threshold for allogeneic red blood cell transfusion was Hb < 8.0 g/dL. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Participants were randomised in the control group or the reinfusion group by use of a table of random digits by blocks of 4.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: during CPB, red blood cells were transfused for haemoglobin concentration below 60 g/L, whereas in the postoperative period, the threshold for homologous red blood cell transfusion was 80 g/L.

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Martin 2000 *(Continued)*

Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Low risk	Before completion of the operation, the perfusionist would tell the surgeon in which group the patient had been randomised, and the drainage system was set up accordingly.
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	The blinding status of outcome assessors was not described. All data were prospectively collected from the chart of every enroled participant by 3 research assistants.
Incomplete outcome data (attrition bias) All outcomes	Low risk	All participants randomised are accounted for in the reported intention-to-treat analysis: of the 198 participants, 196 completed the study in accordance with the protocol. Two participants randomised to the reinfusion system were not subjected to the proper study protocol: in 1 case, the surgeon requested to use the usual drainage system, and in the other case, the postoperative protocol was not observed. The data from those 2 participants are included in the reinfusion group to perform an intent-to-treat analysis.
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	High risk	Multiple factors imbalanced at baseline - Hb, age, weight, red cell mass. Funding and conflicts not reported

Mauerhan 1993

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** regional hospital in Charlotte, NC, USA **Recruitment:** December 1990 to August 1991 (study dates) **Maximum follow-up:** perioperative
Participants	111 participants undergoing elective primary total hip arthroplasty (THA) and total knee arthroplasty (TKA) were randomly assigned to one of two groups: **Study group** (Cell salvage/intervention group): N = 57 **Control group**: N = 54 Mean age of TKA patients was 68 years (range 39 to 88 years). Mean age of THA patients was 62 years (range 27 to 85 years). No other baseline demographic data are reported.
Interventions	**Study group** (Cell salvage/intervention group): autotransfusion group (CBC ConstaVac) had their postoperative drainage collected and filtered. The unwashed red blood cells were reinfused within a 6-hour period. The blood was reinfused through a 20 µm macroaggregate filter. The CBC ConstaVac system has an umbrella valve that ensures that the top 100 mL of fluid containing serum fat and bone debris does not leave the reservoir. **Control group**: treated with a standard postoperative collection system.

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Mauerhan 1993 *(Continued)*

	All participants were encouraged to donate two units of autologous blood prior to both THA and TKA procedures.
Outcomes	**Outcomes reported:** number of participants transfused allogeneic or autologous blood, postoperative drainage, Hb levels
Notes	**Transfusion protocol:** intraoperative blood transfusion was left to the discretion of the operating surgeon. No transfusion threshold or trigger was reported. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study was approved by an Institutional Review Board. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Randomisation was performed using a random number table but no further information on randomisation is provided.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	No transfusion protocol in place: intraoperative blood transfusion was left to the discretion of the operating surgeon, as set forth by Institutional Review Board protocol
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Low risk	Remaining treatment protocols had clear guidelines unlikely to be affected by blinding
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Remaining treatment protocols had clear guidelines unlikely to be affected by blinding, but no transfusion protocol
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	The numbers analysed are not clear, likely to be ITT (all analysed), though this isn't clear based on the reporting

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Mauerhan 1993 *(Continued)*

Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	Baseline imbalance unclear (most demographic details, such as age, reported by subgroup, not by assignment to intervention). Funding and conflicts not reported

McShane 1987

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Dublin, Ireland **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** immediate postoperative
Participants	41 participants undergoing cardiac surgery on CPB were randomly allocated to one of two groups: **Saved blood group** (Cell salvage/intervention group): N = 20. M:F 12:8. Mean age 56.4 (range 37 to 74) **Donor blood group** (Control/no cell salvage group): N = 21. M:F 16:5. Mean age 47.76 (range 15 to 64). No further demographic data are available and no formal between-group baseline comparison has been performed.
Interventions	**Saved blood group** (Cell salvage/intervention group): in the cell salvage group, all perioperative shed blood was aspirated into a reservoir, using a low pressure suction device (< 100 mmHg) to minimise haemolysis. This blood was heparinised by means of heparinised lactated Ringer's solution (heparin 30,000 µL), which was delivered continuously to the tip of the suction wand. The aspirated blood was stored in a cardiotomy reservoir where it was de-foamed and filtered before being passed to the centrifuge bowl of the autotransfusion device. Here, it was centrifuged and washed with lactated Ringer's solution (1000 mL approximately) until the effluent or waste fluid was clear in colour. Thus, the red cells were saved, and plasma, debris, and other cells discarded. These red cells were then suspended in lactated Ringer's solution and pumped to a transfusion bag for reinfusion to the participant. **Donor blood group** (Control/no cell salvage group): received allogeneic blood transfusions only
Outcomes	**Outcomes reported:** mortality, time spent on bypass, length of stay
Notes	**Transfusion protocol:** use of a transfusion protocol is not reported **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** it is unclear whether the study was approved by an ethics committee or institutional review board. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**

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McShane 1987 *(Continued)*

Random sequence generation (selection bias)	Unclear risk	Insufficient detail on randomisation method
Allocation concealment (selection bias)	Unclear risk	Insufficient detail on allocation concealment
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	No transfusion protocol - no detail on how decisions were made to transfuse
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	Not applicable – no subjective outcomes of interest
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Not applicable – no subjective outcomes of interest
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Poorly described
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	High risk	Imbalance of operation types. No conflict of interest or funding statement

Menges 1992

Study characteristics	
Methods	**Design:** RCT, parallel three-arm, single-centre study **Setting:** university teaching hospital, Giessen, Germany **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** not reported
Participants	42 patients undergoing total hip surgery and preoperative plasmaphaeresis (Abbott Autotrans) were randomised to one of three groups:

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Menges 1992 *(Continued)*

	Group 1 (Control/no cell salvage group): N = 12. Mean (SD) age 66.7 (12.7). Mean (SD) weight 67.5 (12.4) kg **Group 2** (Autologous blood) (Cell salvage/intervention group): N = 14. Mean (SD) age 55.9 (18.2). Mean (SD) weight 75.2 (9.7) kg **Group 3** (Autologous blood and intra- and postoperative fresh frozen plasma (FFP)): N = 16. Mean (SD) age 70.6 (7.0). Mean (SD) weight 73.4 (13.1) kg
Interventions	**Group 1** (Control/no cell salvage group): control group for the substitution of blood loss, received in addition to crystalloids and colloids, only allogeneic red blood cells (erythrocyte concentrate). Autotransfusion was not used. **Group 2** (Autologous blood) (Cell salvage/intervention group): autotransfusion group for the substitution of blood loss, received in addition to crystalloids and colloids, only autologous packed red blood cells (erythrocyte concentrate) collected by the Autotrans BT 795 P, Dideco system. **Group 3** (Autologous blood and intra- and postoperative FFP): autotransfusion + FFP group received, additionally, intraoperative and postoperative autologous FFP. NB: study investigated the influence of two different methods of autotransfusion on the intravascular haemostatic system.
Outcomes	**Outcomes reported:** amount of blood re-transfused from the cell saver, number of participants transfused allogeneic blood, blood loss
Notes	**Transfusion protocol:** participants were transfused if haemoglobin fell below 9.0 g/dL or haematocrit fell below 28%. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board. **Language of publication:** German **Study groups:** for the purpose of our review, Group 2 (Autologous transfusion) acts as the intervention group and Group 1 (Control) acts as the control group. **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was unclear.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias)	High risk	No transfusion protocol in place

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Menges 1992 *(Continued)*

Subjective: transfusion protocol		
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	The blinding status of participants and personnel was not described
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	The blinding status of outcome assessors was not described
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	The total number of participants contributing to the outcome measures is not reported; no info on participant flow, only per-group baseline data
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	Baseline imbalance in average age (control mean 10 years older). No info on funding and conflicts

Mercer 2004

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Leeds, Yorkshire, UK **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** 37 days postoperatively
Participants	81 participants undergoing elective repair of infrarenal abdominal aortic aneurysm were randomised to one of two groups: **Intraoperative autotransfusion (IAT)** (Cell salvage/intervention group): N = 40. M:F 34:6. Median (interquartile range) age 72 (69 to 76) **Homologous blood transfusion (HBT)** (Control/no cell salvage group): N = 41; M:F 29:2. Median (interquartile range) age 73 (67 to 78) Patient demographics, risk factors, and median aneurysm size were similar for the two groups.
Interventions	**Intraoperative autotransfusion (IAT)**: autotransfusion group (Haemonetics Cell Saver) had their shed blood collected and processed by the autologous blood recovery system. Processed blood was returned to the patient as soon as haemostasis had been achieved. **Homologous blood transfusion (HBT)**: control group received standard care without autotransfusion.

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Mercer 2004 *(Continued)*

Outcomes	**Outcomes reported:** number of participants transfused allogeneic blood, amount of allogeneic blood transfused, blood loss, adverse events, mortality, hospital length of stay
Notes	**Transfusion protocol:** participants received allogeneic blood transfusion to maintain haemoglobin levels above 8.0 g/dL. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study protocol was approved by the local ethics committee. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	The participants were randomised, using sealed envelopes (no mention of opaqueness)
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: participants in both groups received blood products to maintain a haemoglobin concentration of 8 g/dL during and after surgery. Postoperative transfusion was used only after discussion with the consultant vascular surgeon, to prevent blood transfusion outside the protocol.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	Participants were blinded to the transfusion group allocation. Members of the operating surgical team were responsible for the continuing care of participants, decision to use blood transfusion, and investigation of postoperative complications. They were independent of the research team, but were not blinded to the use of IAT.
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	Participants were blinded to the use of intraoperative autologous transfusion. However, the operating surgical team, responsible for the continuing care of the participants, were not blinded to treatment allocation.
Incomplete outcome data (attrition bias) All outcomes	Low risk	All participants randomised are accounted for in the reported outcomes
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare

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Mercer 2004 *(Continued)*

Other bias	Unclear risk	No baseline imbalance (participant demographics, distribution of risk factors, and median aneurysm size were similar for the two groups (Table 1).) No info on funding and conflicts

Moonen 2007

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** district hospital in Sittard, the Netherlands **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** duration of hospital stay
Participants	160 patients undergoing elective total knee arthroplasty (TKA) or total hip arthroplasty (THA) were randomly allocated to one of two groups: **Reinfusion/study group** (Cell salvage/intervention group): N = 80. M:F 10:70. Mean (SD) age 69.0 (9.5). Mean (SD) BMI 28.9 (4.8) kg/m^2 **Control group**: N = 80. M:F 13:67. Mean (SD) age 69.5 (7.3). Mean (SD) BMI 27.7 (4.6) kg/m^2 The groups were similar with regard to demographic data, other than type of surgery. There was a marked increased number of THA in the study group and a marked increased number of TKA in the control group.
Interventions	**Reinfusion/study group** (Cell salvage/intervention group): cell salvage group (Bellovac ABT, AstraTech AB) had two Redon lines connected to the Bellovac retransfusion system. This system consists of a collection suction bellow (-90 mmHg), vacuumed for 6 hours after surgery, and an autologous transfusion bag with a 200 µm filter to entrap blood clots and debris. Before re-transfusion, the blood was let through a 40 µm filter. Reinfusion of shed blood was started 6 hours after the end of surgery when the collected blood exceeded 100 mL or when the transfusion bag was full (500 mL). After 6 hours postoperatively, the system was used as a regular low-vacuum drain in which drained blood was discarded. **Control group**: control group received regular postoperative low-vacuum drainage (Abdovac, AstraTech, AB) without autotransfusion.
Outcomes	**Outcomes reported:** number of participants transfused allogeneic blood, amount of allogeneic blood transfused, volume of blood re-transfused, adverse events
Notes	**Transfusion protocol:** after surgery, the anaesthesiologist determined the Hb transfusion trigger, that is, 8.1, 8.9, or 9.7 g/dL, depending on comorbidity classified in the ASA (American Society of Anesthesiologists) classification and according to hospital policy. When the Hb level dropped below this trigger, an allogeneic blood transfusion was given. **Prospective registration status:** the trial was published prior to 2010. **Ethical approval:** the study was approved by the hospital's ethical committee. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported
Risk of bias	

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Moonen 2007 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate randomisation sequences is not clear: "Treatment allocation schedule was randomly generated and then concealed in sealed envelopes that were labeled with a consecutive case number from 1 to 160. Blocking and stratification were not used."
Allocation concealment (selection bias)	Unclear risk	Quote: "Treatment allocation schedule was randomly generated and then concealed in sealed envelopes that were labeled with a consecutive case number from 1 to 160. Blocking and stratification were not used." No info on whether envelopes were opaque
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	There was a transfusion protocol but it was dependent on anaesthetist's perception of risk. Quote: "After surgery the anesthesiologist determined the transfusion trigger.[according to a table of ASA and comorbidities]. When Hb level dropped below this trigger, an allogeneic blood transfusion was given."
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	The blinding status of participants and personnel was not described; unclear what impact this would have on outcomes
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	The blinding status of participants and personnel was not described; unclear what impact this would have on outcomes
Incomplete outcome data (attrition bias) All outcomes	Low risk	All participants randomised are accounted for in the reported intention-to-treat analysis
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	Baseline imbalance in type of surgery. No info on funding or conflicts

Munteanu 2009

Study characteristics	
Methods	**Design:** RCT, parallel five-arm, single-centre study **Setting:** speciality orthopaedic hospital, Bucharest, Romania **Recruitment:** recruitment and study dates not reported

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Munteanu 2009 *(Continued)*

	Maximum follow-up: perioperative
Participants	250 participants undergoing elective unilateral knee arthroplasty were randomised across the following five groups: **Group 1 (Control/no cell salvage group):** N = 50. M:F 10:40. Mean (SD) age 64 (8). Median (IQR) weight 71 (67 to 80) kg **Group 2** (Preoperative programmed autotransfusion (PPA)): N = 50. M:F 10:40. Mean (SD) age 61(9). Median (IQR) weight 78 (75 to 83) kg **Group 3 (ConstaVac group) (Cell salvage/intervention group):** N = 50. M:F 11:39. Mean (SD) age 66 (7). Median (IQR) weight 67 (56 to 70) **Group 4** (PPA + normovolaemic haemodilution): N = 50. M:F 12:38. Mean (SD) age 63 (11). Median (IQR) weight 80 (75 to 83) kg **Group 5** (PPA + ConstaVac): N = 50. M:F 9:41. Mean (SD) age 68 (10). Median (IQR) weight 75 (73 to 80) kg No major differences between groups were reported at baseline.
Interventions	**Group 1 (Control/no cell salvage group):** no autotransfusion. Allogeneic blood only **Group 2** (Preoperative programmed autotransfusion (PPA)): blood donated preoperatively (7 to 12 days prior) and given later **Group 3 (ConstaVac group) (Cell salvage/intervention group):** blood collected from drain postoperatively autotransfused back to participant in postoperative period **Group 4** (PPA + normovolaemic haemodilution): preoperative programmed autotransfusion and normovolaemic haemodilution carried out prior to surgery **Group 5** (PPA + ConstaVac): ConstaVac autotransfusion postoperatively plus preoperative programmed autotransfusion Allogeneic blood given to all groups if required.
Outcomes	**Outcomes reported:** allogeneic blood requirement, postoperative complications, blood loss, length of stay
Notes	**Transfusion protocol:** "The optimal level of Hb/Hct maintained during the perioperative period was 24% for those without associated pathology and 27% for those with compensated chronic coronary or respiratory pathology, or 30% in case of angina attacks, ST changes, hemodynamic instability, dyspnea." **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board. **Language of publication:** Romanian **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Methods not clear

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Munteanu 2009 *(Continued)*

Allocation concealment (selection bias)	Unclear risk	Methods not clear
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Unclear risk	Transfusion protocol in place; however, it mentions targets rather than absolute thresholds (though possibly lost in translation: "The optimal level of Hb/Hct maintained during the perioperative period was 24% for those without associated pathology and 27% for those with compensated chronic coronary or respiratory pathology, or 30% in case of angina attacks, ST changes, haemodynamic instability, dyspnoea").
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	Diagnostic criteria not given for some outcomes; no mention of blinding, possibly lost in translation
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Diagnostic criteria not given for some outcomes; no mention of blinding, possibly lost in translation
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Poorly reported, presumed 0 dropouts
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No statement on funding or conflicts of interest. However, baseline characteristics were balanced.

Murphy 2005

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Bristol, Avon, UK **Recruitment:** 16-month period. Specific recruitment and study dates are not reported. **Maximum follow-up:** duration of hospital stay
Participants	61 participants undergoing cardiac surgery were randomly allocated to one of two groups: **Autotransfusion group** (Cell salvage/intervention group): N = 30. M:F 25:5. Mean (SD) age 62.3 (9.3)

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Murphy 2005 *(Continued)*

	Control group: N = 31. M:F 23:8. Mean (SD) age 66.4 (7.6) The groups were balanced before surgery with regard to demographics and comorbidities, apart from a higher frequency of unstable angina symptoms in the auto-transfusion group.
Interventions	**Autotransfusion group**: cell salvage group (Dideco Compact autotransfusion system) underwent intraoperative cell salvage with autotransfusion of washed salvaged red blood cells at the completion of the operative procedure. All blood lost, from skin incision to skin closure, was salvaged via a single-lumen suction tube flushed with heparinised saline and connected to the closed rigid collection chamber of the Dideco Compact autotransfusion device at high-pressure suction. Before autotransfusion, the heparinised salvaged intraoperative blood underwent a washing process, with re-suspension of the red blood cells in saline, to an Hct of approximately 0.6. This red blood cell suspension was then transferred to a sterile collecting bag that was disconnected from the autotransfuser and administered via a standard blood giving set. Salvaged washed red blood cells were autotransfused at the time of skin closure. **Control group**: control group received standard care without autotransfusion.
Outcomes	**Outcomes reported:** number of participants transfused allogeneic blood, volume of blood collected by the cell saver, volume of blood re-transfused from the cell saver, number of participants transfused fresh frozen plasma (FFP), number of participants transfused platelets, blood loss, mortality, adverse events
Notes	**Transfusion protocol:** the threshold for transfusion of allogeneic blood was a haemoglobin level < 8.0 g/dL or a haematocrit < 0.23. In participants with excessive blood loss and cardiovascular instability, blood was given at the discretion of anaesthetic or intensive care unit staff. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study received local ethics committee approval. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Method used to generate allocation sequences was adequate: participants were assigned to 1 of 2 randomised groups, autotransfusion or control, in a 1:1 ratio by using block randomisation. Allocations were generated by a card system and concealed in sealed opaque envelopes.
Allocation concealment (selection bias)	Low risk	Method used to conceal treatment allocation was adequate: participants were assigned to 1 of 2 randomised groups, autotransfusion or control, in a 1:1 ratio by using block randomisation. Allocations were generated by a card system and concealed in sealed opaque envelopes.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias)	Low risk	Transfusion protocol in place: the threshold for transfusion of homologous blood was haemoglobin < 8 g/dL or haematocrit < 0.23.

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Murphy 2005 *(Continued)*

Subjective: transfusion protocol		
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	No blinding, assignment preoperatively, may have impacted on some care
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding, may impact some outcomes, especially LOS
Incomplete outcome data (attrition bias) All outcomes	Low risk	All participants randomised are accounted for in the reported outcomes, appears to be ITT
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	Some baseline imbalance that may impact cardiovascular outcome measures (the 2 groups were balanced before surgery with respect to demographics and comorbidity, apart from a higher frequency of unstable angina symptoms in the autotransfusion group). No info on funding or conflicts

NCT00839241

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** specialist hospital, Szczecin, Poland **Recruitment:** January 2009 to June 2009 (study dates) **Maximum follow-up:** not reported
Participants	45 participants undergoing total knee replacement were randomly allocated to one of two groups: **Autologous blood transfusion group** (Cell salvage/intervention group): N = 20. M:F 7:13. Mean (SD) age 67.1 (10.3) **Allogeneic blood transfusion group** (Control/no cell salvage group): N = 25. M:F 5:20. Mean (SD) age 66.6 (8.3) No formal between-group comparison of baseline data is available. **Inclusion criteria:** provision of informed consent; aged 18 years and over scheduled for total knee replacement; classified as ASA Physical Status Classification System class P1, P2, or P3, according to the American Society of Anaesthesiology **Exclusion criteria:** involvement in the planning and conduct of the study (applies to both Astra Tech staff or staff at the study site); preoperative haemoglobin below normal range as judged by the investigator; previous enrolment or randomisation to treatment in the present study; expected or confirmed

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NCT00839241 *(Continued)*

	participation in another clinical study during the study period; severe non-compliance to protocol as judged by the investigator and/or Astra Tech; current symptoms of haemophilia; history of or presence of malignant disease with propensity for systemic spread during the last 5 years; current or expected use of cytotoxic drugs; current untreated anaemia (e.g. sickle cell anaemia) as deemed by investigator; use of pre-donation; use of recombinant erythropoietin; use of other autologous blood transfusion than that with Bellovac ABT, e.g. washed and centrifuged blood like CellSaver
Interventions	**Autologous blood transfusion group** (Cell salvage/intervention group): Bellovac Autologous Blood Transfusion (ABT) drain **Allogeneic blood transfusion group** (Control/no cell salvage group): Allogeneic blood transfusion
Outcomes	**Outcomes reported:** no relevant outcomes reported in trial registration
Notes	Data are available in the trial registration only. No peer review has taken place. Sponsor: Wellspect HealthCare Study director: Magnus Jacobsson, MD, PhD, Prof.; Dentsply Sirona Implants Study start date: January 2009 Actual primary completion date: June 2009 Other Study ID Numbers: YA-ABT-0004 **Transfusion protocol:** use of a transfusion protocol is not described. **Prospective registration status:** the study was retrospectively registered on ClinicalTrials.gov (1 month following study commencement). **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board. **Language of publication:** information on the ClinicalTrials.gov trial registry is available in English **Trial funding:** Wellspect Healthcare **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Trial registration only - no detail available
Allocation concealment (selection bias)	Unclear risk	Trial registration only - no detail available
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Trial registration only - no detail available. No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Unclear risk	Trial registration only - no detail available; states the study is open-label (unblinded)

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NCT00839241 *(Continued)*

Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	Trial registration only - no detail available; states the study is open-label (unblinded)
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Trial registration only - no detail available. No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Trial registration only - no detail available; states the study is open-label (unblinded)
Incomplete outcome data (attrition bias) All outcomes	Low risk	Participant flow reported in results, significant and unbalanced "incompletes" (15/20 completed in intervention group, 8/25 completed in control group). However, analysed as ITT (all randomised were analysed)
Selective reporting (reporting bias)	Low risk	Full audit trail of trial registration is available. All outcomes reported
Other bias	Unclear risk	Principal Investigators are NOT employed by the organisation sponsoring the study. Possible conflicts: there IS an agreement between Principal Investigators and the Sponsor (or its agents) that restricts the PIs' rights to discuss or publish trial results after the trial is completed - likely the reason data are only available from trial registration.

NCT01251042

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Copehagen, Denmark **Recruitment:** October 2010 to December 2011 (study dates) **Maximum follow-up:** 7 days postoperatively
Participants	51 participants undergoing spinal surgery with expected blood loss of 800 mL to 1500 mL were enroled in the study and 49 were randomised to one of the following two groups: **Sangvia and retransfusion** (Cell salvage/intervention group): N = 26. Mean (SD) age 53 (14). M:F 8:18 **Sangvia and no retransfusion** (Control/no cell salvage group): N = 23. Mean (SD) age 59 (13). M:F 8:15 No further demographic data available and a between-group analysis has not been performed.
Interventions	**Sangvia and retransfusion** (Cell salvage/intervention group): the autologous group used the Sangvia blood salvage system (Sangvia, AstraTech, Molndal, Sweden) intraoperatively and had salvaged blood re-transfused. The re-transfused blood was filtered but unwashed. The volume of autologous blood transfusion was approximately 500 mL. **Sangvia and no retransfusion** (Control/no cell salvage group): the control group used the Sangvia blood salvage system intraoperatively but had salvaged blood discarded.

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NCT01251042 *(Continued)*

Outcomes	**Outcomes reported:** mean blood loss volume (after surgery), frequency of allogeneic blood transfusion (until 96 hours after surgery), adverse events
Notes	The citation corresponds to unpublished data available on ClinicalTrials.gov (NCT01251042) **Transfusion protocol:** use of a transfusion protocol is not reported **Prospective registration status:** the study was retrospectively registered on ClinicalTrials.gov (2 months following study commencement). **Ethical approval:** there is no information available confirming approval by a research ethics committee or institutional review board. **Language of publication:** the study information is available in English **Trial funding:** Wellspect Healthcare **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Details of the randomisation methodology are not provided.
Allocation concealment (selection bias)	Unclear risk	Details of the allocation concealment are not provided.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	No transfusion protocol reported
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	The study was an open-label study with no masking and undefined outcomes
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	The study was an open-label study with no masking and undefined outcomes
Incomplete outcome data (attrition bias) All outcomes	Low risk	Outcome data are available for all 49 participants randomised in the study. No loss to follow-up

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NCT01251042 *(Continued)*

Selective reporting (reporting bias)	Low risk	Full audit trail of trial registration is available. All outcomes reported
Other bias	Unclear risk	The data are unpublished data from the trials registry record of the study. No full-text publication is available for the study. Principal Investigators are NOT employed by the organisation sponsoring the study. Possible conflicts: there IS an agreement between Principal Investigators and the Sponsor (or its agents) that restricts the PIs' rights to discuss or publish trial results after the trial is completed - likely the reason it remains unpublished.

Nemani 2019

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** speciality hospital, New York, NY, USA **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** 3 months postoperatively
Participants	63 participants undergoing long posterior spinal fusion for deformity were randomised to one of two groups: **Group 1 (OrthoPAT)** (Cell salvage/intervention group): N = 30. Mean (SD) age 50.5 (17). M:F 5:25 **Group 2 (Constavac)** (Control/no cell salvage group): N = 33. Mean (SD) age 51.5 (17.6). M:F 10:23 There were no-between group differences at baseline.
Interventions	**Group 1 (OrthoPAT)** (Cell salvage/intervention group): the cell salvage group (autotransfusion group) received the OrthoPAT cell salvage and reinfusion system. The reinfusion drain was converted to a standard (Constavac) drain when the output was < 50 mL/4 hours. The drain was removed when output was < 50 mL/8 hours. **Group 2 (Constavac)** (Control/no cell salvage group):the standard drain (control) group received a standard subfascial closed suction drain (Constavac, Stryker). The drain was removed when output was < 50 mL/8 hours.
Outcomes	**Outcomes reported:** postoperative homologous blood transfusion volume, 24-hour drain output postoperatively, total drain output, transfusion-related reactions and complications
Notes	**Transfusion protocol:** participants received either homologous or autologous blood postoperatively when Hb < 8 g/dL or they had symptomatic anaemia, including sustained hypotension, (SBP < 90 mmHg for two consecutive measurements), sustained tachycardia (heart rate > 110 bpm for two consecutive measurements), dizziness, fatigue, orthostasis as assessed by attending anaesthesiologist or internist. **Prospective registration status:** the study was not prospectively registered with a trials registry. **Ethical approval:** the study was approved by the Institutional Review Board for Hospital for Special Surgery, New York, USA. **Language of publication:** English **Trial funding:** none reported

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Nemani 2019 *(Continued)*

Conflicts of interest: none reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation was performed by a circulating nurse opening the randomisation envelope. Allocation was performed by the Epidemiology and Biostatisitcs Core using randomisation software on a 1:1 basis preoperatively. Participants were assigned to a drain type depending on the order in which they were enroled based on the pre-determined randomisation order. A block randomisation scheme was used.
Allocation concealment (selection bias)	Low risk	Allocation was performed by the Epidemiology and Biostatisitcs Core located elsewhere and investigators were blinded to the block size of the block randomisation protocol used.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: participants received either homologous or autologous blood postoperatively when Hb < 8 g/dL or they had symptomatic anaemia, including sustained hypotension, (SBP < 90 mmHg for two consecutive measurements), sustained tachycardia (heart rate > 110 bpm for two consecutive measurements), dizziness, fatigue, orthostasis, as assessed by attending anaesthesiologist or internist.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	No mention of blinding, use of drains may have masked allocation. Many outcomes not clearly defined, so may be affected by lack of blinding
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	No mention of blinding, use of drains may have masked allocation. Many outcomes not clearly defined, so may be affected by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Low risk	Two participants were lost to follow-up in Group 1, which is unlikely to have had a significant impact on the effect demonstrated.
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare, and vague description of secondary outcome measures (additional data collected included various patient demographic and anthropomorphic variables, and other preoperative, intraoperative, and postoperative data.)
Other bias	Low risk	Funding and conflicts of interest reported. No identified baseline imbalance

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Newman 1997

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Bristol, Avon, UK **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** duration of hospital stay
Participants	70 consecutive participants undergoing unilateral total knee replacement were randomly allocated to one of two groups: **Reinfusion group** (Cell salvage/intervention group): N = 35 **Homologous transfusion group** (Control/no cell salvage group): N = 35 The mean age of participants enroled in study was 72 years. No further demographic data are reported.
Interventions	**Reinfusion group** (Cell salvage/intervention group): cell salvage group (Dideco 797 reinfusion system) had deep and superficial drains inserted before skin closure and connected to the Dideco 797 reinfusion system which maintains a constant suction of -25 mmHg. The drainage collected was mixed with citrate in a ratio of 12:1, filtered during collection and again during reinfusion through a 40 µm filter. No washing took place. Drainage was collected for 6 hours or until 500 mL had accumulated, at which point reinfusion of the unwashed salvaged blood took place. **Homologous transfusion group** (Control/no cell salvage group): control group had deep and superficial drains inserted before skin closure and connected to a standard Haemovac system which maintains a constant suction of -25 mmHg. Autotransfusion was not available to this group.
Outcomes	**Outcomes reported:** amount of blood re-transfused from cell saver, amount of allogenic blood transfused, number of participants transfused allogeneic blood, adverse events, hospital length of stay
Notes	**Transfusion protocol:** use of a transfusion protocol is not reported. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study was approved by an ethics committee. **Language of publication:** English **Trial funding:** none declared **Conflicts of interest:** Sorin biomedical institutional support declared

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Method used to generate allocation sequences was adequate: using random number tables
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)

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Newman 1997 *(Continued)*

Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	No transfusion protocol in place
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	The study was unblinded. The criteria for diagnosing infections were not defined.
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	The study was unblinded. The criteria for diagnosing infections were not defined.
Incomplete outcome data (attrition bias) All outcomes	Low risk	All participants randomised are accounted for in the reported outcomes, ITT analysis
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Low risk	Broadly similar at baseline. Funding declared

Niranjan 2006

Study characteristics	
Methods	**Design:** RCT, parallel four-arm, single-centre study **Setting:** university teaching hospital, London, UK **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** duration of hospital stay
Participants	80 participants undergoing first-time isolated CABG surgery were randomly allocated to one of four groups: **Group A('on-pump' with cell salvage blood transfusion (CSBT))** (cell salvage/intervention group): N = 20. M:F 16:4. Mean (SD) age 66.3 (7.3) **Group B('on-pump' without CSBT)** (control/no cell salvage group): N = 20. M:F 16:4. Mean (SD) age 66.1 (10.8) **Group C ('off-pump' with CSBT)** (cell salvage/intervention group): N = 20. M:F 15:5. Mean (SD) age 67.25 (11.2) **Group D('off-pump' without CSBT)** (control/no cell salvage group): N = 20. M:/F1:1. Mean (SD) age 67.9 (9.5)

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Niranjan 2006 *(Continued)*

	The groups were comparable with regard to demographic and preoperative variables at baseline assessment.
Interventions	**Group A ('on-pump' with cell salvage blood transfusion (CSBT))** (cell salvage/intervention group): cell salvage ('on-pump') group (Dideco Electa autotransfusion device) underwent intraoperative cell salvage with autotransfusion of washed salvaged red blood cells (RBCs) at the conclusion of the procedure. The cell saver was used to collect blood lost from skin incision to the commencement of cardiopulmonary bypass (CPB) and then again after the administration of protamine to skin closure. **Group B ('on-pump' without CSBT)** (control/no cell salvage group): control ('on-pump') group had all blood lost from skin incision to commencement of CPB and protamine reversal to skin closure aspirated into a waste sucker. **Group C ('off-pump' with CSBT)** (cell salvage/intervention group): cell salvage ('off-pump') group (Dideco Electa autotransfusion device) underwent intraoperative cell salvage with autotransfusion of washed salvaged RBCs at the conclusion of the procedure. The cell saver was used to collect blood lost from skin incision to skin closure. **Group D ('off-pump' without CSBT)** (control/no cell salvage group): control ('off-pump') group had all lost blood from skin incision to closure suctioned with a high-pressure sucker into a waste container. NB: prior to autotransfusion, the salvaged blood was washed and centrifuged with re-suspension of the RBCs in saline to a haematocrit of approximately 0.6. This blood was then transferred to a sterile collecting bag and re-transfused into the participant via a standard blood-giving set at the time of skin closure.
Outcomes	**Outcomes reported:** amount of allogeneic blood transfused, volume of blood collected by the cell saver, blood loss, mortality, hospital length of stay, adverse events
Notes	**Transfusion protocol:** allogeneic blood was only transfused if the haemoglobin concentration was < 8.0 g/dL. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the protocol of the study was approved by the Hospital Ethics Committee. **Language of publication:** English **Study groups:** for the purpose of the review, we have used data from the individual groups for our subgroup analyses. Groups A and B have contributed to the cardiac surgery on-bypass subgroup. Groups C and D have contributed to the cardiac surgery off-bypass subgroup. **Trial funding:** British Heart Foundation **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Method used to generate allocation sequences was adequate. Randomisation was achieved by mixing non-transparent envelopes containing cards marked with the code of each group.
Allocation concealment (selection bias)	Low risk	Sealed opaque envelopes were used to conceal treatment allocation
Blinding of participants and personnel (performance bias)	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding

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Niranjan 2006 *(Continued)*

Objective outcome: mortality		
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: homologous blood was only transfused if the haemoglobin concentration was < 8 g/dL.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	The blinding status of participants and personnel was not described, no info defining outcomes
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	The blinding status of participants and personnel was not described, no info defining outcomes
Incomplete outcome data (attrition bias) All outcomes	Low risk	All participants randomised are accounted for in the reported outcomes, appears to be ITT
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Low risk	No baseline imbalance. Funding reported

Page 1989

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** regional cardiothoracic hospital, Liverpool, Merseyside, UK **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** duration of hospital stay
Participants	100 consecutive participants undergoing elective coronary artery or valvular operations were randomly allocated to one of two groups: **Group 2 (reinfusion of shed mediastinal blood**) (Cell salvage/intervention group): N = 48. M:F 38:11. Mean (SD) age 58.3 (8.9) **Group 1 (conventional mediastinal drainage)** (Control/no cell salvage group): N = 51. M:F 38:14. Mean (SD) age 56.9 (9.4) There were no differences between groups at baseline.
Interventions	**Group 2 (reinfusion of shed mediastinal blood**) (Cell salvage/intervention group): autotransfusion group had a Bentley Catr hard-shell cardiotomy reservoir (Bentley-Edwards CVS Division) used during

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Page 1989 (Continued)

	bypass. Both drains were connected to the top of the cardiotomy reservoir, previously used during bypass, and suction of 50 cm H_2O was applied. Patients had their shed mediastinal blood reinfused for up to 18 hours postoperatively. **Group 1 (conventional mediastinal drainage)** (Control/no cell salvage group): control group had a Polystan soft-shell cardiotomy reservoir (Polystan A/S Walgerholm 8) used during bypass. Blood was drained into conventional drainage bottles with an applied suction of 25 cm H_2O. NB: after bypass, any residual blood left in the perfusion circuit was saved and infused through a peripheral vein. Both groups of patients had pericardial and mediastinal drains (Axiom). A variety of both membrane and bubble oxygenators were used in both groups.
Outcomes	**Outcomes reported:** amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of participants transfused allogeneic blood, adverse events, re-exploration for bleeding
Notes	**Transfusion protocol*:*** allogeneic blood or hetastarch was infused to maintain cardiovascular stability and a haematocrit of 30%. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest**: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: "Homologous blood or hetastarch was infused to maintain cardiovascular stability and a hematocrit of 30%"
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	No blinding in the study and other outcome measures deemed high risk of subjectivity
Blinding of outcome assessment (detection bias)	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)

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Page 1989 *(Continued)*

Objective outcomes: mortality and transfusions		
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding in the study and other outcome measures deemed high risk of subjectivity
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	One participant was excluded from the study following a postoperative complication. 100 people at baseline, unclear N for analysis
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No baseline imbalance. Funding and conflicts not reported

Parrot 1991

Study characteristics	
Methods	**Design:** RCT, parallel three-arm, single-centre study **Setting:** university teaching hospital, Dijon, France **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** postoperative
Participants	66 participants undergoing aortocoronary bypass surgery were randomly assigned to one of three groups: **Group 1** (control group): N = 22. Mean age = 61 years **Group 2** (intraoperative cell salvage): N = 22. Mean age = 60 years **Group 3** (intraoperative and postoperative cell salvage): N = 22. Mean age = 55 years There were no differences between groups with respect to age, sex, body surface area, preoperative haematocrit, and bypass duration.
Interventions	**Group 1** (Control group): control group participants received homologous blood transfusion only. **Group 2** (intraoperative cell salvage): cell salvage group received intraoperative autologous blood. Intraoperative autologous blood consisted of the blood contents of the oxygenator after concentration but without any washing, by the Haemonetics Cell Saver III autologous transfusion system. **Group 3** (intraoperative and postoperative cell salvage): cell salvage group received intraoperative and postoperative autologous blood. Postoperative autologous blood consisted of the mediastinal blood shed during the first 6 hours, into a heparinised drainage system (PLEUR-EVACA 4005) which was concentrated and washed by a Haemonetics Haemolite system.
Outcomes	**Outcomes reported:** amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of participants transfused allogeneic blood, adverse events, mortality, blood loss, Hct levels
Notes	**Transfusion protocol:** allogeneic blood transfusions were given if the haematocrit dropped below 20% during bypass, 28% at the end of the procedure, 30% within 24 hours, or if the haemoglobin level was < 10.0 g/dL while on the cardiac surgery ward (8 to 10 days).

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Parrot 1991 *(Continued)*

Prospective registration status: the study was published prior to 2010.

Ethical approval: it is not clear whether the study was approved by an ethics committee or institutional review board.

Language of publication: English

Study groups: for the purpose of our review, specific groups have been used within our subgroup analyses for cell salvage timing. Group 2 versus Group 1 has been used within the intraoperative cell salvage subgroup. Group 3 versus Group 1 has been used within the intraoperative and postoperative cell salvage subgroup.

Trial funding: not reported

Conflicts of interest: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: "All patients received HB ('homologous blood') if their hematocrit dropped below 20% during bypass, 28% at the end of the procedure, 30% within 24 hours, or if their hemoglobin level was < 10 g/dL while on the cardiac surgery ward (8 to I0 days)".
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	No blinding, outcome methods deemed to be at high risk of subjectivity
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding, outcome methods deemed to be at high risk of subjectivity: criteria for diagnosis of infection and method for measuring blood loss not defined
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Only one person excluded (died). Reason for being excluded is death, should therefore have been kept in (mortality outcomes were not reported)
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare

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Parrot 1991 *(Continued)*

Other bias	Unclear risk	Some baseline imbalance (group 3 participants are younger, though authors say no statistical difference). No funding or conflicts reported

Pavelescu 2014

Study characteristics	
Methods	**Design:** RCT, parallel three-arm, single-centre study **Setting:** regional hospital, Bucharest, Romania **Recruitment:** 1 year study. Recruitment and study dates not reported **Maximum follow-up:** 24 hours postoperatively
Participants	78 participants undergoing total knee arthroplasty were randomised to one of three groups: **Group A** (No tranexamic acid and standard vacuum drainage group) **Group B,C** (Tranexamic acid group, no drain) (Control/no cell salvage group) **Group C** (Tranexamic acid and reinfusion system) (Cell salvage/intervention group) Age range for the study was 51 to 89 years.
Interventions	**Group A** (No tranexamic and standard vacuum drainage group): received a standard vacuum drain and no tranexamic acid **Group B,C** (Tranexamic acid group, no drain) (Control/no cell salvage group): received tranexamic acid, 10 mg/kg administered intravenously prior to tourniquet release **Group C** (Tranexamic acid and reinfusion system) (Cell salvage/intervention group): received tranexamic acid 10 mg/kg intravenously prior to tourniquet release and had a reinfusion system drainage sited at the end of surgery
Outcomes	**Outcomes reported:** mean allogeneic blood transfusion volume, number of participants requiring allogeneic blood transfusion, rate of thromboembolic events
Notes	**Transfusion protocol: b**lood transfusion was made at Hb < 9 g/dL or with symptomatic anaemia **Prospective registration status:** information on whether the trial was registered prospectively is not available. No contact information is available for the authors to clarify this. **Ethical approval:** it is unclear whether ethical approval was granted for the study. No contact information is available for the authors to clarify this. **Language of publication:** the abstract was written in English **Study groups:** for the purpose of our review, we have used Group C as our cell salvage/intervention group and Group B/C as our control group. By using Group B,C as a control group, we hope to neutralise any effect of tranexamic acid. **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**

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Pavelescu 2014 *(Continued)*

Random sequence generation (selection bias)	Unclear risk	Abstract only
Allocation concealment (selection bias)	Unclear risk	Abstract only
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Abstract only. No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Unclear risk	Transfusion protocol in place: blood transfusion was made at Hb < 9 g/dL or with symptomatic anaemia. Significant scope for between-participant variability. More information may be available in a full publication (abstract only)
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	Abstract only
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Abstract only. No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Abstract only
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Abstract only
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol, or full text, is available to compare
Other bias	Unclear risk	Abstract only, with no full-text publication available. Therefore, there is limited information available upon which to judge the methodological quality of the study.

Pleym 2005

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Trondheim, Norway **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** duration of hospital stay
Participants	50 participants scheduled for first-time CABG surgery were randomly allocated to one of two groups:

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Pleym 2005 *(Continued)*

	Autotransfusion (Cell salvage/intervention group): N = 23. M:F 21:2. Mean (SD) age 63.8 (9.9) **No autotransfusion** (Control/no cell salvage group): N = 24. M:F 21:3. Mean (SD) age 63.6 (7.9) Three participants were excluded from the final analysis (autologous group n = 2; control group n = 1). There were no differences between the groups at baseline.
Interventions	**Autotransfusion** (Cell salvage/intervention group): after termination of CPB, blood remaining in the CPB circuit was collected and transfused to the participant. Postoperatively, participants had one mediastinal and one pleural drain, each connected to cardiotomy reservoir. Cell salvage group had their shed mediastinal blood infused continuously by means of an autotransfusion pump (Flow-Gard 6200, Baxter OR Terumo TE-171, Terumo) until the postoperative bleeding was < 20 mL/hr for a maximum of 8 hours. **No autotransfusion** (Control/no cell salvage group): after termination of CPB, blood remaining in the CPB circuit was collected and transfused to the participant. Postoperatively, participants had one mediastinal and one pleural drain, each connected to cardiotomy reservoir. The control group did not receive autotransfusion of shed mediastinal blood.
Outcomes	**Outcomes reported:** number of participants transfused allogeneic blood, volume of blood re-transfused from the cell saver, amount of fresh frozen plasma and platelets transfused, blood loss, adverse events, mortality
Notes	**Transfusion protocol:** use of a transfusion protocol was not reported. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study was approved by the Regional Committee for Medical Research Ethics, Central Norway. **Language of publication:** English **Trial funding:** the Norwegian Health Association (Grant 6432), the Research Foundation at St. Olav University Hospital, the SINTEF UNIMED Research Foundation and Dainippon Pharmaceutical Co., Ltd. supplied part of the ELISA kits for the analysis of H-FABP. **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation was performed using a computer programme at a remote location but no further information on how sequences were generated is available
Allocation concealment (selection bias)	Unclear risk	There is insufficient information about group allocation procedures
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	No transfusion protocol in place

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Pleym 2005 *(Continued)*

Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	No blinding; criteria for some outcomes not fully defined
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding; criteria for some outcomes not fully defined
Incomplete outcome data (attrition bias) All outcomes	High risk	Not ITT, although low dropout (47 out of 50 completed). However, study excluded participants who sustained MI, which is an important outcome (two of the three participants excluded sustained a perioperative MI, one of whom subsequently died).
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	Funding reported (pharmaceutical) but no mention of involvement. No baseline imbalance

Reyes 2011

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Madrid, Spain **Recruitment:** February 2009 to June 2009 **Maximum follow-up:** 30 days postoperatively
Participants	63 participants undergoing cardiac surgery were randomised to one of two groups: **Cell salvage group:** N = 34. M:F 24:10. Mean (SD) age 65.5 (12.1) **Control group**: N = 29. M:F 18:11. Mean (SD) age 63.7 (12.7) Demographics of participants in both groups were similar at baseline. There was some minor baseline imbalance seen.
Interventions	**Cell salvage group:** the cell salvage group underwent cardiac surgery on a cardiopulmonary bypass machine with the use of a CATS cell saver (Fresenius Hemocare, France) throughout. At the end of surgery, all remaining blood in the circuit was recovered and concentrated by the cell saver and transfused to the participant via a 200 µm filter. Cardiotomy suction was applied when the participant was anaesthetised and this was reinfused continuously during CPB. **Control group:** the control group underwent cardiac surgery on a CPB machine. All blood in the surgical field was aspirated using cardiotomy suction. All blood aspirated prior to heparin administration and after protamine administration was discarded.

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Reyes 2011 *(Continued)*

Outcomes	**Outcomes reported:** amount of blood recovered by the cell saver, mortality, re-operation for bleeding, number of units of allogeneic blood transfused, number of participants that required blood transfusion, 6-hour postoperative bleeding, 24-hour postoperative bleeding, length of stay in ICU, length of stay (total), postoperative fever, postoperative need for antibiotics, platelets at discharge
Notes	**Transfusion protocol:** the study reported that a transfusion protocol was used in all participants during the surgical procedure and in the ICU; however, no details of the transfusion protocol are provided **Prospective registration status:** the study was not prospectively registered with a trials registry. **Ethical approval:** the study was approved by the local ethics committee for Hospital Universitario La Princesa, Madrid, Spain **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No information is provided on the method used for randomisation
Allocation concealment (selection bias)	Unclear risk	No information is provided on allocation concealment
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	Transfusion protocol in place; however, there is scope for between-participant variability and insufficient details given: "A transfusion protocol was used in all patients during the surgical procedure and in the intensive care unit (ICU)"
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	No mention of blinding in study; many outcomes undefined, with scope for variability and bias
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	No mention of blinding in study; many outcomes undefined, with scope for variability and bias
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No information on participant flow

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Reyes 2011 *(Continued)*

Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	Funding and conflicts not reported. Minor imbalance at baseline (history of stroke five times higher in control group)

Riou 1994

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Paris, France **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** 24 hours postoperatively
Participants	50 participants undergoing elective spinal surgery were randomly assigned to one of two groups: **Solcotrans group** (Cell salvage/intervention group): N = 25. M:F 7:18. Mean (SD) age 52 (16) **Control group**: N = 25. M:F 12:13. Mean (SD) age 52 (17) There were no differences between the groups at baseline.
Interventions	**Solcotrans group** (Cell salvage/intervention group): cell salvage group had their postoperatively drained blood collected into a Solcotrans Orthopedic Plus system. The salvaged blood was considered for reinfusion. No anticoagulation was added to the Solcotrans system. The duration of drainage was limited to the first 5 hours of the postoperative period. At the end of this period, participants from the Solcotrans group whose drained blood volume was > 200 mL had this blood reinfused. **Control group**: control group had their postoperatively drained blood collected into a Solcotrans Orthopedic Plus system but the salvaged blood was not considered for reinfusion.
Outcomes	**Outcomes reported:** amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of participants transfused allogeneic blood
Notes	**Transfusion protocol:** blood transfusion (allogeneic and/or autologous) was given if the haematocrit level was below 25% during the perioperative period. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study was approved by an ethics committee prior to commencement. **Language of publication:** English **Trial funding:** Solco Bask Ltd, Bucks, UK **Conflicts of interest:** not reported

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Low risk	Method used to generate allocation sequences was adequate. A random number table was used to assign participants in equal numbers to the two groups.

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Riou 1994 *(Continued)*

Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: blood transfusion (homologous and/or autologous) was decided if haematocrit was below 25% during the perioperative period
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Low risk	Anaesthesiologist was unaware of assignment
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	Anaesthesiologist was unaware of assignment
Incomplete outcome data (attrition bias) All outcomes	High risk	High number of dropouts from the study: 25 per group randomised; 21 and 16 analysed (unbalanced drop out and > 20%)
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Low risk	No baseline imbalance. Funding reported (non-pharmaceutical)

Rollo 1995

Study characteristics	
Methods	**Design:** RCT, parallel four-arm, single-centre study **Setting:** specialist orthopaedic hospital, Philadelphia, PA, USA **Recruitment:** June 1991 to February 1992 **Maximum follow-up:** 48 hours postoperatively
Participants	153 participants undergoing primary total hip arthroplasty were randomised to one of four groups: **Group 1(intraoperative and postoperative cell salvage (Haemonetics))** (Cell salvage/intervention group): N = 35. M:F 19:16. Mean (range) age 68 (50 to 86)

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Rollo 1995 *(Continued)*

	Group 2(postoperative cell salvage (Solcotrans)) (Cell salvage/intervention group): N = 40. M:F 24:16. Mean (range) age 68 (28 to 87) **Group 3(standard drain (Hemovac))** (Control/no cell salvage group): N = 38. M:F 20:20. Mean (range) age 64 (39 to 85 years) **Group 4 (no drainage system)**: N = 38. M:F 20:18. Mean (range) age 61 (38 to 86) There were no differences between the groups at baseline.
Interventions	**Group 1(intraoperative and postoperative cell salvage (Haemonetics))** (Cell salvage/intervention group): cell salvage group (Haemonetics system) had intraoperative salvage of red blood cells performed with the Haemonetics Cell Saver. A paediatric bowl was used for the processing of salvaged, shed blood. This collection was continued after surgery through two medium drains while the participant remained in the recovery room. A closed-suction standard Hemovac drain was placed when salvage was discontinued. **Group 2(postoperative cell salvage (Solcotrans))** (Cell salvage/intervention group): cell salvage group (Solcotrans system) were treated with a Solcotrans drainage infusion system at the completion of surgery. This system consists of a 500 mL collection canister with 260 µm pre-transfusion filter for collection and a 40 µm filter for transfusion. A minimum of 300 mL of blood had to be collected within a 4-hour period. Total collection/infusion time could not exceed 6 hours. A maximum of 2 units could be reinfused. After the completion of the transfusions, the Solcotrans unit was discarded and replaced with a closed-suction drain. **Group 3(standard drain (Hemovac))** (Control/no cell salvage group): control group (Hemovac drainage system) were treated with a standard 400 mL Hemovac closed-suction drain. **Group 4 (No drainage system)**: control group did not receive drains at the completion of surgery.
Outcomes	**Outcomes reported:** amount of allogeneic and/or autologous blood transfused, number of participants transfused allogeneic blood, adverse events, thigh circumference measures, wound drainage
Notes	**Transfusion protocol:** all decisions for allogeneic blood transfusion were based on the clinical condition of the participant. The absolute value of the haemoglobin or haematocrit was not considered in isolation. Participants who were able to donate at least 2 units of autologous blood preoperatively were included in the study. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board. **Language of publication:** English **Study groups:** for the purpose of our review, we have included the specific group comparisons within our subgroup analyses of cell salvage timing. Group 1 versus Group 3 has been included in the intraoperative and postoperative cell salvage subgroup. Group 2 versus Group 3 has been included in the postoperative cell salvage subgroup. **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Randomised by month of birth

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Rollo 1995 *(Continued)*

Allocation concealment (selection bias)	High risk	No concealment due to allocation by month of birth
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	No transfusion protocol in place
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	No mention of blinding; allocation not concealed (not properly randomised). No transfusion protocols or other definitions for other outcomes
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No mention of blinding; allocation not concealed (not properly randomised). No transfusion protocols or other definitions for other outcomes
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	All participants randomised are accounted for in the reported outcomes; appears to be ITT, though authors admit that not all measures taken in all participants.
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No obvious baseline imbalance. Funding and conflicts not reported

Rosencher 1994

Study characteristics	
Methods	**Design:** RCT, parallel three-arm, single-centre study **Setting:** district hospital, Paris, France **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** not reported
Participants	30 participants undergoing total knee arthroplasty were randomised to one of three groups: **Ortho-evac group** (Cell salvage/intervention group): N = 10. Mean (SD) age 68 (10) **Solcotrans group** (Cell salvage/intervention group): N = 10. Mean (SD) age 70 (10) **Control group**: N = 10. Mean (SD) age 68 (15)

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Rosencher 1994 *(Continued)*

	The three groups were comparable with regard to age, weight, and height.
Interventions	**Ortho-evac group** (Cell salvage/intervention group): cell salvage group (Ortho-evac system - not containing an anticoagulant) had their autotransfusion system connected to the deep suction drains in the operating room, after skin closure and before tourniquet removal. The salvaged blood was reinfused in the subsequent 6 hours via a 40 µm filter. The volume of collected blood was measured, and allogeneic blood was added as required, to maintain a haematocrit of 30%. The Ortho-evac system had a 1000 mL capacity. **Solcotrans group** (Cell salvage/intervention group): cell salvage group (Solcotrans system - not containing an anticoagulant) had their autotransfusion system connected to the deep suction drains in the operating room, after skin closure and before tourniquet removal. The salvaged blood was reinfused in the subsequent 6 hours via a 40 µm filter. The volume of collected blood was measured, and allogeneic blood was added as required, to maintain a haematocrit of 30%. The Solcotrans system had a 500 mL capacity. **Control group**: control group did not receive autotransfusion.
Outcomes	**Outcomes reported:** amount of blood collected by the cell saver, number of participants transfused allogeneic blood
Notes	**Transfusion protocol:** allogeneic blood was transfused to maintain a haematocrit of 30%. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study was approved by the ethics committee of the Cochin-Royal-Port faculty. **Language of publication:** French **Study groups:** for the purpose of our review, we have combined the Ortho-Evac and Solcotrans groups as the 'cell salvage/intervention' group and compared this to the study control group. **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was unclear.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	No transfusion protocol in place
Blinding of participants and personnel (performance bias)	Unclear risk	No information on blinding, no definitions/guidelines for outcomes

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Rosencher 1994 *(Continued)*

Subjective: all other outcomes		
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	No information on blinding, no definitions/guidelines for outcomes
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	30 participants randomised, unclear if all were analysed
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	Funding and conflicts not reported. Authors stated no baseline imbalance, but control group weighed more on average

Sait 1999

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, London, UK **Recruitment:** 2-year period. Recruitment and study dates not reported **Maximum follow-up:** not reported
Participants	120 participants undergoing total knee arthroplasty were randomised to one of two groups: **Group 1 (Standard drain group)** (Control/no cell salvage group): N = 60 **Group 2 (Blood conservation system)** (Cell salvage/intervention group): N = 60 Demographic data were not reported.
Interventions	**Group 1 (Standard drain group)** (Control/no cell salvage group): control group received standard care without the use of autotransfusion. A tourniquet was used throughout the procedure until the dressing was applied. Two drains were inserted and retained for 24 hours postoperatively. **Group 2 (Blood conservation system)** (Cell salvage/intervention group): autotransfusion group had a tourniquet used throughout the procedure until the dressing was applied. Two drains were inserted and connected to a blood conservation system. In this system, the unfiltered blood could be transfused back to the patient.
Outcomes	**Outcomes reported:** number of participants transfused allogeneic blood
Notes	**Transfusion protocol:** the use of a transfusion protocol was not reported. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board.

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Sait 1999 *(Continued)*

Language of publication: English

Trial funding: not reported

Conflicts of interest: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Abstract only
Allocation concealment (selection bias)	Unclear risk	Abstract only
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Unclear risk	Abstract only
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	Abstract only
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Abstract only
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Abstract only
Selective reporting (reporting bias)	Unclear risk	No trial registration, protocol, or full text available - abstract only
Other bias	Unclear risk	Abstract only: authors state no baseline difference in Hb, no other info (conference abstract). Funding and conflicts not reported

Savvidou 2009

Study characteristics

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Savvidou 2009 *(Continued)*

Methods	**Design:** RCT, parallel two-arm, multicentre study **Setting:** 3 general hospitals in Greece **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** not reported
Participants	50 participants scheduled for posterior lumbar fusion were randomised to one of the following 2 groups: **Group A** (Perioperative cell salvage group) (Cell salvage/intervention group): N = 25. M:F 13:12. Mean (SD) age 55.8 (18.5) **Group B** (Control group): N = 25. M:F 12:13. Mean (SD) age 61 (13.5) There was no difference between groups in baseline variables.
Interventions	**Group A** (Cell salvage/intervention group): the cell saver group received perioperative cell salvage. Drained blood from the operative field was collected and washed with a crystalloid solution prior to re-infusion to the participant. The use of the cell saver did not preclude allogeneic transfusion when required. The volume of one unit of cell saved blood was 450 mL. **Group B** (Control group): the control group underwent standard perioperative care and received allogeneic blood transfusions as required, as per the transfusion protocol. The volume of an allogeneic blood transfusion was 350 mL.
Outcomes	**Outcomes reported:** total volume of blood transfused, total blood loss, cost of blood transfusion
Notes	**Transfusion protocol:** "The transfusion protocol was based on the haemoglobin, haematocrit and clinical signes [sic] of anaemia. Absolute indications for transfusion were haemoglobin < 7 g/dL, haematocrit < 21% and symptomatic anaemia." **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study was approved by the Institutional Review Board at Agia Olga Hospital, Athens, Greece. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	The process of random sequence generation is not described
Allocation concealment (selection bias)	Unclear risk	The method of allocation concealment is not described
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)

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Savvidou 2009 *(Continued)*

Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: "The transfusion protocol was based on the haemoglobin, haematocrit and clinical signes [sic] of anaemia. Absolute indications for transfusion were haemoglobin < 7 g/dL, haematocrit < 21% and symptomatic anaemia."
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	No mention of blinding in study, and some outcomes measures are not well-defined, leaving scope for variability when unblinded
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No mention of blinding in study, and some outcomes measures are not well-defined, leaving scope for variability when unblinded
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No mention of individuals identified who did not meet criteria or loss to follow-up
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No baseline imbalance. No mention of conflicts of interest or funding

Schaff 1978

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Baltimore, MD, USA **Recruitment:** January 1977 to April 1977 **Maximum follow-up:** not reported
Participants	114 participants undergoing cardiac surgery were randomised to one of two groups: **Autotransfusion system** (Cell salvage/intervention group): N = 63. M:F 41:22. Mean (SD) age 53.6 (10.3) **Control group**: N = 51. M:F 32:19. Mean (SD) age 53.4 (10.0) Demographic and procedural data were similar between the two groups. No formal statistical comparison was performed.
Interventions	**Autotransfusion system** (Cell salvage/intervention group): cell salvage group (Sorenson autotransfusion system) received shed mediastinal blood processed by the Sorenson autotransfusion system (ATS). Blood collected in the ATS bags was considered suitable for autotransfusion only if 400 mL or more was collected within 4 hours. If the rate of mediastinal bleeding was slow and 4 hours passed without 400 mL volume being collected, this blood was not reinfused. Shed mediastinal blood was given in preference to stored bank blood when volume replacement was necessary.

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Schaff 1978 *(Continued)*

	Control group: control group received only transfusions of stored bank blood. Autotransfusion was not performed.
Outcomes	**Outcomes reported:** amount of allogeneic blood transfused, total blood and blood component replacement, mediastinal blood loss, haematological variables, adverse events
Notes	**Transfusion protocol:** if Hct values were below 35% and left ventricular filling was judged to be adequate, whole blood and/or packed red blood cells were infused to restore intravascular volume. With higher haematocrit values and with low left ventricular filling pressures, participants received an infusion of colloid solution or crystalloid solution (Ringer's lactate). **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board. **Language of publication:** English **Trial funding:** Research Center Grant No. HL-01601 from the National Heart, Lung, and Blood Institute, The Hazel Dell Foundation and Sorenson Research Company. **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Method used to generate allocation sequences was inadequate: randomised by odd or even history numbers
Allocation concealment (selection bias)	High risk	Method used to conceal treatment allocation was inadequate: randomised by odd or even history numbers; could not be concealed
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: "If hematocrit values were below 35 percent and left ventricular filling was judged to be inadequate, whole blood and/or packed red blood cells were infused to restore intravascular volume". Swan-Ganz catheters were placed to measure pulmonary capillary wedge pressure (PCWP) and cardiac output (CO).
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	No mention of blinding and unclear definitions for multiple outcomes, subject to variability
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No mention of blinding and unclear definitions for multiple outcomes, subject to variability

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Schaff 1978 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Low risk	Appears to be ITT for postoperative blood loss and replacement
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Low risk	Funding reported (non-pharmaceutical). No obvious baseline imbalance

Schmidt 1996

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Copenhagen, Denmark **Recruitment:** November 1992 to October 1993 **Maximum follow-up:** not reported
Participants	120 adult participants undergoing primary elective coronary artery bypass grafting were randomly allocated to one of two groups: **Autotransfusion group** (Cell salvage/intervention group): N = 53. M:F 46:7. Mean (SD) age 58.5 (7.4). Mean (SD) weight 82.5 (10.2) kg **Control group:** N = 56. M:F 51:5. Mean (SD) age 57.5 (8.9). Mean (SD) weight 85.0 (12.7) kg There was no difference between the groups with regard to baseline demographic variables.
Interventions	**Autotransfusion group:** cell salvage group had the mediastinal and pleural tubes attached to the inlet port of the Bard cardiotomy/autotransfusion reservoir at the end of the operation. Blood collected in the CPB circuit at the conclusion of CPB was collected for later transfusion. Shed mediastinal blood from the cardiotomy reservoir was transfused every hour for the first 18 postoperative hours if > 20 mL of blood had accumulated. Prior to transfusion, the shed mediastinal blood was filtered through a 40 µm filter in the cardiotomy reservoir. **Control group:** control group had the cardiotomy reservoir used for mediastinal drainage only. Autotransfusion was not performed.
Outcomes	**Outcomes reported:** amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of participants transfused allogeneic blood, adverse events, sternal infections, myocardial infarction, sepsis, mortality, blood loss
Notes	**Transfusion protocol:** participants were transfused allogeneic blood if the haemoglobin concentration was < 5.0 mmol/L in the intensive care unit and < 5.5 mmol/L during the rest of the hospital stay. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study was approved by the regional ethics committee. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported
Risk of bias	

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Schmidt 1996 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation is unclear.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: Hb < 5 mmol/L in ICU, or Hb < 5.5 mmol/L in surgical ward
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Low risk	Randomisation in ICU (postoperatively), therefore no performance bias likely
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	The blinding status of outcome assessors was not described, and some outcome variables are not defined
Incomplete outcome data (attrition bias) All outcomes	High risk	Five participants with significant postoperative events were excluded from the study following randomisation. 120 randomised, 109 analysed. 11 reasons given for exclusion (only 3 were valid for technical failures)
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No baseline imbalance. No funding or conflicts reported

Schnurr 2018

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, multicentre study **Setting:** 3 hospitals in Germany (1 university teaching hospital, 2 general hospitals) **Recruitment:** April 2015 to June 2016 **Maximum follow-up:** 42 days postoperatively
Participants	200 participants undergoing total knee arthroplasty were randomised to one of two groups:

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Schnurr 2018 *(Continued)*

	Autologous blood transfusion drain (Cell salvage/intervention group): N = 100. M:F 24:76. Mean age 70. Mean BMI 31. **Redon drain group** (Control/no cell salvage group): N = 100. M:F 31:69. Mean age 70. Mean BMI 30. Demographic and preoperative variables were comparable between the two groups at baseline assessment.
Interventions	**Autologous blood transfusion drain** (Cell salvage/intervention group): the ABT group received an OrthoPAT (Haemonetics, Braintree, USA) re-transfusion drain, connected to the intra-articular drain for 6 hours postoperatively. At 6 hours, the transfusion system was replaced with a Redon drain without vacuum assistance. **Redon drain group** (Control/no cell salvage group): the Redon group received a Redon drain without vacuum assistance connected to the intra-articular drain. Drains in both groups were removed after 24 hours.
Outcomes	**Outcomes reported:** blood loss, number of participants exposed to allogeneic blood transfusion, volume of allogeneic blood transfused, complications
Notes	**Transfusion protocol:** autologous transfusion was initiated for the following reasons: • Collected blood volume > 100 mL and haemoglobin < 100 g/dL • Collected blood volume > 100 mL and clinical symptoms of anaemia The following transfusion triggers were used for allogeneic blood transfusions in both groups: • In patients with no history of coronary heart disease – haemoglobin < 10 g/dL and symptoms of anaemia or haemoglobin < 7 g/dL without symptoms. • In patients with a history of coronary heart disease – haemoglobin < 10 g/dL with symptoms of anaemia or haemoglobin < 9 g/dL without symptoms. When a transfusion was required, a single unit of blood (300 mL) was given and re-evaluation was performed 6 hours afterwards. **Prospective registration status:** the study was not prospectively registered with a trials registry **Ethical approval:** the study was approved by the Institutional Review Board for Ärztekammer Nordrhein, Düsseldorf, Germany (reference number 2014378) **Language of publication:** English **Trial funding:** none reported **Conflicts of interest:** none reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Participants were randomised to one of two groups using 200 pre-prepared sealed (shuffled) envelopes containing the group name. One of the sealed envelopes was selected by the anaesthetist
Allocation concealment (selection bias)	Unclear risk	Sealed envelopes were pre-prepared prior to randomisation process, no mention of opaqueness
Blinding of participants and personnel (performance bias)	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)

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Schnurr 2018 *(Continued)*

Objective outcome: mortality		
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: (A) Participants with no history of a coronary heart disease: 1. haemoglobin < 10 g/dL and symptoms of anaemia (nausea, vomiting, hypotension, tachycardia, cardiac symptoms); 2. haemoglobin < 7 g/dL with or without symptoms of anaemia. (B) Participants with a history of a coronary heart disease: 1. haemoglobin < 10 g/dL and symptoms of anaemia (nausea, vomiting, hypotension, tachycardia, cardiac symptoms); 2. haemoglobin < 9 g/dL with or without symptoms of anaemia. Where a transfusion was required, a single blood unit (300 mL) was given.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	No information is available regarding the blinding of outcome assessors
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	No information is available regarding the blinding of outcome assessors, but transfusion protocol and blood loss calculation thorough. Not sure how PJI and wound complications were determined
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No mention of individuals identified who did not meet criteria or loss to follow-up
Selective reporting (reporting bias)	High risk	No trial registration or published protocol is available to compare, but there is discrepancy between the described outcome measures in the methodology and those presented in the results.
Other bias	Low risk	No baseline imbalance, conflicts declared (none), funding declared (none)

Schönberger 1993

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, multicentre study **Setting:** 3 university teaching hospitals in the Netherlands **Recruitment:** January 1992 to April 1992 (intervention dates) **Maximum follow-up:** duration of hospital stay
Participants	40 participants undergoing elective primary unilateral internal mammary (IMA) artery bypass grafting were randomly assigned to one of two groups: **Group 1 (Autotransfusion (AT) group)** (Cell salvage/intervention group): N = 20. M:F 15:5. Mean (SD) age 64 (10.7) **Group 2 (Control group)**: N = 20. M:F 15:5. Mean (SD) age 63 (6.3) Demographic and preoperative variables were similar across the two groups at baseline.

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Schönberger 1993 *(Continued)*

Interventions	**Group 1 (Autotransfusion (AT) group)** (Cell salvage/intervention group): cell salvage group underwent internal mammary artery (IMA) surgery with pre-bypass removal of autologous blood, reinfusion of the remaining volume in the extracorporeal circuit (ECC) after aortic decannulation, administration of 200 mL aprotinin containing 280 mg of aprotinin (2 million kallikrein inactivator units) added to the pump prime, acceptance of normovolaemic anaemia (Hct > or equal to 25%) and autotransfusion of the shed blood postoperatively. After insertion of the drainage tubes, postoperative shed blood was collected in cardiotomy reservoir. Blood was transferred from the cardiotomy reservoir to a bag via a filter prior to re-transfusion. **Group 2 (Control group)**: control group participants underwent IMA surgery under the same conditions as Group 1 with the exclusion of autotransfusion (AT). Autotransfusion refers specifically to the re-transfusion of 'shed blood', as per the description in the abstract
Outcomes	**Outcomes reported:** amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of participants transfused allogeneic blood, adverse events, re-exploration for bleeding, blood loss
Notes	**Transfusion protocol:** allogeneic packed red cells were transfused when the postoperative Hct fell below 25%. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study was approved by the medical-ethical committee of the host institution. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: packed cells were administered when the postoperative haematocrit fell below 25%.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Low risk	The blinding status of participants and personnel is unknown. But low risk of bias for remaining outcomes due to well-defined diagnosis/decision-making criteria
Blinding of outcome assessment (detection bias)	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding

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Schönberger 1993 *(Continued)*

Objective outcomes: mortality and transfusions		
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	The blinding status of participants and personnel is unknown. But low risk of bias for remaining outcomes due to well-defined diagnosis/decision-making criteria
Incomplete outcome data (attrition bias) All outcomes	Low risk	All were analysed (no exclusions)
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No baseline imbalance. Funding or conflicts not reported

Scrascia 2012

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Bari, Italy **Recruitment:** September 2009 to March 2010 **Maximum follow-up:** duration of hospital stay
Participants	34 participants undergoing first-time, elective CABG surgery on cardiopulmonary bypass (CPB) were randomised to one of two groups: **Cell salvage group** (Cell salvage/intervention group): N = 17. M:F 8:9. Mean (SD) age 71 (8). Mean (SD) BMI 27 (4) **Control group**: N = 17. M:F 13:4. Mean (SD) age 66 (10). Mean (SD) BMI 28 (4) Preoperative participant characteristics were similar between the two groups.
Interventions	**Cell salvage group** (Cell salvage/intervention group): in the cell salvage group, a cell saving system was used to collect residual blood within the CPB circuit at the end of the operation. The blood was salvaged using a double-lumen suction tube flushed with heparinised normal saline. The device used was the Haemonetics Cell Saver 5 (Haemonetics Corporation, Braintree, MA, USA). A 225 mL collection bowl was used. Salvage blood was washed and centrifuged prior to re-transfusion at the time of skin closure. Cardiotomy suction blood was returned to the venous reservoir without processing. **Control group**: the control group had no residual CPB blood re-transfused and all blood lost from skin incision to commencement of CPB and from protamine reversal to skin closure was discarded via a waste sucker. During CPB, blood was collected via cardiotomy suction into the venous reservoir without processing.
Outcomes	**Outcomes reported:** estimated blood loss, intraoperative blood transfusion, number of participants with intraoperative transfusion, postoperative blood transfusion, number of participants with postoperative transfusion, length of stay, atrial fibrillation, cardiovascular events, mortality
Notes	**Transfusion protocol:** use of a transfusion protocol was not reported. **Prospective registration status:** the study was not prospectively registered with a trials registry.

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Scrascia 2012 *(Continued)*

Ethical approval: the study was approved by the ethics committee of the Policlinico University Hospital of Bari, Italy.

Language of publication: English

Trial funding: none reported

Conflicts of interest: none reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation was performed using a computer generation randomisation sequence on the day before surgery.
Allocation concealment (selection bias)	Unclear risk	No mention of allocation concealment
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	No transfusion protocol
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	No mention of blinding. Other outcomes not well-defined, subject to possible bias
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No mention of blinding. Other outcomes not well-defined, subject to possible bias
Incomplete outcome data (attrition bias) All outcomes	Low risk	All participants randomised are accounted for within the outcomes
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	High risk	Conflicts (none) and funding (none) reported. Some baseline imbalance, though authors claim it was not statistically significant, despite it being a large difference that could impact outcomes (gender, and previous cardiovascular event)

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Shen 2016

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** regional hospital, Hangzhou, Zhejiang, China **Recruitment:** April 2013 to September 2014 **Maximum follow-up:** duration of hospital stay
Participants	110 participants scheduled for elective cardiac surgery on CPB were randomised to one of the following two groups: **Group CS** (Cell Salvage/intervention group): N = 55. 2 participants were excluded from the analysis due to equipment failure (N = 1) and death (N = 1). Total number analysed was therefore N = 53. M:F 27:23. Mean (SD) age 50.42 (15.43) **Group C** (Control/no cell salvage group): N = 55. 5 participants were excluded from the analysis due to cell salvage use (N = 4) or death (N = 1). Total number analysed was therefore N = 50. M:F 24:26. Mean age (SD) 52.53 (15.65) There were no differences between the groups at baseline assessment.
Interventions	**Group CS** (Cell Salvage/intervention group): cell salvage group had shed blood from the wound and mediastina collected in the cell saver reservoir (Haemonetics, USA). A 125 mL collection bowl was used. Residual CPB circuit blood was also collected in the reservoir at completion. Collected blood was filtered, centrifuged, washed and concentrated prior to re-transfusion. All collected and cell salvaged blood was returned to the patient prior to the end of surgery. **Group C** (Control/no cell salvage group): in the control group, shed blood from the wound and mediastina were aspirated and discarded. Residual CPB circuit blood was also discarded.
Outcomes	**Outcomes reported:** volume of intraoperative blood loss, volume of mediastinal tube drainage at 6 hours and 24 hours postoperatively, volume of perioperative blood transfusion (including volume of autologous blood), volume of allogeneic blood transfused, adverse postoperative events (excessive bleeding, re-operation, cardiovascular failure, severe arrhythmias, myocardial infarction, infection, renal failure, respiratory failure, epileptic syndrome, cognitive decline, death)
Notes	**Transfusion protocol:** "Allogeneic RBC were transfused if Hb < 8 g/dL in Group C (Control group). In Group CS (Autotransfusion group), allogeneic RBC transfusion was used only if Hb was < 8 g/dL after all autologous blood was transfused." **Prospective registration status:** the study was prospectively registered with a trials registry (ChiCTR-TRC-13003268). **Ethical approval:** the study was approved by the Ethics Committee of the Zhejiang Provincial People's Hospital (Approval document ID: 2013KY035). **Language of publication:** English **Trial funding:** Natural Science Foundation of Zhejiang Province **Conflicts of interest:** none reported

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Randomisation list used. No further details available

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Shen 2016 *(Continued)*

Allocation concealment (selection bias)	Unclear risk	Randomisation was performed using an open randomisation schedule (randomisation list); unclear whether this meant the allocation schedule was visible in advance
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: allogeneic RBC were transfused if Hb < 8 g/dL in Group C (control group). In Group CS (autotransfusion group), allogeneic RBC transfusion was used only if Hb was < 8 g/dL after all autologous blood was transfused.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	No blinding of study personnel, which the authors acknowledge may have introduced bias to the study results
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding of study personnel, which the authors acknowledge may have introduced bias to the study results. Method for measuring blood loss clearly defined. Methods for measuring other outcome measures not defined.
Incomplete outcome data (attrition bias) All outcomes	Low risk	No loss to follow-up, all outcomes reported. CONSORT diagram
Selective reporting (reporting bias)	Low risk	A study protocol is available and reported outcomes are in line with those specified. However, an important outcome, mortality, was excluded from the study. Two participants died within 24 hours of surgery and were excluded from the analysis, though data could be extracted for these participants.
Other bias	Low risk	No baseline imbalance. Funding (non-pharmaceutical) and conflicts (none) were reported

Shenolikar 1997

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** regional hospital, Swansea, Wales, UK **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** 3 months postoperatively
Participants	100 consecutive participants undergoing total knee replacement were randomised to one of two groups:

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Shenolikar 1997 *(Continued)*

	Autologous group (Cell salvage/intervention group): N = 50. M:F 21:29. Mean (range) age males 70.4 (47 to 78 years). Mean (range) age females 69.3 (52 to 81) **Allogeneic group** (Control/no cell salvage): N = 50. M:F 24:26. Mean (range) age males 67.9 (51 to 82). Mean (range) age females 70.8 (46 to 88) Demographic variables were similar between the two groups at baseline; however, no formal statistical comparison was performed.
Interventions	**Autologous group** (Cell salvage/intervention group): cell salvage group participants had postoperative drainage blood processed by a Haemonetics Cell Saver 3. Blood was collected via the wound drains following the release of the tourniquet. The collected blood was anticoagulated with heparinised saline. The machine aspirated the wound drainage into the centrifuge bowl via roller pumps. The blood underwent accelerated sedimentation, being spun at 5600 revs/minute. The supernatant was discarded and the resulting red cells washed and re-suspended in normal saline. The machines produced a product with a haematocrit of over 55% and a volume of 250 mL. **Allogeneic group** (Control/no cell salvage): control group did not receive autotransfusion.
Outcomes	**Outcomes reported:** amount of blood collected by the cell saver, amount of allogeneic blood transfused, number of participants transfused allogeneic blood, adverse events, hospital length of stay
Notes	**Transfusion protocol:** allogeneic blood was given in the postoperative period when the haemoglobin fell below 9.0 g/dL. Routine procedure of crossmatching two units of packed cells was performed for all participants in the study. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study was approved by the local research ethics committee. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Method used to generate allocation sequences was adequate. A computer-generated randomisation schedule was used
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: when the postoperative haemoglobin of participants in the autologous group fell below the preset haemoglobin trigger (9 g/dL), they were rescued with an allogeneic blood transfusion
Blinding of participants and personnel (performance bias)	Unclear risk	The blinding status of participants and personnel was not described. No detail on how decisions were made for remaining outcomes

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Shenolikar 1997 *(Continued)*

Subjective: all other outcomes		
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	The blinding status of participants and personnel was not described. No detail on how decisions were made for remaining outcomes
Incomplete outcome data (attrition bias) All outcomes	Low risk	All participants randomised are accounted for in the reported outcomes. 100 randomised, 100 analysed
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No baseline imbalance. No mention of funding or conflicts

Shirvani 1991

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, London, UK **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** 7 days postoperatively
Participants	42 participants undergoing first-time coronary artery bypass graft surgery were randomly divided into one of two groups: **Group 1 (Control)**: N = 21 **Group 2 (Autotransfusion group)** (Cell salvage/intervention group): N = 21 Demographic data were not reported; however, the study states that the two groups were assessed at baseline for similarity and no differences were identified.
Interventions	**Group 1 (Control):** participants were transfused postoperatively with blood from volunteer donors. **Group 2 (Autotransfusion group)** (Cell salvage/intervention group): participants were autotransfused using an IMED 960 Volumetric Infusion Pump. Donor blood was also available if needed.
Outcomes	**Outcomes reported:** amount of allogeneic blood transfused, number of participants transfused allogeneic blood, adverse events, re-operation for bleeding, blood loss
Notes	**Transfusion protocol:** the indication for allogeneic blood transfusion was the maintenance of a haematocrit (Hct) level of 30% to 35%. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board.

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Shirvani 1991 *(Continued)*

Language of publication: English

Trial funding: not reported

Conflicts of interest: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: Hct of 30% to 35%
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	No mention of blinding; unclear risk for other outcomes due to no info/guidelines to minimise bias
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	No mention of blinding; unclear risk for other outcomes due to no info/guidelines to minimise bias
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	The total number of participants contributing to the outcome measures is not reported: 21 per group (42 total) randomised; unclear if this is the number analysed
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No baseline imbalance. No mention of funding or conflicts

Smith 2007

Study characteristics

Methods	**Design:** RCT, parallel two-arm, single-centre study

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Smith 2007 *(Continued)*

	Setting: district general hospital, Weston-super-Mare, Somerset, UK **Recruitment:** December 2003 to December 2005 **Maximum follow-up:** 8 weeks postoperatively
Participants	190 participants undergoing elective primary total hip replacement were randomised to one of two groups: **Group A (vacuum drain)** (Control/no cell salvage group): N = 82. M:F 40:42. Mean (range) age 75.5 (46 to 91). Mean (range) BMI 27 (17 to 36) kg/m^2 **Group B (postoperative salvage - ABTrans Autologous Retransfusion System)** (Cell salvage/intervention group): N = 76. M:F 36:40. Mean (range) age 73.5 (52 to 87). Mean (range) BMI 29 (17 to 51) kg/m^2 The two groups were comparable at baseline assessment. NB: from the 190 participants who agreed to participate, 158 sets of complete data were obtained. There were 22 incomplete haemoglobin (Hb) values and 10 participants did not fulfil the inclusion criteria.
Interventions	**Group A (vacuum drain)** (Control/no cell salvage group): control group received two standard Medinorm vacuum drains. The Medinorm vacuum drains were removed 48 hours after surgery. **Group B (postoperative salvage - ABTrans Autologous Retransfusion System)** (Cell salvage/intervention group): cell salvage group had wound drainage processed by the ABTrans autologous re-transfusion system. The autologous closed circuit system included two drains and a 125 µm filter through which the blood passes through before entering the 1200 mL reservoir. Autologous re-transfusion was given at 4-hourly intervals from opening of the drain or when 400 mL had collected in the reservoir. The maximum time between collection and completion of each transfusion was 6 hours. The system was used for 24 hours or up to a total of 1600 mL.
Outcomes	**Outcomes reported:** number of participants transfused allogeneic blood, amount of allogeneic blood transfused, volume of blood re-transfused from the cell saver, hospital length of stay, adverse events
Notes	**Transfusion protocol:** the individual orthopaedic team decided whether to give allogeneic blood transfusion. Local practice was to give 2 units if the postoperative Hb was < 8.0 g/dL or if participants were symptomatic with Hb in the range of 8.0 g/dL to 10.0 g/dL. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study was approved by the local research ethics committee. **Language of publication:** English **Trial funding:** commercial third party **Conflicts of interest:** benefits were received and directed solely to a research fund, foundation, educational institution, or other nonprofit organisation with which one or more of the authors are associated

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Method used to generate allocation sequences was adequate. The participants were block-randomised (computer-generated) to one of two groups from sealed envelopes opened by a nurse after reduction of the prosthesis
Allocation concealment (selection bias)	Unclear risk	The participants were block-randomised (computer-generated) to one of two groups from sealed envelopes opened by a nurse after reduction of the prosthesis (unclear if envelopes were opaque)

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Smith 2007 *(Continued)*

Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	No strict transfusion protocol in place: the individual orthopaedic team decided whether to give homologous blood transfusion. Local practice was to give two units if the postoperative Hb was < 8.0 g/dL or if participants were symptomatic with Hb in the range of 8.0 g/dL to 10.0 g/dL.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Low risk	Authors address potential performance bias from unblinding of group allocation via statistical method. No significant difference in outcome/of bias found: blinded until nurse opened envelop after reduction of prosthesis (so no impact on care)
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No blinding postoperatively, high for many outcomes due to no protocols for decision-making and diagnosis
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	190 enroled, only 158 (82 and 76) analysed; reasons for 32 exclusions given, but no breakdown by group (to see if this was balanced)
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Low risk	No baseline imbalance. Funding and conflicts declared

So-Osman 2006

Study characteristics	
Methods	**Design:** RCT, parallel three-arm, single-centre study **Setting:** university teaching hospital, Leiden, the Netherlands **Recruitment:** in 2003. Specific recruitment and study dates not reported **Maximum follow-up:** duration of hospital stay
Participants	70 participants undergoing primary or revision total hip replacement or total knee replacement were randomised to one of three groups: **Group A (control group)**: N = 22. M:F 7:15. Mean (SD) age 58 (14.3) **Group B (reinfusion system of continuous suction)** (Cell salvage/intervention group): N = 23. M:F 9:14. Mean (SD) age 66 (15.6) **Group C (reinfusion system of intermittent suction)** (Cell salvage/intervention group)): N = 24. M:F 10:14. Mean (SD) age 58 (17.2)

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So-Osman 2006 *(Continued)*

	Minor baseline imbalance existed between groups. Group A (control) was heavier than intervention Groups B and C. The authors also mention varying distributions in type of surgery (P = 0.06 with Group A being different to others); Group B had a higher mean age compared to Groups B and C. NB: of the 70 participants included in the study, one was not operated on, leaving 69 evaluable participants.
Interventions	**Group A (Control group)**: control group received standard closed suction wound drainage. **Group B (reinfusion system of continuous suction)** (Cell salvage/intervention group): autotransfusion group (I) had their drainage processed by the DONOR system. The re-infusion system uses continuous suction at a vacuum pressure of 120 mmHg and just prior to re-infusion a double-shielded 40 µm filter (Pall Lipiguard VS filter) entrapping lipids larger than 10 µm and 2 log of leukocytes. **Group C (reinfusion system of intermittent suction)** (cell salvage/intervention group): autotransfusion group (II) had their drainage processed by the Bellovac A.B.T. system. The re-infusion system uses intermittent suction pressure by a manually expandable bag at a maximum pressure of 90 mmHg and three filters, a 200 µm filter, a secondary 80 µm filter and, prior to re-infusion, a third 40 µm filter.
Outcomes	**Outcomes reported:** number of participants transfused allogeneic blood, amount of allogeneic blood transfused, volume of blood re-transfused from the cell saver, blood loss, hospital length of stay, adverse events
Notes	**Transfusion protocol:** during the study, a restrictive transfusion trigger according to the Dutch guidelines was used (CBO consensus guidelines, 2004). **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study was approved by the local medical ethical committee. **Language of publication:** English **Study groups:** for the purpose of analysis within our review, Groups B and C have been combined to form a single 'cell salvage/intervention group' that is compared to Group A. **Trial funding:** Van Straten Medical and Astra Tech supplied the re-infusion systems used in the study and financial support of the authors' in vitro studies. **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Method used to generate allocation sequences was adequate. A randomisation list was generated by a statistical software package. Sealed envelopes were made which contained the randomisation group
Allocation concealment (selection bias)	Unclear risk	A randomisation list was generated by a statistical software package. Sealed envelopes were made which contained the randomisation group. Preoperatively, participants were allocated to one of the groups by opening a sealed envelope (unclear if envelopes were opaque).
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)

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So-Osman 2006 *(Continued)*

Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: during the study, a restrictive transfusion trigger according to the Dutch guidelines was used (CBO consensus guidelines, 2004)
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	The blinding status of participants and personnel is unclear. There is a transfusion protocol in place, but other outcomes deemed at high risk of subjectivity
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	The blinding status of outcome assessors is not described. Outcome measures for infection are defined. There is differential measurement of blood loss between groups
Incomplete outcome data (attrition bias) All outcomes	Low risk	One participant was excluded after randomisation as they did not proceed with operative intervention: 70 randomised, 69 analysed; 1 exclusion explained
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	High risk	Minor baseline imbalance (Group A control heavier than intervention B and C); authors also mention distribution in type of surgery (P = 0.06, Group A different to others); Group B slightly older. Funding reported (pharmaceutical company provided equipment)

So-Osman 2014

Study characteristics	
Methods	**Design:** RCT, factorial design, multicentre study **Setting:** all hospitals participating in the study (1 university hospital and 3 medium-sized to large general hospitals) were located in the Netherlands **Recruitment:** May 2004 to October 2008 **Maximum follow-up:** 3 months postoperatively
Participants	2579 eligible participants were randomised; however, only 2442 participants were included in the study due to participant withdrawal (104 not operated/operated elsewhere, 23 withdrew consent, 9 still on waiting list at end of study, 1 minor surgery). A total of 683 participants were included in stratum I and 1759 participants included in stratum II. Erythropoietin = EPO; total hip replacement = THR; total knee replacement = TKR Stratum I **Group 1(Epo and autologous transfusion (AUTO + EPO))** (cell salvage/intervention group): N = 214. M:F 30:184. Mean (SD) age 70 (13). THR = 150. TKR = 64. Primary THR = 129. Primary TKR = 61.

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So-Osman 2014 *(Continued)*

Group 2(Epo only (EPO, no CS) (control/no cell salvage group): N = 125. M:F 12:113. Mean (SD) age 71 (12). THR = 64. TKR = 61. Primary THR = 56. Primary TKR = 56.

Group 3 (Autotransfusion only (AUTO only)) (cell salvage/intervention group): N = 206. M:F 29:177. Mean (SD) age 71 (12). THR = 136. TKR = 70. Primary THR = 120. Primary TKR = 64.

Group 4(No autotransfusion (no EPO, no CS)) (control/no cell salvage group): N = 138. M:F 16:122. Mean (SD) age 70 (11). THR = 77. TKR = 61. Primary THR = 67. Primary TKR = 60.

Stratum II

Group 1 (AUTO) (cell salvage/intervention group): intraoperative cell salvage and/or postoperative re-infusion drain (Autotransfusion group). N = 1061. M:F 367:694. Mean (SD) age 69 (10). THR = 695. TKR = 366. Primary THR = 643. Primary TKR = 344.

Group 2 (Control/No AUTO) (control/no cell salvage group): no autotransfusion (control group). N = 698. M:F 288:410. Mean (SD) age 68 (10). THR = 342. TKR = 356. Primary THR = 319. Primary TKR = 339.

There was no baseline imbalance between groups.

Interventions

Stratum I

Group 1(Epo and autologous transfusion (AUTO + EPO)) (cell salvage/intervention group): participants received EPO 40,000 U (Neorecormon or Eprex) for 3 weeks prior to the date of surgery. Epo was given in conjunction with ferrous fumarate 200 mg three times a day (TDS). The OrthoPAT Cell saver was used for both intra- and postoperative autotransfusion. Postoperative drain salvage for retransfusion was performed using either the Bellovac-BT (Astra-Tech, Zoetermeed, the Netherlands) or DONOR system (Van Straten Medical, Nieuwegein, the Netherlands). The DONOR system uses a continuous suction at a vacuum pressure of 150 mmHg and filters blood prior to re-transfusion. The Bellovac-ABT system uses intermittent suction pressure by a manually expandable bag at 90 mmHg and is sequentially filtered three times prior to re-transfusion. Participants undergoing total knee replacement only received postoperative drain salvage interventions as the operations were performed under tourniquet and so intraoperative blood loss was thought to be negligible and did not warrant cell salvage use.

Group 2(Epo only (EPO, noCS) (control/no cell salvage group): epo-only group received epo in concordance with the schedule described for Group 1.

Group 3 (Autotransfusion only (AUTO only)) (cell salvage/intervention group): autotransfusion-only group (autotransfusion group) received either intraoperative cell salvage or postoperative drain salvage in concordance with the devices described in Group 1.

Group 4(No autotransfusion (no EPO, no CS)) (control/no cell salvage group): the no autotransfusion group received neither autotransfusion or epo.

Stratum II

Group 1 (AUTO) (cell salvage/intervention group): the cell saver and postoperative drain reinfusion group (Autotransfusion group) received either intraoperative and postoperative cell salvage via the OrthoPAT cell saver (Haemonetics, Breda, the Netherlands) or postoperative drain reinfusion via the Belovac-ABT or DONOR reinfusion systems. Participants undergoing total knee replacement only received postoperative reinfusion drains as the procedure was performed under tourniquet and therefore intraoperative blood loss was deemed negligible and did not warrant use of intraoperative cell saver.

The OrthoPAT cell saver collected blood intraoperatively and up to 6 hours postoperatively in participants undergoing total hip replacement. The collected shed blood was washed, centrifuged, and concentrated to a haematocrit of 60% to 80% prior to retransfusion.

Group 2 (Control/No AUTO) (control/no cell salvage group): the no autologous transfusion group received standard care with no intra- or postoperative cell salvage or autotransfusion.

Outcomes

Primary outcomes: intra- and postoperative mean erythrocyte use, proportion of transfused participants up to 3 months after surgery

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So-Osman 2014 *(Continued)*

	Secondary outcomes: cost and cost-effectiveness at 3 months after surgery, serious adverse events up to 3 months after surgery (death, life-threatening events, prolonged hospitalisation, dislocation, wound infection, deep prosthetic infection, fractures, limitation in movement, thromboembolic events, cardiovascular events, allergy, infection, malignancy, and other)
Notes	**Transfusion protocol:** the Dutch national transfusion protocol was applied for the use of allogeneic erythrocyte transfusions. A single unit transfusion policy was used. Autologous blood was reinfused independent of haemoglobin value. **Prospective registration status:** the study was retrospectively registered with a trials registry (ISRCTN 96327523; Dutch Trials registry No. NTR305). Study start date was one year before registration. **Ethical approval:** the study was approved by the local ethics committees at each participating site. **Language of publication:** English **Study groups:** two strata have been combined into a single comparison of Autotransfusion (Stratum I: Group 1(AUTO+EPO) and Group 3(AUTO only); Stratum II: Group 1(AUTO)) versus no autotransfusion (Stratum 1: Group 2(EPO, no AUTO) and Group 4(no EPO, no AUTO); Stratum II: Group 2(Control/No AUTO)). **Trial funding:** Sanquin Blood Supply (PPOC-03-002), ZonMW (06-601), Roche and Haemonetics **Conflicts of interest:** none reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation took place in one run for all possible combinations using a computer-generated allocation table
Allocation concealment (selection bias)	Low risk	Randomisation and group allocation were performed prior to recruitment using a computer-generated randomisation sequence and the results placed into a sealed, opaque envelope opened after participant recruitment and informed consent.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: all participants were transfused according to a restrictive transfusion policy as advised in the Dutch transfusion guidelines.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	Clinical site staff, clinicians, research nurses, and participants were not blinded to treatment allocation, and a number of outcomes are lacking clear diagnostic/decision-making guidelines
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)

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So-Osman 2014 *(Continued)*

Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Study investigators were blinded to treatment allocation, but multiple outcome data were collected by unblinded clinicians
Incomplete outcome data (attrition bias) All outcomes	Low risk	Analyses performed as ITT
Selective reporting (reporting bias)	Low risk	A study protocol was published and the trial registered prior to participant recruitment. All outcomes specified in the study protocol are described in the paper.
Other bias	Low risk	No baseline imbalance. Funding (mixed pharmaceutical and non-pharmaceutical) and conflicts (none) reported. Authors state that the "sponsors of the study had no input in study design, data collection, data analysis, data interpretation, writing of the report, or the decision to submit the article for publication".

Spark 1997

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Leeds, Yorkshire, UK **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** duration of hospital stay
Participants	50 participants undergoing elective infrarenal abdominal aortic aneurysm surgery were randomised to one of two groups: **Autologous blood** (Cell salvage/intervention group): N = 23. M:F 19:4. Median (IQR) age 71 (54 to 78) **Homologous blood** (Control/no cell salvage group): N = 27. M:F 20:7. Median (IQR) age 68 (54 to 82) There was no imbalance between groups at baseline.
Interventions	**Autologous blood** (Cell salvage/intervention group): cell salvage group participants received autologous blood via intraoperative autotransfusion (IAT). A COBE Baylor rapid autologous transfusion system was employed for intraoperative cell salvage. Blood was retrieved from the operative site by suctioning into a double lumen catheter at < 150 mmHg, to minimise haemolysis. Blood was anticoagulated with heparin (30,000 units/1 litre 0.9% saline). The salvaged blood was then collected in a reservoir where a macrofilter of 150 µm removed larger particles of debris. When 500 mL of blood was collected, it was pumped to a spinning centrifuge bowl. The red cells were washed with 0.9% saline, and concentrated to an Hct above 50%. The effluent containing plasma fractions, platelets, leukocytes, free haemoglobin, anticoagulant, and saline was discarded. The washed red cells, suspended in saline, were pumped from the centrifuge to the patient through a microfilter of either 20 µm or 40 µm. **Homologous blood** (Control/no cell salvage group): control group did not receive autotransfusion.
Outcomes	**Outcomes reported:** amount of allogeneic blood transfused, number of participants transfused allogeneic blood, adverse events, hospital length of stay, blood loss, mortality
Notes	**Transfusion protocol:** participants were transfused allogeneic blood if the Hct fell below 25%. **Prospective registration status:** the study was published prior to 2010.

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Spark 1997 *(Continued)*

Ethical approval: the study protocol was approved by the local ethics committee.

Language of publication: English

Trial funding: Yorkshire Vascular and Surgical Research Fund

Conflicts of interest: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Using sealed envelopes (does not state whether they were opaque)
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	No transfusion protocol in place
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	No mention of blinding; multiple outcomes lack guidelines/diagnostic criteria needed to avoid bias
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No mention of blinding; multiple outcomes lack guidelines/diagnostic criteria needed to avoid bias
Incomplete outcome data (attrition bias) All outcomes	Low risk	ITT analysis
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Low risk	No baseline imbalance. Funding reported (non-pharmaceutical)

Springer 2016

Study characteristics

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Springer 2016 *(Continued)*

Methods	**Design:** RCT, parallel three-arm, single-centre study **Setting:** orthopaedic specialist centre, Charlotte, NC, USA **Recruitment:** May 2012 to October 2015 (study dates) **Maximum follow-up:** duration of hospital stay
Participants	Participants undergoing primary unilateral total hip arthroplasty (THA) or total knee arthroplasty (TKA) were randomised to one of three groups: **Reinfusion drain** (Cell salvage/intervention group): N = 60 **Hemovac drain** (Control/no cell salvage group): N = 61 **Tranexamic acid (TXA)**: N = 65 The average (range) age was 63.3 (33.1 to 81.8) years. No other demographic data are available.
Interventions	**Reinfusion drain** (Cell salvage/intervention group): the cell salvage group received a reinfusion drain postoperatively (OrthoPAT, Haemonetics, Braintree, USA). The reinfusion drain was used intra- and postoperatively for THA participants and postoperatively only for TKA participants as the procedure was performed under tourniquet and intraoperative blood loss would therefore be negligible. The drain was removed on postoperative day 1 at 06:00. The OrthoPAT drain collects, washes, and returns a highly concentrated volume of haematocrit to the patient for up to 12 hours postoperatively. Collected bags are re-infused within 6 hours of collection. **Hemovac drain** (Control/no cell salvage group): the drain group received a Hemovac suction drain. This was removed at 06:00 on postoperative day 1. **Tranexamic acid (TXA)*:*** TXA group received 20 mg/kg of tranexamic acid just prior to skin incision and a further dose 10 minutes prior to tourniquet release for TKA patients.
Outcomes	**Outcomes reported:** allogeneic blood transfusion, change in haemoglobin level (delta haemoglobin), autologous blood reinfusion, hospital costs
Notes	**Transfusion protocol:** standard and established transfusion guidelines were based on physiological need rather than a set haemoglobin level. Once hypovolaemia had been corrected, participants were transfused if there were ongoing clinical signs of anaemia. Symptomatic anaemic patients were transfused according to the physicians' discretion. **Prospective registration status:** the study was retrospectively registered with a trials registry (NCT01636414). The study start date was before registration. **Ethical approval:** it is unclear whether the study received approval from a Research Ethics Committee or Institutional Review Board. **Language of publication:** English **Study groups:** for the purpose of our review, we have used data from theReinfusion drain (cell salvage/intervention) group and Hemovac drain (control/no cell salvage) group. **Trial funding:** Novant Health, Charlotte Orthopedic Hospital, Carolinas Medical Center, Mercy Hospital **Conflicts of interest:** reported but inaccessible

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	A random number generator (random.org) was used to generate the stratified randomisation schedule.

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Springer 2016 *(Continued)*

Allocation concealment (selection bias)	Low risk	A 1:1:1 randomisation schedule was performed the day before surgery by the study co-ordinator and the surgeon and hospital staff were notified of the treatment allocation by email.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	Transfusion protocol in place for the study; however, there is scope for significant between-participant variability: "Standard and established transfusion guidelines were based on physiological need rather than a set haemoglobin level. Once hypovolaemia had been corrected, patients were transfused if there were ongoing clinical signs of anaemia. Symptomatic anaemic patients were transfused according to the physicians' discretion".
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	Study participants and personnel were not blinded to treatment allocation, though no information on other outcomes
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	The blinding of outcome assessors is not described and so a judgement cannot be made, though no information on other outcomes
Incomplete outcome data (attrition bias) All outcomes	Low risk	No loss to follow-up, all outcomes reported
Selective reporting (reporting bias)	Low risk	A study protocol is available and was registered prior to participant recruitment. All outcomes listed are described in the study.
Other bias	Unclear risk	Funding (non-pharmaceutical) and conflicts of interest (inaccessible online) declared. Unable to assess baseline imbalance as these data are not presented.

Teetzman 2014

Study characteristics	
Methods	**Design:** RCT, parallel two-group, single-centre study **Setting:** regional hospital in Norway **Recruitment:** December 2009 to December 2012 (study dates) **Maximum follow-up:** duration of hospital stay
Participants	164 participants undergoing elective hip surgery were randomised to one of two treatment groups:

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Teetzman 2014 *(Continued)*

	Group 1 (Autotransfusion of autologous blood) (cell salvage/intervention group): N = 74. Mean age 73 **Group 2 (Allo-transfusion group)** (control/no cell salvage group): N = 90. 87 participants were included in the final analysis after one perioperative death and erroneous administration of autologous blood to two participants. Mean age of the included 87 participants was 73. The authors state that there were no significant differences in baseline characteristics, though the percentages show differences in multiple domains (gender, medication for blood pressure, medications affecting platelets).
Interventions	**Group 1 (Autotransfusion of autologous blood)** (cell salvage/intervention group): participants in the autologous transfusion group underwent cell salvage using the Sangvia Blood Salvage System. Blood was collected intra- and postoperatively. The maximum collection time was 6 hours and maximum collection volume was 1500 mL. Autologous transfusion was routinely given to participants in this group unless there was a failure in the collection process or the sample was insufficient (< 200 mL). The salvaged blood was not washed prior to reinfusion. **Group 2 (Allo-transfusion group)** (control/no cell salvage group): the control group received standard perioperative care and allogeneic blood transfusions, as required, according to the clinical judgement of the doctor on duty.
Outcomes	**Primary outcome:** difference in infection rates between groups **Secondary outcomes:** volume of blood transfused, transfusion reactions, length of hospital stay, number of days on antibiotic treatment, days with body temperature > 38C
Notes	**Transfusion protocol:** allogeneic transfusions were prescribed by the doctor on duty according to clinical judgement. **Prospective registration status:** the study was retrospectively registered with a trials registry (NCT01725724). The study start date was 3 years before registration. **Ethical approval:** the study was approved by the regional ethics committee for Stord Hospital, Helse Fonna HF, Norway. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	The randomisation method is not described
Allocation concealment (selection bias)	Unclear risk	The method of allocation concealment is not described
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias)	High risk	No transfusion protocol: all allogeneic transfusions were prescribed by the doctor on duty according to a clinical judgement.

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Teetzman 2014 *(Continued)*

Subjective: transfusion protocol		
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	No blinding of personnel, and multiple outcomes have no clearly defined decision-making/diagnostic criteria
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	No blinding of outcome assessors, but infection outcome has clearly-defined criteria that minimises risk of bias
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Low number of dropouts, but all in the control group: 3 participants were excluded from the control group following randomisation: 1 secondary to perioperative mortality and 2 due to erroneous administration of autologous blood. Imbalance in group size, no info on participant flow, so it is unclear why this is the case (whether more participant were excluded or crossed over)
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	Funding and conflicts not reported. Authors state no significant difference in baseline characteristics, though the percentages show differences in multiple domains (gender, medication for blood pressure, medications affecting platelets).

Thomas 2001

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** regional hospital, Swansea, Wales, UK **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** 7 days postoperatively
Participants	231 participants undergoing elective total knee replacement surgery were randomly allocated to one of two groups: **Autologous** (cell salvage/intervention group): N = 115. M:F 44:71. Mean age of males 67.4 years; mean age of females 70.5 years **Allogeneic** (control/no cell salvage group): N = 116. M:F 55:61. Mean age of males 69.7 years; mean age of females 70.2 years Groups were comparable at baseline assessment.
Interventions	**Autologous** (cell salvage/intervention group): cell salvage group participants received autotransfusion of wound drainage if the volume of blood collected was > 125 mL postoperatively. The collected blood

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Thomas 2001 *(Continued)*

	was washed and re-suspended in saline before re-infusion using a centrifugal cell washing machine (Haemonetics Cell Saver 5). Participants in the cell salvage group were transfused allogeneic red blood cells if their haemoglobin fell below a haemoglobin level of 9.0 g/dL after autotransfusion was completed. **Allogeneic** (control/no cell salvage group): control group were treated without the use of cell salvage (autotransfusion). All drainage blood was discarded.
Outcomes	**Outcomes reported:** number of participants transfused allogeneic blood, amount of allogeneic blood transfused, adverse events
Notes	**Transfusion protocol:** allogeneic blood was transfused if the haemoglobin level fell below 9.0 g/dL. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study was approved by the local research ethics committee. **Language of publication:** English **Trial funding:** Welsh Office for Research and Development in Health and Social Care **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: pre-set transfusion trigger of 9 g/dL. The participants in the cell salvage group were also transfused if their haemoglobin fell below the preset trigger after autotransfusion.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	Adverse events were scrutinised in a blinded fashion to determine those possibly related to transfusion effect (wound infection, embolic events, MI, and cardiopulmonary (CP) complications). Appears to be based on the recordings taken by a research nurse - no protocols described and no mention of whether the research nurse was blinded.
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	Adverse events were scrutinised in a blinded fashion to determine those possibly related to transfusion effect (wound infection, embolic events, MI, and CP complications). Appears to be based on the recordings taken by a research

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Thomas 2001 *(Continued)*

		nurse - no protocols described and no mention of whether the research nurse was blinded.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	ITT analysis
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Low risk	No baseline imbalance. Funding reported (non-pharmaceutical)

Thomassen 2011

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, international, multicentre study **Setting:** 6 European hospitals were involved, located in the Netherlands (3 clinics), Spain, Norway and Austria **Recruitment:** May 2009 to April 2010 **Maximum follow-up:** 60 days postoperatively
Participants	227 participants undergoing elective primary or revision total hip replacement (THR) were randomised to one of the following two groups: **Sangvia** (cell salvage/intervention group): N = 106. M:F 30:76. Mean (SD) age 67 (11). Mean (SD) BMI 27.3 (4.6). Primary N = 100. Revision THR N = 6 **Control** (control/no cell salvage group): N = 110. M:F 40:70. Mean (SD) age 65 (12). Mean (SD) BMI 27.5 (4.6). Primary THR N = 104. Revision THR N = 6 Groups were comparable at baseline assessment.
Interventions	**Sangvia** (cell salvage/intervention group): the intervention group received the Sangvia Blood Management System (Astra Tech AB, Molndal, Sweden). This autotransfusion device performs both intraoperative and postoperative cell salvage and transfusion. Postoperatively, the Sangvia blood collection drain was used for postoperative cell salvage. The drain remained in situ until the first postoperative morning. **Control** (control/no cell salvage group): the control group did not receive cell salvage intraoperatively and had a standard low-vacuum drain sited at the end of surgery (Bellovac, Astra Tech AB, Molndal, Sweden). The drain remained in situ until the first postoperative morning.
Outcomes	**Primary outcome:** allogeneic blood transfusion frequency (measured at day of discharge) **Secondary outcomes:** total number of units transfused per patient, blood loss (intraoperative and postoperative), safety (vital signs, laboratory variables, adverse events), quality of life (EuroQol EQ-5D)
Notes	**Transfusion protocol:** Hb < 8.5 g/dL or Hb > 8.5 g/dL and clinical signs of anaemia **Prospective registration status:** the study was prospectively registered with a trials registry (NCT00822588) **Ethical approval:** the study received ethical approval from the following ethics committees: Medisch-ethische commissie at Onze lieve vrouwe gasthuis (reference WO 09.033), METC Zuidwest Holland (reference 09–031), Medisch Centrum Haaglanden (reference RVB/RZ/1444), Reinier de Graaf Groep (ref-

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Thomassen 2011 *(Continued)*

erence CZ/CS/2009-086), CEIC-IMAS (reference YA-DRA-0001, version 2.0, date 12/01/2009), Det medisinske fakultet Regional komite for medisinsk og helsefaglig forskningsetikk Helseregion Midt-Norge (reference 4.2009.421), Ethik-kommission der Medizinischen Universita¨t Wien und des Allgemeinen Krankenhauses Der stadt Wien AKH (reference 011/2009).

Language of publication: English

Trial funding: Astra Tech AB, Mölndal, Sweden

Conflicts of interest: declared

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Treatment allocation was stratified by hospital and type of surgery (i.e. primary or revision procedure). A separate randomisation list was generated for each hospital using a computer and integrated into a web-based log-in system. The randomisation plan and generated list were only known to study personnel not involved in the clinical procedures.
Allocation concealment (selection bias)	Low risk	A separate randomisation list was generated for each hospital using a computer and integrated into a web-based log-in system. The randomisation plan and generated list were only known to study personnel not involved in the clinical procedures.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	Transfusion protocol in place: Hb < 8.5 g/dL or Hb > 8.5 g/dL and clinical signs of anaemia. However, the authors state: "we cannot rule out potential bias as allogeneic transfusions were also allowed for clinical symptoms and transfusion decisions were taken by clinicians aware of treatment allocation in acute situations during surgery".
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	Study personnel were not blinded to treatment allocation; no guidelines for clinical decision-making noted
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	Described as assessor-blinded
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Results are presented for 216 participants in an ITT analysis due to withdrawal of 11 participants following randomisation (surgery outside of study period n = 3; withdrew consent n = 5; met exclusion criteria n = 3). A further 19 participants had major protocol deviations and so a per-protocol analysis (PPA) was performed in addition to the ITT analysis. Adverse events

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Thomassen 2011 *(Continued)*

		reported as ITT. Transfusion rate reporting for ITT is unclear, therefore had to use per-protocol (PP) for this outcome
Selective reporting (reporting bias)	Low risk	A study protocol is available and was published prior to participant recruitment. All outcomes described are presented within the paper.
Other bias	High risk	Support provided by a pharmaceutical company: representatives from the company were involved in the study design, data analysis, and preparation of the manuscript. The funder has supported the planning, conduct, and reporting of the study. They have contributed with writing the study protocol and manuscript, organised study meetings, monitored the data and data analysis. No baseline imbalance noted.

Thomassen 2014

Study characteristics	
Methods	**Design:** RCT, parallel three-arm, multicentre study **Setting:** 2 hospitals within the Netherlands **Recruitment:** November 2010 to November 2012 **Maximum follow-up:** 6 weeks postoperatively
Participants	Adult participants undergoing primary THR or primary TKR were eligible. 575 participants were randomised to one of three treatment groups: **Group A (No wound drainage)** (Control/no cell salvage group): N = 190. M:F 58:132. Mean age 68.9. Mean BMI 28.2 **Group B(Autologous blood reinfusion at 6 hours and drain removal at 6 hours)** (cell salvage/intervention group): N = 191. M:F 68:123. Mean age 69.5. Mean BMI 28.2 **Group C (Autologous blood reinfusion at 6 hours and drain removal at 24 hours)** (cell salvage/intervention group): N = 194. M:F 74:120. Mean age 68.2. Mean BMI 28.1 Groups were comparable at baseline assessment.
Interventions	**Group A (No wound drainage)** (Control/no cell salvage group): no wound drainage was performed. **Group B (Autologous blood reinfusion at 6 hours and drain removal at 6 hours)** (cell salvage/intervention group): in Group B, salvaged blood was reinfused at 6 hours and the ABT drain was removed after 6 hours. **Group C (Autologous blood reinfusion at 6 hours and drain removal at 24 hours)** (cell salvage/intervention group): in group C, the re-infusion drainage bottle was replaced with a low-vacuum Bellovac drain (WellSpect Healthcare) after the first 6 hours, and then removed during the first postoperative morning (between 18 and 24 hours postoperatively). The re-infusion drains were used in groups B and C according to the manufacturer's instructions for postoperative autologous blood collection and re-infusion. The collected shed blood was returned to participants in both reinfusion groups irrespective of their haemoglobin (Hb) level.
Outcomes	**Primary outcome:** proportion of postoperative participants receiving an allogeneic blood transfusion

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Thomassen 2014 *(Continued)*

	Secondary outcomes: perioperative blood loss (THR only), transfusion volumes, length of hospital stay, adverse events
Notes	**Transfusion protocol:** the decision to transfuse allogeneic blood was according to the restrictive Dutch transfusion threshold regime. Allogeneic transfusion was only given when the Hb level was > 8 g/dL in symptomatic patients; Hb 6.4 g/dL for patients ASA 1 or ASA 2-3 undergoing uncomplicated surgery; Hb 8 g/dL for patients ASA 2-3 undergoing surgery with blood loss > 500 mL; Hb 9.6 g/dL for ASA 2-3 with minor complications during surgery. **Prospective registration status:** the study was retrospectively registered with a trials registry (Dutch Trials Registry No. NTR2501). Registration was 1 month after the study start date. **Ethical approval:** the study was approved by a medical ethics committee (NL27458.098.10). **Language of publication:** English **Trial funding:** benefits were received and directed solely to a research fund, foundation, educational institution, or other non-profit organisation with which one or more of the authors are associated. **Conflicts of interest:** declared

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Stratification was carried out per clinic and variable block sizes were used to ensure 3 balanced groups were achieved. A computer-generated randomisation plan was sealed in opaque envelopes by an independent person. Randomisation was performed in the operating theatre at the point of wound closure.
Allocation concealment (selection bias)	Low risk	A computer-generated randomisation plan was sealed in opaque envelopes by an independent person
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	The decision to transfuse allogeneic blood was according to the restrictive Dutch transfusion threshold regime. Allogeneic transfusion was only given when the Hb level was > 8 g/dL in symptomatic patients; Hb 6.4 g/dL for patients ASA 1 or ASA2-3 undergoing uncomplicated surgery; Hb 8 g/dL for patients ASA 2-3 undergoing surgery with blood loss > 500 mL; Hb 9.6 g/dL for ASA2-3 with minor complications during surgery. However, authors report that "37% of patients potentially transfused 'unjustifiably'".
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	Study personnel were not blinded to treatment allocation
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)

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Thomassen 2014 *(Continued)*

Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	The blinding status of outcome assessors is not described. However, adverse events are well-defined.
Incomplete outcome data (attrition bias) All outcomes	Low risk	25 participants received incorrect treatment and so a per-protocol analysis was performed as well as the ITT analysis
Selective reporting (reporting bias)	Low risk	A study protocol is available and was published prior to participant recruitment. All outcomes specified are reported within the study
Other bias	High risk	Support provided by a pharmaceutical company: "Representatives from the company were involved in the study design, data analysis and preparation of the manuscript. The funder has supported in the planning, conduct and reporting of the study. They have contributed with writing the study protocol and manuscript, organized study meetings, monitored the data and data analysis". No baseline imbalance noted.

Thompson 1990

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Southampton, Hampshire, UK **Recruitment:** 15-month study period. Specific recruitment and study dates not reported **Maximum follow-up:** 30 days postoperatively
Participants	67 participants undergoing elective abdominal aortic reconstruction were randomised to one of the following two groups: **Cell saver:** N = 33. Median (range) age 69 (43 to 84). Median (range weight 67 (59 to 74) kg **Control:** N = 34. Median (range) age 68 (47 to 80). Median (range) weight 68 (60 to 76) kg There is a similar distribution of characteristics between groups.
Interventions	**Cell saver:** the Haemolite cell saver system was used during operation and intraoperative autotransfusion carried out. Homologous blood given after surgery if required. **Control:** homologous blood was given as required in the postoperative period.
Outcomes	**Outcomes reported:** donor blood requirement, length of hospital stay
Notes	**Transfusion protocol:** "Transfusion policy was agreed with anaesthetic colleagues, and was standardised for all patients. The autotransfusion group were to receive all salvaged blood immediately. Postoperatively, no patient was to receive red cells unless their haemoglobin fell to < 9.5-10 g/dL, in association with a haematocrit of < 0.30". **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study protocol was approved by the local ethical committee. **Language of publication:** English

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Thompson 1990 *(Continued)*

Trial funding: not reported

Conflicts of interest: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Insufficient detail about how randomisation sequence was generated
Allocation concealment (selection bias)	Unclear risk	Envelopes sealed but does not state if they were opaque. Not clear who was responsible for randomisation and if they were independent of the operating staff.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: "Transfusion policy was agreed with anaesthetic colleagues, and was standardised for all patients. The autotransfusion group were to receive all salvaged blood immediately. Postoperatively, no patient was to receive red cells unless their haemoglobin fell to < 9.5-10 g/dL, in association with a haematocrit of < 0.30".
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	Insufficient detail on postoperative care, likely to be affected by lack of blinding
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	Some subjective outcomes at high risk for bias: e.g. length of stay, complications (without strict diagnostic criteria) likely to be affected by lack of blinding
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Poorly described
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	Balanced baseline characteristics. No conflict of interest or funding statement provided

Thurer 1979

Study characteristics

Methods	**Design:** RCT, parallel two-arm, single-centre study

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Thurer 1979 *(Continued)*

	Setting: academic medical centre, Cleveland, OH, USA **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** duration of hospital stay
Participants	113 consecutive adult participants undergoing cardiac surgical procedures requiring cardiopulmonary bypass were randomised to one of two groups: **Autotransfused group** (cell salvage/intervention group): N = 54. M:F 48:6. Mean (range) age 55.9 (24 to 72) **Control group:** N = 59. M:F 55:4. Mean (range) age 54.8 (38 to 73) The groups were comparable at baseline assessment.
Interventions	**Autotransfused group** (cell salvage/intervention group): cell salvage group had their shed mediastinal blood collected postoperatively by an autotransfusion system (Sorenson). Suction was applied (-20 cm H_2O), allowing shed blood to flow into the upper bag of the system and then through two 170 µm filters into a lower 800 mL collection bag. The lower bag was then disconnected from the system and its contents infused, the collected blood being transfused through an in-line 40 µm filter. No blood was allowed to remain in the system longer than 4 hours. Shed blood that was not utilised during this time period was discarded. When notable bleeding ceased (4 to 8 hours), retransfusion was no longer employed. Blood remaining in the CPB circuit at the end of the procedure was saved for later transfusion. **Control group**: control group received usual care without the use of cell salvage. Blood remaining in the CPB circuit at the end of the procedure was saved for later transfusion. NB: intraoperative and postoperative haemodilution was performed in all participants but not equally distributed between groups.
Outcomes	**Outcomes reported:** amount of blood collected by the cell saver, amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, adverse events, myocardial infarction, mortality, postoperative infections, blood loss
Notes	**Transfusion protocol:** intraoperative blood replacement was left to the discretion of the staff surgeon and anaesthesiologist. In patients who were unstable haemodynamically and in those patients whom complete revascularisation was not possible, the haematocrit was raised to 30% or higher. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.

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Thurer 1979 *(Continued)*

Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	No transfusion protocol in place: intraoperative blood replacement was left to the discretion of the staff surgeon and anaesthesiologist
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	No mention of blinding, no clear processes for decision-making
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	No mention of blinding, no definitions/criteria for MI and blood loss, good definition for diagnosis of infection based on blood cultures
Incomplete outcome data (attrition bias) All outcomes	Low risk	ITT analysis
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No baseline imbalance. No mention of funding or conflicts

Touzopoulos 2021

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Alexandroupolis, Greece **Recruitment:** January 2020 to August 2020 (study dates) **Maximum follow-up:** postoperative
Participants	40 participants undergoing total knee arthroplasty were randomly allocated to one of two groups: **Group 1 (Self-transfusion of collected blood)** (Cell salvage/intervention group): N = 20. M:F 4:16. Mean(SD) age 68 (7.5). Mean (SD) BMI 33.6 (4.9) **Group 2 (Conventional drain)** (Control/no cell salvage group): N = 20. M:F 4:16. Mean (SD) age 69.8 (7.6). Mean (SD) BMI 31.1 (5.3) No significant differences between groups at baseline.

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Touzopoulos 2021 *(Continued)*

Interventions	**Group 1 (Self-transfusion of collected blood)** (Cell salvage/intervention group): the transfusion filter set for salvaged blood (Summit Medical Ltd, Gloucestershire, UK) was randomly used in 20 participants postoperatively. Participants, who received autologous blood, were transfused with the collected amount of blood, only once, 6 hours postoperatively. All participants received the same pain management medication and the same physiotherapeutic protocol until they were discharged. **Group 2 (Conventional drain)** (Control/no cell salvage group): participants received a conventional drain and no autotransfusion was performed. All participants received the same pain management medication and the same physiotherapeutic protocol until they were discharged.
Outcomes	**Outcomes reported:** serum gentamicin level, total blood loss, haemoglobin concentration, renal function, wound drain fluid level, number of participants exposed to donor blood, number of units of donor blood given
Notes	**Transfusion protocol:** a "low transfusion trigger point (haemoglobin < 9 g/dL) was used, as a protocol in our department, since it had been proven to be safe and effective when reducing the need of allogeneic blood transfusion". **Prospective registration status:** the study was retrospectively registered, 8 months following study commencement. **Ethical approval:** the study was approved by the ethics committee of the host institution. **Language of publication:** English **Trial funding:** none reported **Conflicts of interest:** none reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Unclear how randomisation sequence was generated: "The randomisation process was non-blinded and was made with the method of 'sealed envelopes' containing the sentences 'use of self-transfusion' or 'no self-transfusion'".
Allocation concealment (selection bias)	High risk	Envelopes sealed but not necessarily opaque. Allocation was unblinded: "The randomisation process was non-blinded and was made with the method of 'sealed envelopes' containing the sentences 'use of self-transfusion' or 'no self-transfusion'".
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: "A low transfusion trigger point (haemoglobin < 9 g/dL) was used, as a protocol in our department, since it had been proven to be safe and effective when reducing the need of allogeneic blood transfusion".
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	Unblinded trial, no defined protocol that could prevent performance bias

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Touzopoulos 2021 *(Continued)*

Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Low risk	Unblinding of allocation may impact subjective outcomes but the outcomes of interest reported here include units transfused, number of patients exposed to allogeneic blood transfusion, and blood loss. Lack of blinding is mitigated by the use of a transfusion protocol, and authors provide calculation for total blood loss.
Incomplete outcome data (attrition bias) All outcomes	Low risk	Reported and none lost to follow up; number analysed = number randomised
Selective reporting (reporting bias)	High risk	Trial registration available (retrospectively registered): but when viewing the protocol on Clinical Trials register (NCT04505748), the only primary outcome has been defined as gentamicin serum concentration. No other outcomes of interest are listed.
Other bias	Low risk	No significant baseline imbalances. Funding (none) and conflicts (none) reported

Tripkovic 2008

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Zagreb, Croatia **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** 48 hours postoperatively
Participants	60 participants undergoing primary total hip replacement were randomly allocated to one of two groups: **Reinfusion group** (cell salvage/intervention group): N = 30. M:F 14:16. Mean (SD) age 68 (12) **Control group**: N = 30. M:F 12:18. Mean (SD) age 71 (11) The groups were balanced at baseline assessment.
Interventions	**Reinfusion group** (cell salvage/intervention group): cell salvage group had their shed blood processed by the BIODREN system. This system is a closed autologous blood recovery system. The vacuum pump provides an adjustable constant vacuum kept below 100 mmHg. The system is connected to two CH14 drains during the final stage of the operation and active suction is initiated after skin closure. When collection of shed blood in the reservoir is completed (600 mL of blood is collected or after maximum of 360 minutes of collection is passed), the blood flows through a 260 µm filter to the blood bag, from which autotransfusion through a 40 µm filter (Pall blood transfusion set) is done. **Control group**: control group did not receive autotransfusion.
Outcomes	**Outcomes reported:** number of participants transfused allogeneic blood, amount of allogeneic blood transfused, blood loss

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Tripkovic 2008 *(Continued)*

Notes	**Transfusion protocol:** participants received allogeneic blood to maintain a haemoglobin level of 10.0 g/dL or haematocrit level of 30%. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the experimental protocol was approved by the local ethics committee. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was not described.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: "Patients in both groups received blood products to maintain a hemoglobin level of 100 g/L or hematocrit level of 30%."
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Low risk	No mention of blinding, and several variations - transfusion protocol for allogeneic blood, but not for autologous pre-donated blood, which is separate to the cell salvage blood (assume same threshold is used)
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	No mention of blinding, and several variations - transfusion protocol for allogeneic blood, but not for autologous pre-donated blood, which is separate to the cell salvage blood (assume same threshold is used)
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	States 30 per group were enroled, and 30 per group at baseline. Then a breakdown of allogeneic and autologous blood as 30 per group. But unclear if this was for all outcomes (i.e. blood loss)
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No baseline imbalance. No mention of funding or conflicts

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Unsworth 1996

Study characteristics	
Methods	**Design:** RCT, parallel three-arm, single-centre study **Setting:** university teaching hospital, London, UK **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** not reported
Participants	105 participants undergoing primary elective coronary artery bypass graft surgery were randomised to one of three groups: **Group 1 (No autotransfusion)** (Control/no cell salvage group): N = 34. M:F 30:4. Median (range) age 63 (58 to 67) **Group 2 (Autotransfusion group - uncoated circuit)** (cell salvage/intervention group): N = 36. M:F 30:6. Median (range) age 64 (58 to 67) **Group 3 (Autotransfusion group - heparin-coated circuit)** (cell salvage/intervention group): N = 35. M:F 31:4. Median (range) age 62 (55 to 67) years The groups were comparable at baseline assessment.
Interventions	**Group 1 (No autotransfusion)** (Control/no cell salvage group): control group had their chest drains connected to underwater sealed drainage bottles with suction applied at 10 kilopascal (kPa). Autotransfusion was not performed. **Group 2 (Autotransfusion group - uncoated circuit)** (cell salvage/intervention group): autotransfusion group (uncoated circuit) had their chest drains connected to a cardiotomy reservoir (CATR 3500) to which suction at 10 kPa was applied. This reservoir contained a 20 µm filter which removed debris and clots from the drained blood. From there, blood was carried via an infusion pump which incorporated an air-in-line detector to a peripheral line. Autotransfusion commenced when there was > 100 mL in the cardiotomy reservoir and continued thereafter for 10 hours. Infusion was in hourly pulses according to the previous hour's drainage. **Group 3 (Autotransfusion group - heparin-coated circuit)** (cell salvage/intervention group): autotransfusion group (heparin-coated circuit) had the autotransfusion circuit bonded with heparin. The heparin-bonded circuit comprised an identical system of drains and tubes except that all surfaces, including the cardiotomy reservoir and connector but excluding the piston chamber of the infusion pump and the intravenous cannula, were coated with heparin by the Duraflow II methodology.
Outcomes	**Outcomes reported:** amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of participants receiving allogeneic blood, adverse events, re-exploration for bleeding, blood loss, mortality
Notes	**Transfusion protocol:** allogeneic blood was transfused to maintain the haematocrit level > 25%. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study was approved by the Ethics Committee of St George's Hospital. **Language of publication:** English **Trial funding:** British Heart Foundation, British Cardiac Society **Conflicts of interest:** not reported
Risk of bias	

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Unsworth 1996 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	A computer randomisation program. This program minimised differences between groups in age, sex, body surface area, aspirin ingestion within a week of surgery, and surgeon.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: homologous blood was transfused to maintain the haematocrit > 25%.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Low risk	No blinding mentioned, but appears that all outcomes measured had protocols or were objectively measured
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	The blinding status of outcome assessors was not described. Outcome measures not clearly defined
Incomplete outcome data (attrition bias) All outcomes	Low risk	All participants randomised are accounted for in the reported outcomes, appears to be ITT
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Low risk	No baseline imbalance. Funding reported (non-pharmaceutical)

Vermeijden 2015

Study characteristics	
Methods	**Design:** RCT, factorial design, multicentre trial **Setting:** hospitals across the Netherlands **Recruitment:** January 2005 to January 2009 **Maximum follow-up:** 1 year postoperatively

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Vermeijden 2015 *(Continued)*

Participants	Of 995 eligible participants undergoing elective, on-pump cardiac surgery that were screened, 738 were randomised to one of the following four treatment groups: **Group cell salvage** (Cell salvage/intervention group): N = 192. M:F 134: 55. Mean (SD) age 66 (9.5) **Group cell salvage and leucodepletion filter (LDF)** (Cell salvage/intervention group): N = 180. M:F 140: 40. Mean (SD) age 65 (9.7) **Group LDF only** (Control/no cell salvage group): N = 182. M:F 132: 50. Mean (SD) age 66 (10.5) **Group control** (Control/no cell salvage group): N = 184. M:F 127:50. Mean (SD) age 66 (9.7)
Interventions	**Group cell salvage**(Cell salvage/intervention group): participants allocated to the cell salvage group (autologous group) underwent intraoperative cell salvage. Individual centres used the cell salvage machines available to them (CATS (Fresenius), Brat 5 (Haemonetics, Braintree, MA, USA) or Dideco-Electa (Sorin, Milan, Italy). Cardiotomy suction blood, blood from the surgical field and residual CPB machine blood was collected, washed via the cell savers and retransfused through a standard transfusion set. **Group cell salvage and leucodepletion filter (LDF)**(Cell salvage/intervention group): the cell salvage and LDF group underwent cell salvage as per group 1 but had the blood re-transfused through a LDF. The LDF used was the Biofil 2 LD filters (Fresenius) and changed after 250 mL of cell salvage processed blood. **Group LDF only** (Control/no cell salvage group): in group 3 (LDF group/control group), cardiotomy suction blood, blood from the surgical field and residual CPB blood was collected and re-transfused through a LDF. **Group control** (Control/no cell salvage group): participants in group 4 (control group) had cardiotomy suction blood and blood from the surgical field discarded after reversal of heparin. Residual blood in the CPB machine was re-transfused through a standard transfusion set. No cell saver or LDF was used.
Outcomes	**Primary outcome**: number of allogeneic blood products used in each group during hospital admission **Secondary outcomes:** percentage of participants who received any allogeneic blood products, number of re-explorations, myocardial infarction, stroke, postoperative ventilation time, length of stay in the intensive care unit, length of stay in hospital, 1-year mortality, number of infections (reported in Van Klarenbosch 2020 paper)
Notes	**Transfusion protocol:** the transfusion protocol was based on the Dutch transfusion guidelines. RBC were transfused when the postoperative Hb level was < 5 mmol/L. Transfusion during CPB was according to the clinical judgement of the anaesthetist and perfusionist. Transfusions of FFP and platelets occurred in cases of excessive bleeding. **Prospective registration status:** the study was retrospectively registered with a trials registry (ISRCTN58333401). Study start date was one year before registration date. **Ethical approval:** the study was approved by the local ethics committee. **Language of publication:** English **Study groups:** for the purpose of our review, we have combined the following groups for our comparison of interest: Group Cell Salvage (CS) (Group 1) and CS+LDF (Group 2) (as cell salvage/intervention group) versus Groups LDF (Group 3) and Control (Group 4) (as control/no cell salvage group). **Trial funding:** the Netherlands Organization for Health Research and Development (ZonMw) **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement

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Vermeijden 2015 *(Continued)*

Random sequence generation (selection bias)	Low risk	Participants were randomised using a computer-generated randomisation table with a group for each of the 4 possible treatment allocation groups.
Allocation concealment (selection bias)	Low risk	Allocation was done with sealed, sequentially-numbered envelopes
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	The transfusion protocol was based on the Dutch transfusion guidelines. RBC were transfused when the postoperative Hb level was < 5 mmol/L. Transfusion during CPB was according to the clinical judgement of the anaesthetist and perfusionist. Transfusions of FFP and platelets occurred in cases of excessive bleeding.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	The operative team were not blinded to treatment allocation; however, the personnel and staff delivering postoperative care were blinded. The blinding status of participants is not described.
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	The operative team were not blinded to treatment allocation; however, the personnel and staff delivering postoperative care were blinded. The blinding status of participants is not described. Blood loss and re-operation have no clear decision-making criteria
Incomplete outcome data (attrition bias) All outcomes	Low risk	22 (out of 738) participants did not complete the study.
Selective reporting (reporting bias)	Low risk	A study protocol is available and published. All outcomes specified in the protocol are reported.
Other bias	Low risk	No baseline imbalance. Funding reported (non-pharmaceutical). Conflicts not reported

Ward 1993

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** Veterans Medical Centre, Minnesota, MN, USA **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** not reported

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Ward 1993 *(Continued)*

Participants	35 consecutive male participants undergoing elective myocardial revascularisation or valve replacement were randomised to one of two groups: **Autotransfusion group** (cell salvage/intervention group): N = 18. Mean (SD) age 64 (8.5) **Control (no autotransfusion) group** (control/no cell salvage group): N = 17. Mean (SD) age 63 (8.2) Before the onset of the experimental protocol, there were significant differences between the two groups with respect to cross-clamp time, total pump time, and amount of intraoperative colloid transfusion. In all instances, the group randomised to receive autotransfusion had higher values.
Interventions	**Autotransfusion group** (cell salvage/intervention group): autotransfusion group participants received autotransfusion of mediastinal shed blood for the first 12 hours postoperatively. Autotransfusion involved reinfusion within 4 hours, a minimum of 100 mL of chest drainage in the reservoir before initiation of autotransfusion, and discontinuation of autotransfusion for core temperatures > 39.5 °C. A two-filter system was employed to minimise emboli. **Control (no autotransfusion) group** (control/no cell salvage group): control group were treated with standard chest drainage and fluid replacement. NB: mediastinal chest drainage tubes were placed in all participants and connected to an in-line autotransfusion system. The chest drainage system was placed on suction (20 cm H_20), and the tubes were milked every 15 minutes. Haemodilution was tolerated to a haemoglobin level of 8.0 g/dL.
Outcomes	**Outcomes reported:** amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of participants transfused allogeneic blood, adverse events, re-operation for bleeding, blood loss, mortality, myocardial infarction, wound infection
Notes	**Transfusion protocol:** participants in both groups received transfusions intraoperatively and postoperatively with packed red blood cells when the haemoglobin level fell to < 8.0 g/dL. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study was approved by the Hospital Ethics Committee and Human Studies Committee on 27 July 1989. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Participants were randomised according to the last digit of their social security number.
Allocation concealment (selection bias)	High risk	Method used to conceal treatment allocation was inadequate. Participants were randomised according to the last digit of their social security number.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias)	Low risk	Transfusion protocol in place: received transfusions intraoperatively and postoperatively with packed red blood cells when the haemoglobin level fell to < 8 g/dL.

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Ward 1993 *(Continued)*

Subjective: transfusion protocol		
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Low risk	"The operative team was blinded to the randomization until the patient arrived in the surgical intensive care unit."
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	No blinding mentioned for outcome measures postoperatively (in surgical ICU); no guidelines for re-operation and wound infection (low for transfusion and objective measures)
Incomplete outcome data (attrition bias) All outcomes	Low risk	All participants randomised are accounted for in the analysis: 17 and 18 analysed; 35 randomised
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	High risk	Baseline imbalance: before the onset of the experimental protocol, there were significant differences between the two groups with respect to cross-clamp time, total pump time, and amount of intraoperative colloid transfusion. In all instances, the group randomised to receive autotransfusion had higher values. No mention of funding or conflicts

Westerberg 2004

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Gothenburg, Sweden **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** 12 hours postoperatively
Participants	35 participants undergoing cardiac surgery were randomly allocated to one of two groups: **Retransfusion group** (cell salvage/intervention group): N = 12. M:F 9:3. Mean (SD) age 64 (7.0) **No retransfusion group** (control/no cell salvage group): N = 17. M:F 16:1. Mean (SD) age 67 (8.3) There was imbalance between groups in aortic cross-clamp time and CPB time. All other demographic and baseline data were comparable between groups. NB: 6 participants were excluded from the final analysis.
Interventions	**Retransfusion group** (cell salvage/intervention group): autotransfusion group had their cardiotomy suction blood during cardiopulmonary bypass (CPB) and mediastinal shed blood during the first 12 hours postoperatively re-transfused.

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Westerberg 2004 *(Continued)*

	No retransfusion group (control/no cell salvage group): control group had their cardiotomy suction blood and mediastinal shed blood discarded. NB: all participants received intravenous tranexamic acid (TXA) 2 g before surgery and 2 g after skin closure.
Outcomes	**Outcomes reported:** number of participants transfused allogeneic blood, volume of shed mediastinal blood, blood loss
Notes	**Transfusion protocol:** the use of a transfusion protocol was not reported. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** the study protocol was approved by the Research Ethics Committee of the Medical Faculty, University of Gothenburg. **Language of publication:** English **Trial funding:** Gothenburg Medical Association **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was not described.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	No transfusion protocol in place
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	The blinding status of participants and personnel was not described.
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	The blinding status of outcome assessors was not described.

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Westerberg 2004 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	High risk	35 randomised, 29 analysed - 6 excluded but seems wrong to exclude them. Nearly 20% excluded; appears to be imbalanced (more excluded from re-transfusion group)
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	Minor baseline imbalance, likely due to unbalanced exclusions (did it impact males in the retransfusion group only). Funding reported (non-pharmaceutical)

Xie 2015

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** regional hospital, Hangzhou, Zhejiang, China **Recruitment:** June 2013 to December 2013 **Maximum follow-up:** duration of hospital stay
Participants	150 eligible participants undergoing cardiac surgery with high bleeding risk were randomly assigned to one of two treatment groups: **Cell salvage group** (cell salvage/intervention group): N = 72. M:F 35:37. Mean (SD) age 51.7 (15.6) **Control group** (control/no cell salvage group): N = 69. M:F 29: 40. Mean (SD) age 53.1 (15.1) The groups were comparable at baseline assessment.
Interventions	**Cell salvage group** (cell salvage/intervention group): participants in cell salvage group had shed blood from the wound and mediastina sucked into the cell saver reservoir (Haemonetics, USA) during the period of non-heparinisation. The volume of the disposable centrifuge bowl was 125 mL. Residual blood in the CPB machine was sucked directly into the reservoir on termination. Salvaged blood was filtered, centrifuged, washed and concentrated prior to transfusion back to the participant. All autologous red blood cells was re-transfused before the end of surgery. **Control group** (control/no cell salvage group): participants in the control group had shed blood from the wound, mediastina and residual blood from the CPB machine discarded.
Outcomes	**Outcomes reported:** perioperative blood transfusion (volume, proportion and quantity of allogeneic blood transfusion), postoperative adverse events (excessive bleeding, re-sternotomy, cardiovascular failure, severe arrhythmias, myocardial infarction infection, renal failure, respiratory failure, epileptic syndrome, cognitive decline, death), costs of transfusion
Notes	**Transfusion protocol:** if Hb < 80g/L, patients in the control group were transfused with allogeneic blood, while patients in the autotransfusion group were transfused with autologous blood first. If Hb remained < 80 g/L after autologous blood was used, then allogeneic blood was transfused. **Prospective registration status:** the study was prospectively registered with a trials registry (ChiCTR-TRC-13003209). **Ethical approval:** the study was approved by the Ethics Committee of the Zhejiang Provincial People's Hospital. **Language of publication:** English

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Xie 2015 *(Continued)*

Trial funding: Natural Science Foundation of Zhejiang Province (LY12H08005)

Conflicts of interest: none declared

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	There is insufficient detail regarding the randomisation process to make a judgement.
Allocation concealment (selection bias)	Unclear risk	Allocation concealment is not described.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: if Hb < 80g/L, patients in the control group were transfused with allogeneic blood, while patients in the autotransfusion group were transfused with autologous blood first. If Hb remained < 80 g/L after autologous blood was used, then allogeneic blood was transfused.
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	No mention of blinding; no mention of additional outcomes relevant to this review
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	Objective outcome (mortality) unlikely to be influenced by blinding
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	No mention of blinding; no mention of additional outcomes relevant to this review
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Three participants died within 24 hours of surgery and were excluded from the analysis: 2 in control group, 1 in intervention group. Small proportion, but impact of these exclusions is unclear (cause of death not described)
Selective reporting (reporting bias)	Low risk	A study protocol is available and all outcomes described are reported.
Other bias	Low risk	No baseline imbalance. Conflicts (none) and funding (non-pharmaceutical) declared

Zhang 2008

Study characteristics

Methods	**Design:** RCT, parallel three-arm, single-centre hospital

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Zhang 2008 *(Continued)*

	Setting: regional hospital, Zhenhai, Ningbo, China **Recruitment:** March 2005 to December 2006 **Maximum follow-up:** 48 hours postoperatively
Participants	60 participants undergoing orthopaedic procedures were randomly allocated to one of three groups: **Group 1(Platelet-rich plasmapheresis + autotransfusion group)**: n = 20 **Group 2(Simple autologous blood)** (cell salvage/intervention group): n = 20 **Group 3 (Untreated group)** (control/no cell salvage group): n = 20 Demographic data not reported for each trial arm.
Interventions	**Group 1(Platelet-rich plasmapheresis + autotransfusion group)**: platelet-rich plasmapheresis group received platelet-rich plasma (PRP)and autotransfusion with the use of the Haemonetics Cell Saver 5 system. **Group 2(Simple autologous blood)** (cell salvage/intervention group): autotransfusion group received intraoperative autotransfusion of shed blood using the Haemonetics Cell Saver 5 system. **Group 3 (Untreated group)**(control/no cell salvage group): control group received standard care without PRP and autotransfusion.
Outcomes	**Outcomes reported:** number of participants transfused allogeneic blood, blood loss
Notes	**Transfusion protocol:** the use of a transfusion protocol is not reported within the translated article. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** it is unclear whether the study was approved by an ethics committee or institutional review board. **Language of publication:** Chinese **Study groups:** for the purpose of our review, the comparison of interest is Group 2 (autotransfusion only) versus Group 3 (untreated group). **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was unclear (translation).
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was unclear (translation).
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)

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Zhang 2008 *(Continued)*

Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	No transfusion protocol in place (translation)
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	No protocols; no blinding (translation)
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	No protocols; no blinding (translation)
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	60 analysed, but no info on number randomised, or any protocol violations (translation)
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No baseline imbalance (there was no significant difference in age, weight, gender composition amongst the 3 groups (P > 0.05)). No mention of funding or conflicts of interest in translation

Zhao 1996

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Beijing, China **Recruitment:** recruitment and study dates not reported **Maximum follow-up:** 48 hours postoperatively
Participants	42 participants undergoing cardiac operations were randomised to one of two groups: **Group 1 (Autotransfusion of shed mediastinal blood (ATS)** (cell salvage/intervention group): N = 22. Mean (SD) age 49 (11.0) **Group 2 (Non-ATS/Banked blood)** (Control/no cell salvage group): N = 20. Mean (SD) age 45 (12.0) There were no significant differences in age, gender, and surgery between the transfusion and control groups.
Interventions	**Group 1 (Autotransfusion of shed mediastinal blood (ATS)** (cell salvage/intervention group): autotransfusion group participants received non-washed shed mediastinal blood during the postoperative period.

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Zhao 1996 *(Continued)*

	Group 2 (Non-ATS/Banked blood) (Control/no cell salvage group): control group participants received banked blood only. Autotransfusion was not performed.
Outcomes	**Outcomes reported:** amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, blood loss, Hb levels
Notes	**Transfusion protocol:** the use of a transfusion protocol was not reported in the translated article. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board. **Language of publication:** Chinese **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described (translation).
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was not described (translation).
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	No transfusion protocol in place
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	No protocols; no blinding (translation)
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	No protocols; no blinding (translation)
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	42 were randomised into 2 groups. Unclear if they were all analysed

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Zhao 1996 *(Continued)*

Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No baseline imbalance (there were no significant differences in age, gender, and surgery between the transfusion and control groups.) No mention of funding or conflicts of interest in translation

Zhao 2003

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** university teaching hospital, Beijing, China **Recruitment:** January 2000 to October 2000 **Maximum follow-up:** not reported
Participants	60 participants undergoing elective primary coronary artery bypass graft surgery were randomly allocated to one of two groups: **Group 1 (Shed mediastinal blood)** (cell salvage/intervention group): N = 30. M:F 26:4. Mean (SD) age 59.5 (8.0) **Group 2 (Banked blood only)** (control/no cell salvage group): N = 30. M:F 27:3. Mean (SD) age 59.2 (8.2) There were no differences between groups at baseline assessment.
Interventions	**Group 1 (Shed mediastinal blood)** (cell salvage/intervention group): cell salvage group participants received non-washed shed mediastinal blood re-transfused postoperatively after CABG using a cell saver device (Beijing PerMed Biomedical Engineering Company) up to 18 hours post-surgery. Shed blood not returned within 4 hours was discarded and a new bag attached. When > 200 mL of shed mediastinal blood was collected within 4 hours, the patients received autologous blood if volume replacement was considered necessary. Extracorporeal blood was routinely returned to patients after CABG. **Group 2 (Banked blood only)** (control/no cell salvage group): control group received banked allogeneic blood only. Autotransfusion was not used. Extracorporeal blood was routinely returned to patients after CABG.
Outcomes	**Outcomes reported:** number of participants transfused allogeneic blood, volume of allogeneic blood transfused, number of participants transfused autologous blood, volume of autologous blood transfused, blood loss
Notes	**Transfusion protocol:** the use of a transfusion protocol for allogeneic blood transfusion was not reported. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported
Risk of bias	

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Zhao 2003 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Method used to generate allocation sequences was not described.
Allocation concealment (selection bias)	Unclear risk	Method used to conceal treatment allocation was not described.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	High risk	No transfusion protocol in place
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	No protocols; no blinding
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	No protocols; no blinding
Incomplete outcome data (attrition bias) All outcomes	Low risk	All participants randomised are accounted for in the reported outcomes; appears to be ITT
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	No baseline imbalance. No mention of funding or conflicts of interest

Zhao 2016

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** regional hospital, Taicang, China **Recruitment:** March 2013 to March 2015 **Maximum follow-up:** 6 hours postoperatively

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Zhao 2016 *(Continued)*

Participants	200 participants undergoing primary, unilateral total hip replacement were randomised to one of the following groups: **Autologous blood transfusion group** (cell salvage/intervention group): N = 127. M:F 59:68. Mean (SD) age 65.84 (9.37). Mean (SD) BMI 61.51 (7.10) **Negative pressure wound drainage without re-transfusion** (control/no cell salvage group): N = 73. M:F 27:46. Mean (SD) age 64.31 (8.69). Mean (SD) BMI 60.25 (6.96)
Interventions	**Autologous blood transfusion group** (cell salvage/intervention group): participants in the experimental group (cell salvage group) had a negative pressure drain inserted, which was subsequently connected to a postoperative autologous re-transfusion device. The device used was not specified. The drained blood was filtered by the autotransfusion device prior to storage for up to 6 hours or until required for re-transfusion. If re-transfusion of the salvaged blood was not required, the blood was discarded. The drain was removed at 24 hours postoperatively. **Negative pressure wound drainage without re-transfusion** (control/no cell salvage group): participants in the control group had a negative pressure drain inserted during wound closure. Drained blood was collected in a standard collection bottle and discarded. The drain was removed at 24 hours postoperatively.
Outcomes	**Outcomes reported:** the amount of blood drained, the amount of autologous blood transfused, the amount of allogeneic blood required postoperatively, adverse events related to blood transfusion
Notes	**Transfusion protocol:** the criterion for allogeneic blood transfusion after the replacement was a haemoglobin value < 80 g/L. **Prospective registration status:** the study was not registered on a trials registry. **Ethical approval:** the trial was approved by the hospital ethics committee for the First People's Hospital of Taicang, Suzhou University, Taicang 215400, Jiangsu Province, China. **Language of publication:** Chinese **Trial funding:** not reported **Conflicts of interest:** none declared

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomisation was performed using a random number table
Allocation concealment (selection bias)	Unclear risk	The method of allocation concealment is unclear: open random allocation schedule (translated)
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: the criterion for allogeneic blood transfusion after the replacement was a haemoglobin value < 80 g/L (translated)

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Zhao 2016 *(Continued)*

Blinding of participants and personnel (performance bias) Subjective: all other outcomes	Unclear risk	The blinding status of participants and personnel is not described (translated)
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	Unclear risk	The blinding status of study outcome assessors is not described, and method for measuring blood loss not defined (translated)
Incomplete outcome data (attrition bias) All outcomes	Low risk	Outcome data are available for all participants recruited to the study (translated)
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	Baseline imbalance in group size and gender distribution, though authors state there is no significant difference. Conflicts of interest (none) declared; funding not mentioned (translated)

Zhao 2017

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** specialist cardiac surgery hospital, Zhengzhou, China **Recruitment:** August 2012 to January 2013 **Maximum follow-up:** duration of hospital stay
Participants	120 participants with coronary heart disease scheduled for elective, primary, three-vessel CABG using 3 to 6 grafts. Enroled participants were randomly allocated to one of the following two groups: **Experimental group** (cell salvage/intervention group): N = 60. M:F 39:21. Mean (SD) age 60.48 (9.22) **Control group:** N = 60. M:F 37:23. Mean (SD) age 59.26 (7.45) The groups were comparable at baseline assessment.
Interventions	**Experimental group** (cell salvage/intervention group): participants in the experimental group (autologous group) underwent blood cell salvage intraoperatively using the Dideco Electa blood cell separator (Sorin Group, Italy) and a disposable kit. Blood salvaged from the surgical field was collected using negative pressure suction apparatus and then washed prior to re-transfusion. **Control group:** participants in the control group did not undergo blood cell salvage and autotransfusion and were transfused with allogeneic blood as required.

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Zhao 2017 *(Continued)*

Outcomes	**Outcomes reported:** number of units of allogeneic red blood cell transfusion, volume (mL) of allogeneic blood plasma transfusion, ICU retention time, complications, endotracheal intubation, postoperative hospital stay, average hospitalisation cost
Notes	**Transfusion protocol:** a haemoglobin level < 8 g/dL was considered the standard for all patients. **Prospective registration status:** the study was not prospectively registered with a trials registry. **Ethical approval:** the study was approved by the Ethics Committee of Henan Province People's Hospital. **Language of publication:** English **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	The randomisation methodology is not described.
Allocation concealment (selection bias)	Unclear risk	The method of allocation concealment is not described.
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: a haemoglobin level < 8 g/dL was considered the standard for all patients
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	The blinding status of study participants and personnel is not described.
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	The blinding status of outcome assessors is not described. Blood loss measurement could lead to significant variability
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Number contributing to outcomes is not clear

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Zhao 2017 *(Continued)*

Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare.
Other bias	Unclear risk	No baseline imbalance. No mention of funding or conflicts of interest

Šarkanoviü 2013

Study characteristics	
Methods	**Design:** RCT, parallel two-arm, single-centre study **Setting:** regional hospital, Novi Sad, Serbia **Recruitment:** during 2010. Specific recruitment and study dates not reported. **Maximum follow-up:** not reported
Participants	112 participants undergoing total knee replacement (TKR) were randomised to one of two groups: **Group 1 (Allogeneic blood)** (Control/no cell salvage group): N = 55. Mean age 65.24. M:F: 14:41 **Group 2 (Autologous blood)** (Cell saver/intervention group): N = 57. Mean age 67.2. M:F 12:45 There were minor differences in baseline characteristics between the groups.
Interventions	**Group 1 (Allogeneic blood)** (Control/no cell salvage group): cell salvage group received postoperative cell salvage and autotransfusion once drainage volume reached 200 mL. Intraoperative cell salvage was also used (Haemonetics 5+, USA) to scavenge blood from the operative field and reinfuse after processing. **Group 2 (Autologous blood)** (Cell saver/intervention group): allogeneic transfusion group (control group) received standard perioperative care and allogeneic blood transfusions when required.
Outcomes	**Outcomes reported:** blood loss, time to sitting, time to standing, time to walking, length of hospital stay, number of participants receiving allogeneic blood transfusion, venous thromboembolism (VTE) rate, perioperative infection, wound complications, major cardiovascular morbidity - MACE definition not specified
Notes	**Transfusion protocol:** the transfusion trigger for the group that received allogeneic blood was 85 g/L. **Prospective registration status:** no information is available to determine whether the study was prospectively registered with a trials registry. We attempted to contact the authors to request this information but received no response. **Ethical approval:** no information is available to determine whether the study received ethical approval. We attempted to contact the authors to request this information but received no response. **Language of publication:** English and Serbian **Trial funding:** not reported **Conflicts of interest:** not reported

Risk of bias		
Bias	**Authors' judgement**	**Support for judgement**

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Šarkanoviü 2013 *(Continued)*

Random sequence generation (selection bias)	Unclear risk	No mention of randomisation process
Allocation concealment (selection bias)	Unclear risk	Allocation concealment is not described and so a judgment cannot be made
Blinding of participants and personnel (performance bias) Objective outcome: mortality	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of participants and personnel (performance bias) Subjective: transfusion protocol	Low risk	Transfusion protocol in place: "The transfusion trigger for the group that received allogeneic blood was 85 g/L."
Blinding of participants and personnel (performance bias) Subjective: all other outcomes	High risk	Subjective outcome measures not defined or, where definitions provided, vague with significant scope for between-participant variability
Blinding of outcome assessment (detection bias) Objective outcomes: mortality and transfusions	Low risk	No objective outcomes reported (mortality unlikely to be affected by blinding if reported in future publications)
Blinding of outcome assessment (detection bias) Subjective outcomes	High risk	Subjective outcome measures not defined or, where definitions provided, vague with significant scope for between-participant variability
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No mention of individuals identified who did not meet criteria or loss to follow-up
Selective reporting (reporting bias)	Unclear risk	No trial registration or published protocol is available to compare
Other bias	Unclear risk	Minor differences in baseline characteristics. No mention of conflicts or funding

ABT: autologous blood transfusion; **ACD-A:** anticoagulant citrate dextrose solution; **AE:** adverse event; **ASA:** American Society of Anesthesiologists; **BMI:** body mass index; **CABG:** coronary artery bypass graft; **CPB:** cardiopulmonary bypass; **DVT:** deep vein thrombosis; **F:** female; **FFP:** fresh frozen plasma; **Hb:** haemoglobin; **Hct:** haematocrit; **ICU:** intensive care unit; **IQR:** interquartile range; **ITT:** intention-to-treat; **LOS:** length of stay; **M:** male; **MACE:** major adverse cardiac events; **NHS:** National Health Service; **NSAID:** non-steroidal anti-inflammatory drug; **PE:** pulmonary embolism; **PJI:** prosthetic joint infection; **RBC:** red blood cell; **SBP:** systolic blood pressure; **SD:** standard deviation; **THA/THR:** total hip arthroplasty/total hip replacement; **TKA/TKR:** total knee arthroplasty/total knee replacement

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Albano 2010	No control group. Compared three active interventions

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Study	Reason for exclusion
Barbara 2010	No control group. Two active interventions (two cell salvage techniques)
Bartels 1996	No control group. Compared two active interventions
Bisleri 2016	Not a randomised controlled trial
Bosboom 2022	Ineligible comparison (cross-over RCT, assessing volume/pressure overload (saline versus autologous blood)
Boyle 2019	No control group. Two active interventions (different cell salvage techniques)
Campbell 2012b	Complex intervention – tested multiple interventions (CPB blood was processed in one arm and unwashed in the other, alongside difference of cell salvage versus no cell salvage). Unable to separate out the impact of cell salvage alone
Chen 2020	No control group. Compared two active interventions (one suction device versus two suction devices for cell salvage)
Cheng 2014	Non-RCT (no mention of randomisation)
ChiCTR-OCC-15006016	Non-RCT (observational cohort)
ChiCTR-ORN-17013372	Non-RCT (observational)
ChiCTR1800016656	Ineligible intervention (apheresis)
ChiCTR1800018689	Non-RCT (observational/case series)
Choi 2019	Not a randomised controlled trial
Conn 2018	Ineligible study design (non-intervention assessment of quality control)
Deramoudt 1991	No control group. Three active arms (acute normovolaemic haemodilution, cell salvage, and combination of both)
Dickenson 2022 (WHITE-9)	Ineligible population (emergency/trauma only)
Djaiani 2012 (NCT00296985)	Ineligible comparison (cell saver/separator to process blood versus unprocessed) Djaiani 2012 lists trial registration as NCT00193999, though the study details do not match. NCT00296985 listed in Djaiani 2007, study details match
DRKS00025454	Ineligible comparison (vacuum versus roller pump blood collection)
Duramaz 2018	Not a randomised controlled trial
Ela 2009	Ineligible intervention (acute normovolaemic haemodilution (ANH))
Elawad 1992	Ineligible comparison: dual intervention in intervention group (intervention group used both preoperative autologous donation and intraoperative cell salvage; control group received neither)
Garg 2015	No control group. Compared two active interventions (cell salvage using two different pumps)
Gorki 2017 (HEPCON II)	Ineligible comparison (factorial randomisation to assess pericardial fluid treatment and volume correction for heparin and protamine dosing)

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Study	Reason for exclusion
Gu 2009	No control group. Compared two active interventions (salvaged blood was concentrated versus not concentrated before leucocyte filtration)
Gunaydin 2013	Ineligible intervention (assessed filtration versus no filtration)
Gunaydin 2018	No control group. Compared two active interventions (cell salvage with different processing techniques)
Gäbel 2013b	Ineligible comparison (processed using cell saver then re-transfused versus no processing then re-transfused)
Han 2021	Ineligible intervention (stored autologous autotransfusion)
Harlaar 2012	Ineligible intervention (pre-donated autologous blood)
Hasan 2017	Ineligible intervention (intervention of interest is acute normovolaemic haemodilution (ANH); cell salvage was standard care)
Hogan 2014	Ineligible comparison (filtration with Hemosep versus no filtration). This may be the same study as Hogan 2015 but the sample size is different, and we could not confirm if they are the same study so we assessed it independently.
Hogan 2015	Ineligible comparison (filtration with Hemosep vs no filtration). This may be the same study as Hogan 2014 but the sample size is different, and we could not confirm if they are the same study so we assessed it independently.
ISRCTN59539154 (MASS III)	Ineligible comparison (off-pump versus on-pump CPB surgery)
ISRCTN85756518	Complex intervention – tested multiple interventions (autologous transfusion: acute normovolaemic haemodilution and integrative cell salvage versus control). Unable to separate out the impact of cell salvage alone
ISRCTN87590585	Ineligible comparator (reinfusion of unprocessed blood)
Jenni 2011	No control group. Compared two active interventions (smart suction device versus a routine continuous autotransfusion system (C.A.T.S.))
JPRN UMIN 000019726	Non-RCT (observational)
JPRN UMIN 000022227	Ineligible intervention (opened-fashion versus closed-fashion cardiopulmonary bypass circuit system)
JPRN UMIN 000025157	Non-RCT (observational)
JPRN UMIN 000043920	Non-RCT (historic control)
Karlsson 2019	Complex intervention – tested multiple interventions (cell salvage plus CPB closed circuit versus no cell salvage (normal cardiotomy) plus CPB open circuit). Unable to separate out the impact of cell salvage alone
Khan 2022	Non-RCT (no mention of randomisation)
Khanuja 2023	Systematic review – references checked for inclusion

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Study	Reason for exclusion
Laub 1993	Complex intervention – tested multiple interventions (CPB blood was washed in one arm and unwashed in the other, alongside difference of cell salvage versus no cell salvage). Unable to separate out the impact of cell salvage alone
Mayer 1985	Ineligible intervention: assesses cell separation versus no cell separation, blood was returned in both arms (not a cell salvage versus no cell salvage comparison)
McGill 2002	Complex intervention – tested multiple interventions (CPB blood was washed in one arm and unwashed in the other, alongside difference of cell salvage versus no cell salvage). Unable to separate out the impact of cell salvage alone
McNair 2013	Ineligible intervention (centrifugation versus multiple-pass haemoconcentration)
McNair 2020	Non-RCT (no randomisation; prospective cohort)
Morisaki 2013	Non-RCT (no mention of randomisation; prospective cohort study)
Murtha-Lemekhova 2022	Systematic review – references checked for inclusion
Naumenko 2003	Ineligible intervention (used cell saver in both groups, as standard care, with the intervention of interest being the impact of the autologous donation preoperatively)
NCT00176657	Ineligible intervention (re-transfused plasma and other blood products within the same unit as red cells versus red cell reinfusion alone)
NCT01435304	No control group. Two active interventions (method of returning residual CPB blood (Hemobag®))
NCT02338947	Ineligible intervention (CABG whilst on- or off-pump)
NCT02654028	Non-RCT (not randomised)
NCT03995160	Ineligible intervention (closed suction drainage)
NCT04304287	Ineligible intervention (preoperative autologous blood donation)
NCT04588350	Non-RCT (single-arm study)
NCT05164406	Non-RCT (observational case-control)
NCT05401175	Non-RCT; ineligible population (non-surgical population); ineligible intervention (bone marrow aspiration and re-transfusion)
NCT05545930	Ineligible comparison (methods to wring blood out of sponges)
NTR1589	Ineligible comparison (withdrawal of autologous blood during anaesthesia, then returned at various points intraoperatively)
NTR2712	Non-RCT (not randomised)
Nunes 2019	Non-RCT and ineligible population (emergency surgery)
Quispe-Fernández 2020	Non-RCT (prospective cohort)
Santiago-Lopez 2021	Non-RCT (no mention of randomisation)

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Study	Reason for exclusion
Schmidt 1997	Ineligible intervention and comparison (used Dual-isotope labelling technique (chromium 51 and technetium 99m) to investigate the 24-hour survival of RBCs from shed mediastinal blood and RBCs from circulating blood)
Sirvinskas 2007	Non-RCT (no mention of randomisation)
Slagis 1991	Non-RCT (no mention of randomisation)
Soliman 2022	Ineligible intervention (mild or moderate haemodilution during CPB)
Sridhar 2019	Ineligible intervention (drain versus no drain; not a re-transfusion drain, all blood discarded)
Starlinger 2016	Ineligible population (traumatic femoral neck fracture)
Tachias 2022	Complex intervention – tested multiple interventions (CPB blood was processed in one arm and not processed in the other before being returned at the end of bypass (confirmed by trialists), alongside difference of cell salvage versus no cell salvage). Unable to separate out the impact of cell salvage alone
Tempe 1996	Complex intervention – tested multiple interventions (CPB blood was processed in one arm and unwashed in the other, alongside difference of cell salvage versus no cell salvage). Unable to separate out the impact of cell salvage alone
Tempe 2001	Complex intervention – tested multiple interventions (CPB blood is processed in one arm and unwashed in the other, alongside difference of cell salvage versus no cell salvage). Unable to separate out the impact of cell salvage alone
Trubel 1995	No control group. Compared two active interventions (washed versus non-washed intraoperative cell salvage)
Ubee 2010	Non-RCT (retrospective case-control)
Ulrich 2014	Ineligible comparison (processed versus unprocessed re-transfusion)
Vertrees 1996	No control group. Compared two active interventions (washed versus non-washed intraoperative cell salvage)
Vonk 2012	No control group. Compared three active interventions for processing residual CPB blood before re-transfusion (cell salvage, centrifugation, ultrafiltration)
Wang 2012	No control group. Three active interventions assessing processing of salvaged blood (cell saver, autolog, continuous autotransfusion system (C.A.T.S.))
Wang 2022	Systematic review – references checked for inclusion
Weltert 2013	No control group. Compared two active interventions (traditional cell salvage plus chest drain versus cardioPAT)
Whitlock 2013	Ineligible intervention (ultrafiltration of CPB blood)
Wong 2002	Complex intervention – combined acute normovolaemic haemodilution (ANH) and intraoperative cell salvage (ICS) (with allogeneic transfusion) versus allogeneic transfusion alone. Unable to assess the impact of cell salvage alone

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Study	Reason for exclusion
Wu 2019	Complex intervention – assessed combining multiple interventions (transfusion of pre-donated autologous blood plus cell salvage) versus no pre-donation or cell salvage. Unable to separate out the effect of cell salvage alone
Xing 2014	Complex intervention – assessed combining multiple interventions (transfusion of pre-donated autologous blood plus cell salvage) versus no pre-donation or cell salvage. Unable to separate out the effect of cell salvage alone
Zacharopoulos 2007	Complex intervention – assessed different interventions at different stages (or differences in standard care between groups after randomisation). Unable to separate out the effect of cell salvage alone
Zacharowski 2022	Systematic review – references checked for inclusion
Zhou 2014	Non-RCT (no mention of randomisation)
Zhou 2020	Irrelevant intervention (platelet separation)

ANH: acute normovolaemic haemodilution; **CABG:** coronary artery bypass graft; **CPB:** cardiopulmonary bypass; **RBCs:** red blood cells; **RCT:** randomised controlled trial

Characteristics of studies awaiting classification *[ordered by study ID]*

Aghdaii 2012

Methods	Participants undergoing primary, elective, on-pump CABG were randomised to cell savage and autologous transfusion or homologous (allogeneic) blood transfusion. Randomisation methods are not stated. The trial is described as double-blind; however, the method of allocation concealment is not described.
Participants	50 participants undergoing primary, elective, on-pump CABG were randomised to one of two groups: **Group C** (Cell saver autotransfusion group): N = 25. M:F 17:8. Mean (SD) age 55 (14). Mean (SD) weight (kg) 74 (6) **Group H** (Homologous (allogeneic) blood transfusion) (Control): N = 25. M:F 16:9. Mean (SD) age 58 (5.4). Mean (SD) weight (kg) 72 (7) No differences in demographic data between the two groups were identified. There was a statistically significant difference in baseline mean arterial pressure (MAP) between the two groups.
Interventions	**Group C**: cell saver (autotransfusion) group had salvaged blood from the wound, operative field, and cardiopulmonary bypass (CPB) machine processed and reinfused postoperatively. Intraoperative cell salvage of shed blood was used in all participants from skin incision to closure of the sternum at completion of surgery. The type of cell saver used is not given. **Group H**: participants in the control group received allogeneic (homologous) blood transfusion only. The management of blood remaining in the CPB circuit is unclear.
Outcomes	**Outcomes reported**: packed red blood cell (allogeneic) transfusions (mL), activated clotting time (ACT), postoperative blood loss (mL and mL/kg), number of participants receiving allogeneic packed red blood cell transfusion, re-operation for bleeding, mortality to discharge, mean arterial pressure (MAP), central venous pressure (CVP)
Notes	**Transfusion protocol**: a transfusion threshold of Hb < 7 g/dL or haematocrit (Hct) < 21% while on CPB was used. A transfusion trigger of Hb < 8 g/dL or Hct < 24% was used for the control group

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Aghdaii 2012 *(Continued)*

	(Group H) following CPB. The transfusion threshold for the intervention group (Group C) postoperatively is not given. **Prospective registration status**: the trial was not registered prospectively. **Ethical approval**: authors state that the study received Research Ethics Committee approval. The name of the committee and date this approval was received is not available. **Language**: the trial is reported in the English language. **Reason for awaiting classification status**: management of blood remaining in the CPB circuit in the control group is unclear.

Bell 1992

Methods	Participants undergoing CABG, valve replacement (VR), CABG plus VR or re-operation were randomised to either intraoperative cell salvage or standard care. Randomisation was performed according to the theatre to which the participant was randomly allocated. The method of randomisation is not described. The method of allocation concealment is not described. The blinding status of trial participants, staff and outcome assessors is not described.
Participants	320 participants undergoing CABG, VR, CABG plus VR or re-operation were included in the study and randomised to one of the following two groups: **Intraoperative autologous transfusion (IOAT) group**: N = 177. Mean (SD) age 60 (9) **Control group**: N = 143. Mean (SD) age 59 (10) The number of re-operation cases was unbalanced between groups (IOAT 25/177, Control 8/143). Across the entire sample, 227 were male and 93 were female.
Interventions	**IOAT group**: participants underwent intraoperative autologous transfusion using the Haemonetics Cell Saver Mark 4. The machine was operated by a blood transfusion nurse fully trained in aphaeresis procedures. Any blood remaining in the bypass reservoir at the end of the procedure was added to the fluid processed by the Cell Saver. **Control group**: did not receive intraoperative autologous transfusion. Any blood remaining in the bypass reservoir at the end of the procedure for control patients was retransfused to the patient where this was the normal practice of that particular surgeon/anaesthetist team.
Outcomes	**Outcomes reported:** transfusion requirement from the time of operation to discharge from hospital, measured as red cells (red cell concentrate (RCC) and whole blood (WB)) and total donor exposure (red cells plus platelet concentrates, fresh frozen plasma (FFP), and cryoprecipitate). Postoperative haemoglobin concentration, duration of stay on ITU/ICU, use of inotropes, incidence of major complications (including return to theatre, infection, thromboembolism and death prior to discharge)
Notes	**Transfusion protocol:** blood was transfused to maintain a haemoglobin level greater than 8 g/dL during the time on bypass and between 11 and 12 g/dL in the postoperative period. **Prospective registration status:** the registration status of the trial is not described. **Ethical approval:** it is not clear whether the study protocol was reviewed by an institutional review board or ethics committee. **Language:** the trial is reported in the English language.

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Bell 1992 *(Continued)*

	Reason for awaiting classification status: it is unclear whether blood remaining in the CPB circuit in the control group was processed prior to re-transfusion and the number of patients that had blood re-transfused or discarded.

Bouboulis 1994

Methods	Study was conducted between January 1993 and May 1993. Consecutive participants underwent elective or urgent coronary artery bypass surgery. All procedures were performed by the same cardiac surgeon. The method of randomisation and allocation concealment was not described.
Participants	75 consecutive participants undergoing coronary artery bypass graft surgery were randomised into one of two groups: **Autotransfusion group**: N = 42. Mean (SD) age = 60 (7) **Control group**: N = 33. Mean (SD) age = 59 (8) There was a between-group baseline imbalance in cross-clamp time (minutes).
Interventions	**Autotransfusion group**: autotransfusion group received autotransfusion of shed mediastinal blood using the cardiotomy reservoir, after the completion of the coronary artery bypass grafting (CABG). As soon as the chest was closed, the mediastinal tubes were attached to the inlet port of the cardiotomy reservoir, which allows the chest tube drainage to pass through a 20 micron filter. The filtered blood was collected in the bottom of the cardiotomy reservoir, ready for reinfusion. The vacuum port was attached to wall suction apparatus and negative pressure was instituted at 20 cm H_2O. The chest drains were milked every 30 minutes. The collected blood was reinfused using a standard infusion pump. The hourly volume of mediastinal drainage was measured and the infusion pump adjusted to deliver this amount of blood over the next hour. Reinfusion was continued until the drainage was less than or equal to 50 mL per hour for two consecutive hours. **Control group**: control group received standard chest drainage. It is unclear whether blood remaining in the CPB at the end of the procedure was discarded or re-transfused.
Outcomes	**Outcomes reported:** amount of blood collected by the cell saver, amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of participants transfused allogeneic blood, complications, wound infection, re-operation for bleeding, hospital length of stay, fever, mortality
Notes	**Transfusion protocol:** allogeneic packed cells were transfused intraoperatively or postoperatively when the haematocrit fell below 30%. **Prospective registration status:** the study was published prior to 2010. **Ethical approval:** approval by an institutional review board or ethics committee is not described. **Language:** the study is reported in English. **Reason for awaiting classification status:** the study contains a mixed population of participants undergoing elective and urgent surgery. No subgrouping has been performed for these indications.

Cavolli 2011

Methods	40 participants undergoing off-pump coronary artery bypass grafting (CABG) were randomised to one of two groups. The method of randomisation and allocation concealment is not described. The blinding status of participants, personnel, and outcome assessors is not described.
Participants	40 participants undergoing off-pump CABG were randomised to one of two groups:

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Cavolli 2011 *(Continued)*

	Group A (Autotransfusion group): off-pump CABG with cell saver blood transfusion (CSBT) **Group B** (Control group): off-pump CABG without CSBT The abstract declares preoperative patient demographics were well-matched but specific demographic data are not provided.
Interventions	**Group A** (Autotransfusion group): participants underwent off-pump CABG with CSBT **Group B** (Control group): participants underwent off-pump CABG without CSBT
Outcomes	**Outcomes reported:** amount of salvaged mediastinal blood available, volume of homologous blood transfused, postoperative blood loss, clotting profile, postoperative morbidity
Notes	**Transfusion protocol:** homologous blood was transfused when haemoglobin concentration fell below 8 g/dL (80 g/L) postoperatively. **Prospective registration status:** it is unclear whether this RCT was prospectively registered. **Ethical approval:** it is unclear whether approval was received from an ethics committee or institutional review board. **Language:** the conference abstract is available in English. **Reason for awaiting classification status:** study report available as a conference abstract only. Further information required in order for this study to be eligible for inclusion.

ChiCTR-IOR-17010508

Methods	Elderly individuals undergoing spinal surgery were randomly allocated to one of two groups. Randomisation was performed using a random number table. It is unclear how allocation concealment was performed and maintained. The blinding status of participants, personnel, and outcome assessors is not described.
Participants	The study aimed to randomise 60 elderly individuals, between 60 and 80 years of age and of both sexes, undergoing spinal surgery, to one of two groups: **Group 1** (Autotransfusion group): N = 30 **Group 2** (Control group): N = 30
Interventions	**Group 1** (Autotransfusion group): underwent perioperative cell salvage using leucocyte depletion filter and autotransfusion **Group 2** (Control group): received allogeneic blood transfusion
Outcomes	**Outcomes reported**: oxygenation index (OI), respiratory index (RI), alveloar surface-active substances related proteins-A concentration (SP-A) (primary outcome), serum malondialdehyde (MDA), superoxide dismutase (SOD), interleukin 6 (IL-6), tumour necrosis factor (TNF)-alpha concentration, blood transfusion reactions, postoperative respiratory complications within 72 hours
Notes	**Transfusion protocol:** a transfusion protocol is not described **Prospective registration status:** the study was reported to be prospectively registered on the Chinese Clinical Trials registry. **Ethical approval:** the study was approved by the Ethics Committee of Second Affiliated Hospital of Zhejiang Chinese Medical University (No. 20156) on 14 January 2015.

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ChiCTR-IOR-17010508 *(Continued)*

Language: study information on the Chinese Clinical Trials registry in Chinese and English languages

Reason for awaiting classification status: this study corresponds to a trial registration only and lacks sufficient information about intervention and comparator to assess for inclusion.

Damgaard 2010

Methods	Participants were randomised using sealed, opaque, and numbered envelopes to one of two groups: a cell salvage group and a control group. Allocation concealment was achieved during the randomisation process.
Participants	30 participants aged over 18, undergoing CABG, who provided informed consent were randomised to one of the following groups using the methodology described above: **Cell saver**: N = 15. Median (IQR) age 66 (53 to 72). M:F 12:3 **Control**: N = 14. Median (IQR) age 68 (65 to 74). M:F 11:3
Interventions	**Cell saver:** in the cell salvage group, all suctioned blood was processed using an Autolog Cell Saver (Medtronic, Minneapolis, MN) prior to re-transfusion. Residual blood in the cardiopulmonary bypass machine was processed prior to re-transfusion; however, the cardiotomy suction blood was not processed. Autotransfusion was performed immediately postoperatively. **Control**: in the control group, all suctioned blood from before and after the start of CPB was collected using the waste suction and discarded. Cardiotomy suction was used during CPB. It is unclear how blood remaining in the bypass machine at the end of the procedure was handled. No postoperative autotransfusion of drain blood was performed in either group.
Outcomes	**Outcomes reported:** patient plasma concentration of interleukin 6 (IL-6) at 6, 24 and 72 hours after the end of CPB; plasma concentrations of Il-1B, IL-8, IL-10, IL-12, tumour necrosis factor alpha (TNF-a), TNF-R1, sTNF-RII and procalcitonin at 6, 24 and 72 hours after the end of CPB; bleeding; allogeneic transfusions; cell saver effectiveness regarding inflammatory marker reduction; complications
Notes	**Transfusion protocol:** a haemoglobin concentration of < 6 mmol/L or a haematocrit of < 25% triggered an allogeneic transfusion. **Prospective registration status:** the study was not prospectively registered on a trials registry (NCT00159926). **Ethical approval:** the study was approved by the regional research ethics committee to Department of Cardiothoracic Surgery, Rigshospitalet, Copenhagen University Hospital, Blegdamsvej 9, DK-2100 Copenhagen, Denmark. **Language:** the study was published in English. **Reason for awaiting classification status:** it is unclear how blood remaining in the cardiopulmonary bypass circuit was handled.

Dietrich 1989

Methods	The efficacy of four different blood conservation techniques in decreasing allogeneic blood transfusion in different cardiac operations were studied in 100 participants undergoing myocardial

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Dietrich 1989 *(Continued)*

	revascularisation. Method of randomisation and allocation concealment was not described. The blinding status of study participants, personnel, and outcome assessors is not described.
Participants	100 participants undergoing myocardial revascularisation were randomly assigned to one of four groups. The potential comparison of interest in this study was as follows: **Group 4** (intervention) **Group 3** (control) The authors report no differences between groups at baseline.
Interventions	**Group 1**: participants received unprocessed oxygenator blood after the termination of extracorporeal circulation (ECC). **Group 2**: the blood remaining in the oxygenator after ECC was processed to packed cells with a cell separator (Haemonetics Cell Saver) and re-transfused until the end of the operation. **Group 3**: after the induction of anaesthesia and before the start of the operation, isovolumetric haemodilution (harvesting of 10 mL/kg autologous blood) was performed under electrocardiographic and haemodynamic control. The blood loss was replaced with hydroxyethyl starch. After termination of ECC, the blood remaining in the oxygenator was processed by a cell separator. The preoperatively drawn blood and the packed cells were retransfused before the end of the operation. **Group 4**: participants in Group 4 were managed as in Group 3. In addition, the shed mediastinal blood was re-transfused in the ICU. The cardiotomy reservoir of the heart lung machine was used to collect this blood. The drained blood was re-transfused intermittently according to the circulatory state of the patient and when at least 250 mL of blood had been collected in the reservoir. The last re-transfusion was performed 6 hours postoperatively.
Outcomes	**Outcomes reported:** amount of blood re-transfused from the cell saver, amount of allogeneic blood transfused, number of participants transfused allogeneic blood, complications, mortality, ICU length of stay, blood loss, re-exploration for bleeding, operation time, haematological variables, Hct levels
Notes	**Transfusion protocol:** in all participants, signs of hypovolaemia and haematocrit values below 30% were indications for allogeneic blood transfusion. **Prospective registration status:** the study was not prospectively registered. **Ethical approval:** the study received approval from a clinical investigation committee. **Language:** the study was published in English. **Reason for awaiting classification status:** it is unclear whether CPB blood in the control group was discarded or re-transfused.

Fragnito 1995

Methods	To determine if autotransfusion of unwashed shed mediastinal blood led to a reduction in postoperative banked blood requirements. A prospective randomised study of 82 participants undergoing myocardial revascularisation was conducted in 1994 at the Cardiovascular Center of Parma. Method of randomisation and allocation concealment were not described. The blinding status of study participants, personnel, and outcome assessors was not described.
Participants	82 participants undergoing myocardial revascularisation were randomised to one of two groups:

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Fragnito 1995 *(Continued)*

	ATS (Autotransfusion group): N = 41; M:F = 37:4. Mean (SD) age = 60.2 (9.3) **Non-ATS** (No autotransfusion group): N = 41. M:F = 33:8. Mean (SD) age = 62.7 (8.9) The authors report no difference between the groups at baseline. The study contains a mixed population. No subgroup data are provided for the elective participants for inclusion within this review. We have requested the data.
Interventions	**ATS**: Autotransfusion group (Atrium 2550 autotransfusion system) had their drained blood processed using the autotransfusion system. **Non-ATS**: control group did not receive autotransfusion.
Outcomes	**Outcomes reported:** amount of blood collected by the cell saver, number of participants transfused allogeneic blood, amount of allogeneic blood transfused, blood loss, mortality
Notes	**Transfusion protocol:** allogeneic blood transfusion was given during surgery if the haemoglobin level fell below 7.5 g/dL. **Prospective registration status:** it is unclear whether the trial was prospectively registered. **Ethical approval:** it is unclear whether the study received approval from an ethics committee or institutional review board. **Language**: the study was published in Italian. **Reason for awaiting classification status:** the study contains a mixed population. No subgroup data are provided for the elective participants for inclusion within this review. We have requested the data.

Güzel 2016

Methods	Participants undergoing unilateral total knee arthroplasty (TKA) were randomised to one of three groups. The method of randomisation and allocation concealment is not described. The blinding status of participants, study personnel, and outcome assessors is not described. The study is described as randomised in both the abstract and methods; however, the discussion describes its retrospective nature as a limitation. We emailed the authors for clarification (5 December 2022).
Participants	176 people undergoing primary unilateral TKA were randomised to one of three groups: **PAT group** (Postoperative autologous transfusion) (Autotransfusion group): N = 50. M:F 8:42. Mean (SD) age 66.9 (5.1) **Topical TXA group:** N = 50. M:F 7:43. Mean (SD) age 66.5 (5.1) **Routine drainage group** (Control group): N = 50. M:F 10:40. Mean (SD) age 67 (4.5) The groups were comparable for age, gender, and preoperative haemoglobin level at baseline.
Interventions	**PAT group (Postoperative autologous transfusion)** (Autotransfusion group): the CellTrans (SUMMIT, Gloucestershire, UK) autologous transfusion drain was used. A drain was inserted into the knee joint at the end of TKA, and low suction drainage was started 30 minutes later. If more than 150 mL of blood had accumulated within 6 hours, it was re-infused into the patient. After that, the system was used as a normal closed drain system. **Topical TXA group**: a drain and injector tip were placed within the joint before closing the arthrotomy. The drain was clamped and 12.5g TXA (Transamine, FAKO, Istanbul, Turkey) diluted in 100 mL normal saline was injected intra-articularly via the injector tip. The drain was released after 1 hour.

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Güzel 2016 *(Continued)*

	Routine drainage group (Control group): a low-suction drain was placed in the knee joint and removed after 24 hours. The relevant group comparison eligible for inclusion in this review is PAT group versus routine drainage group.
Outcomes	**Outcomes reported**: lowest postoperative haemoglobin concentration, drain volume, number of participants who received allogeneic blood transfusion, total transfusion cost, acute infection, deep venous thrombosis, pulmonary embolism, myocardial infarction, stroke
Notes	**Transfusion protocol:** blood transfusion was indicated when the haemoglobin level fell below 8 g/dL (80 g/L) or the patient was symptomatic of anaemia. **Prospective registration status:** the registration status of the study is not known. **Ethical approval:** the study was approved by the ethics committee associated with Ordu University Medical School, Turkey. **Language:** the study is published in English. **Reason for awaiting classification status:** the study is described as randomised in both the abstract and methods; however, the discussion describes its retrospective nature as a limitation. We emailed the authors for clarification (5 December 2022).

ISRCTN24531848

Methods	Participants undergoing primary total knee replacement were randomised to one of two groups. The method of randomisation and allocation concealment is not described. The blinding status of participants, study personnel, and outcome assessors is not described.
Participants	120 participants undergoing primary total knee replacement were randomised to one of two groups: **Group A** (Control group): N = 60 **Group B** (Autotransfusion group): N = 60
Interventions	**Group A** (Control group): received homologous transfusion **Group B** (Autotransfusion group): received wound drained autotransfusion
Outcomes	The outcome measures used are not known
Notes	**Transfusion protocol:** it is not known whether a transfusion protocol was used. **Prospective registration status:** the study was registered retrospectively on ISRCTN on 12 September 2003. **Ethical approval:** it is not known whether ethical approval was received. **Language:** information on the trial registration on ISRCTN is in English. **Reason for awaiting classification status:** the study corresponds to a trial registration record on ISRCTN, which states the study is completed. There is insufficient information available to determine whether the study meets inclusion criteria.

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ISRCTN55488814

Methods	Participants aged 18 and over scheduled for hip or knee replacement at a single centre were randomised to one of two groups. The method of randomisation and allocation concealment is not described. The trial is described as double-blind but does not state to whom this refers.
Participants	A target of 130 participants aged 18 years and over scheduled for hip or knee replacement surgery at a single centre were randomised to one of two groups: **Autotransfusion group** **Control group**
Interventions	**Autotransfusion group**: the autotransfusion group will receive their own wound blood within 6 hours after the operation **Control group**: the control group will not receive their own wound blood within 6 hours after the operation.
Outcomes	**Outcomes reported**: serum concentrations of Hb, activated partial thromboplastin time (APTT), prothrombin time (PT), fibrinogen, thrombin-antithrombin (TAT) assay. Prothrombin fragment (PF1+2) and D-dimer levels measured at 12 hours pre-operatively, 3 hours postoperatively, 1 and 4 hours after re-infusion of autologous wound blood, 24 hours, 14 days, 6 weeks and 3 months post-operatively; the number of allogeneic blood transfusions registered; colour duplex sonography; number of postoperative transfusion reactions; number of secondary wound infections
Notes	**Transfusion protocol:** a transfusion protocol was used but details of this are not available. **Prospective registration status:** the study was registered retrospectively. **Ethical approval:** the study was approved by the Medical Ethical Board of the Maxima Medical Centre, Eindhoven on 15 April 2004 (ref: 0419). **Language:** study information on the ISRCTN registration page is available in English. **Reason for awaiting classification status:** study information is available from the ISRCTN registration page. Study results are not yet available despite the trial having been completed for more than 2 years. There is insufficient information to determine whether the study is eligible for inclusion.

Lei 2022

Methods	Participants undergoing Caesarean section were randomised at a 1:1 ratio into one of two groups. The method of the 1:1 randomisation is not described. The method of allocation concealment is not described. The blinding status of participants, study personnel, and outcome assessors is not described.
Participants	130 participants undergoing Caesarean section were recruited and randomised to one of two groups: **Intraoperative cell salvage (ICS)** (Autotransfusion group): N = 65. Mean (SD) age 33 (1). Number (%) of emergency Caesarean sections included = 13 (12.31%) **Control group**: N = 65. Mean (SD) age 32 (1). Number (%) of emergency Caesarean sections included = 27 (41.54). Study participants underwent Caesarean section for elective and emergency indications. Results are presented for the mixed population, with no subgrouping for elective and emergency surgery groups.

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Lei 2022 *(Continued)*

Interventions	**Intraoperative cell salvage (ICS) group**: an XTRA Autotransfusion System (LivaNova, UK) was installed before the operation. After delivery and placental separation, an anticoagulant solution (25,000 IU of heparin per 1000 mL of 0.9% NaCl) was dripped into the operation field and mixed with the maternal blood. Blood mixed with anticoagulant saline solution in the surgical field was sucked into the collection reservoir and centrifuged to separate RBCs from other components in the XTRA Autotransfusion SysteM. RBCs were then washed and suspended with 0.9% saline, passed through a white blood cell filter, and infused back into the participant's own circulation as soon as possible. If the participant's haemoglobin was still less than 80 g/L, allogeneic RBCs were provided to increase the haemoglobin level to 80 g/L. **Control group**: participants in the control group were transfused with allogeneic RBCs.
Outcomes	**Outcomes reported**: blood loss, allogeneic RBC transfusion volume, volume of recollected and re-transfused ICS, infusion volume of other blood products, adverse events, surgical complications, infections. Postoperative haemoglobin level, complete blood count, haematocrit level blood gas analysis, electrolytes, liver and kidney function, and coagulation tests were performed at 24 hours and 3 days.
Notes	**Transfusion protocol:** during the operation, ICS or allogeneic RBCs were given to the participants who had a haemoglobin level < 80 g/L to achieve a haemoglobin level ≧ 80 g/L at the end of surgery. **Prospective registration status:** the registration status of the study is not clear. **Ethical approval:** the study received ethical approval from the Ethics Committee of Haidian Maternal and Child Health Hospital, Beijing, China. **Language:** the study is published in English. **Reason for awaiting classification status:** study participants underwent Caesarean section for elective and emergency indications. Results are presented for the mixed population, with no subgrouping for elective and emergency surgery groups.

Liang 2015

Methods	Participants undergoing posterior instrumented spinal fusion for scoliosis were randomised into one of two groups using a probability randomisation scheme. Further details of the randomisation methods are not provided. The method of allocation concealment is not described. The blinding status of participants, study personnel, and outcome assessors is not described.
Participants	110 participants with spinal scoliosis scheduled for posterior instrumented spinal fusion were randomised to one of two groups: **CS group** (Autotransfusion): N = 55. M:F 15:40. Mean(SD) age 15.53(5.6). Mean(SD) BMI 19.56(3.48) kg/m2 **NCS group** (Control): N = 55. M:F 10:45. Mean(SD) age 16.81(6.97). Mean(SD) BMI 19.24(3.08). There were no differences reported between groups at baseline. The study includes a mixed population of patients above and below the age of 18. No subgroup data for patients above and below this age threshold is available in the published manuscript however the authors have been contacted to request the adult (> 18 years) only data (16 Nov 2022).
Interventions	**Cell salvage group** (Autotransfusion): participants were operated on with the use of a machine for intraoperative blood salvage. The Haemonetics Cell Saver 5 cell salvage device was used (Haemonetics Corporation, Braintree, MA, USA).

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Liang 2015 *(Continued)*

	No cell salvage group (Control): participants were operated on without the use of intraoperative blood salvage.
Outcomes	**Outcomes reported**: estimated blood loss, blood drainage after operation, postoperative haemoglobin and haematocrit values, intraoperative allogeneic transfusion, perioperative allogeneic transfusion rate, complications and adverse events
Notes	**Transfusion protocol:** allogeneic blood transfusion was performed if haemoglobin decreased to < 7.0 mg/dL or if anaemia symptoms developed, such as decrease in blood pressure to < 100 mmHg systolic, tachycardia greater than 100 beats/minute, or a low urine output of < 30 mL/hour, even after initial fluid challenge with 500 mL normal saline in patients with haemoglobin level between 7.0 and 8.0 mg/dL. **Prospective registration status:** the registration status of the study is not known. **Ethical approval:** the study consent was approved by an Institutional Review Board. **Language:** the study is published in English. **Reason for awaiting classification status:** the study includes a mixed population of participants above and below the age of 18. No subgroup data for participants above and below this age threshold are available in the published manuscript. We contacted the authors to request the adult (> 18 years) data only (16 November 2022).

Liu 2020

Methods	Participants undergoing Caesarean section were randomised to one of two groups in a 1:1 ratio and according to a random number table generated by a computer. The research centre then performed random grouping according to their assigned patient identification number. The blinding status of study participants, personnel, and outcome assessors is not described.
Participants	116 women undergoing Caesarean section for both elective and emergency indications were randomised to one of the following two groups: **Intraoperative cell salvage (ICS) group** (Autotransfusion): N = 58. Mean (SD) age 35.32 (4.61). Mean (SD) weight 67.61 (5.38) kg **Control group**: N = 58. Mean (SD) age 36.11 (4.83). Mean (SD) weight 68.12 (5.85) kg Participants undergoing Caesarean section for both elective and emergency indications were eligible for inclusion. No subgroup data are provided for the elective Caesarean section participants. We contacted the authors to request this information (15 August 2022).
Interventions	**Intraoperative cell salvage (ICS) group** (Autotransfusion): an autologous blood recycling machine was installed before the operation. After delivery and placental separation, anticoagulant composed of 25,000 IU of heparin per 1000 mL of 0.9% NaCl solution was drip fed (1 drop/s) into the operation field and allowed to mix with the maternal blood in the operative field. The blood-saline solution was then recovered using a separate suction tube of an isolation suction system at a vacuum pressure of 20 KPa into a sterile reservoir and centrifuged to allow larger, denser red blood cell cells (RBCs) to cling to the wall of the tube, while all other blood components were discarded directly to the waste bag. RBCs were washed with and resuspended in sterile isotonic sodium chloride (0.9% NaCl) using a blood recycling machine and then infused back into the patient after passing through a white blood cell filter as soon as possible both during and after surgery. Autologous blood was not stored for more than 6 hours. Amniotic fluid was aspirated using another suction unit. Infusion was stopped when haemoglobin concentration reached 80 g/L. If the patient's haemoglobin concentration was still < 80 g/L, allogeneic red blood cells were infused until haemoglobin concentration reached 80 g/L.

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Liu 2020 *(Continued)*

	Control group: allogeneic RBCs were infused when the haemoglobin concentration was < 80 g/L. When the haemoglobin concentration was ≧ 80 g/L, no blood cell transfusion was given. The amount of RBC transfusion depended on the bleeding amount and rate as well as the haemoglobin level.
Outcomes	**Outcomes reported*:*** haemoglobin concentration at 30 minutes, 24 hours, 3 days and 7 days after surgery or at discharge; coagulation function (prothrombin time/activated partial thromboplastin time (PT/APTT)) at 24 hours, 3 days and 7 days after surgery or at discharge; results of blood gas analysis at 30 minutes and 24 hours after surgery; blood type antibody screened at 5 days after surgery; use of allogeneic blood products during hospitalisation; occurrence of amniotic fluid embolism, sepsis, acute respiratory distress syndrome (ARDS), disseminated intravascular coagulation (DIC), pulmonary embolism (PE), complications of various organ systems and/or complications related to blood transfusion during the postoperative hospitalisation; hospitalisation time and expenses; complications during follow-up; completion of the study, death, withdrawal and rejection
Notes	**Transfusion protocol:** allogeneic RBCs or recovered autologous blood-washed RBCs after filtration were transfused to patients with haemoglobin < 80 g/L in the control or ICS groups, respectively. **Prospective registration status:** the study was prospectively registered on the Chinese Clinical Trials Registry (ChiCTR-ICC-15007096) (28 September 2015). **Ethical approval:** the study received approval from the Hospital Ethical Review Committee (No. 2016-XJS-003-01). **Language:** the study is published in English. **Reason for awaiting classification status:** participants undergoing Caesarean section for both elective and emergency indications were eligible for inclusion. No subgroup data are provided for the elective Caesarean section participants. We contacted the authors to request this information (15 August 2022).

Martin 2009

Methods	Participants undergoing total knee arthroplasty (TKA) were divided into one of three groups. It is unclear whether the study used randomisation. The method of allocation concealment is not clear. The blinding status of study participants, personnel, and outcome assessors is not described.
Participants	150 participants undergoing TKA were divided into one of three groups: **Group A**: three wound drainages with an autotransfusion system and suction. N = 50 **Group B**: no wound drainage. N = 50 **Group C**: one intra-articular wound drainage without suction. N = 50 There was between-group baseline imbalance for age, weight, body surface area, haemoglobin concentration, and red cell mass.
Interventions	**Group A**: three wound drainages with an autotransfusion system and suction **Group B**: no wound drainage **Group C**: one intra-articular wound drainage without suction All participants were treated with tourniquets intraoperatively.

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Martin 2009 *(Continued)*

Outcomes	**Outcomes reported**: haemoglobin values, blood transfusion requirements, blood loss, postoperative range of motion, knee society score, rate of complications
Notes	**Transfusion protocol:** a transfusion protocol is not described. **Prospective registration status:** it is unclear whether the study was prospectively registered. **Ethical approval:** it is unclear whether the study was approved by an ethics committee or institutional review board. **Language:** the available abstract is published in English. **Reason for awaiting classification status:** the study is published as a conference abstract only. Further details regarding the study design are not clear. The abstract does not mention randomisation. More information is required to assess for inclusion.

Matkovic 2010

Methods	Participants undergoing coronary artery bypass grafting (CABG) were randomised to two equal groups. The method of randomisation is not described. The method of allocation concealment is not described. The blinding status of study participants, personnel, and outcome assessors is not described.
Participants	60 participants undergoing CABG were randomised to one of two groups: **Cell salvage group (CS)** **No cell salvage group (control)** Per group demographic data are not described.
Interventions	**Cell salvage group (CS):** had intraoperative cell salvage used **No cell salvage group (Control):** did not have intraoperative cell salvage used
Outcomes	**Outcomes reported*:*** allogeneic transfusion requirements, haematological parameters, postoperative drainage, clinical complications, and mortality
Notes	**Transfusion protocol:** a transfusion protocol is not described. **Prospective registration status:** the registration status of the study is not clear from the information presented in the abstract. **Ethical approval:** it is not clear whether approval was provided by an ethics committee or institutional review board. **Language:** the abstract is published in English. **Reason for awaiting classification status:** information regarding this study is available from a conference abstract only. Further information is required to assess for full inclusion eligibility.

Morgenschweis 2011

Methods	Participants undergoing primary hip or knee replacement were randomised to one of two groups. The method of randomisation and allocation concealment is not described. The blinding status of study participants, personnel, and outcome assessors is not described.

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Morgenschweis 2011 *(Continued)*

Participants	379 participants undergoing primary hip or knee replacement were randomised to one of two groups: **Cell salvage group (Autotransfusion group)** **Control group** Demographic data of the participants are not provided and the authors do not state whether there was any baseline imbalance between groups.
Interventions	**Cell salvage group** (Autotransfusion group): participants underwent primary hip or knee replacement with cell salvage. The collection and recycling of blood was performed by a Latham-bowl discontinued centrifugation processing. **Control group**: participants underwent hip or knee replacement surgery without cell salvage. It is unclear from the abstract whether participants in the cell salvage group, control group, or both had preoperative autologous donation performed.
Outcomes	**Outcomes reported**: rate of allogeneic blood transfusion
Notes	**Transfusion protocol:** it is unclear whether a transfusion protcol was used in the study. **Prospective registration status:** it is not clear whether the study was registered prospectively. **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board. **Language**: the abstract is published in English. **Reason for awaiting classification status:** it is unclear from the abstract whether participants in the cell salvage group, control group, or both had preoperative autologous donation performed.

Murphy 2004

Methods	This randomised controlled trial was designed to ascertain whether cell salvage and autotransfusion after first time elective coronary artery bypass grafting (CABG) is associated with a significant reduction in the use of allogeneic blood, a clinically significant derangement of postoperative clotting profiles, or an increased risk of postoperative bleeding. Between March 2002 and January 2003, patients admitted for CABG operations utilising cardiopulmonary bypass (CPB) were enroled in the study.
Participants	200 participants undergoing first time elective coronary artery bypass grafting (CABG) were randomised to one of two groups: **Autotransfusion group**: N = 99; M:F 86:13. Mean (SD) age 64.35 (9.23) **Control group**: N = 97. M:F = 74:23. Mean (SD) age 62.3 (18.73) There were no differences reported between groups at baseline. NB: a total of 16 participants failed to complete the study. In 4 participants (Autotransfusion n = 1; Control n = 3), it was decided intraoperatively to perform the grafts off-pump. These participants were excluded from further analysis. The remaining 12 participants were included in the analysis on the basis of intention-to-treat.
Interventions	**Autotransfusion group**: autotransfusion group (Autolog, Medtronic) had all blood loss, from skin incision to commencement of CPB and then after administration of protamine to skin closure, salvaged via a single lumen suction tube flushed with heparinised saline (0.9%) connected to the closed rigid collection chamber of the Autolog autotransfusion device at high pressure suction.

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Murphy 2004 *(Continued)*

	During CPB, all spilt blood was aspirated by the CPB machine cardiotomy suckers and returned to the venous reservoir. All blood remaining in the CPB circuit after discontinuation of bypass was re-transfused via the aortic cannula before decannulation and was never transferred to the autotransfuser. Shed mediastinal blood for the first 12 hours postoperatively was collected and autotransfused. **Control group**: control group had all spilt blood before commencement of CPB and after the administration of protamine discarded. Postoperative mediastinal drainage was discarded. There is a lack of information on how bypass blood remaining in the circuit was handled in the control group.
Outcomes	**Outcomes reported*:*** number of participants transfused allogeneic blood, number of participants transfused fresh frozen plasma (FFP), number of participants transfused platelets, volume of blood autotransfused, blood loss, adverse events, mortality, hospital length of stay
Notes	**Transfusion protocol:** participants were transfused allogeneic red blood cells when the haemoglobin level fell below 7.0g/dL or if clinically indicated in patients with excessive blood loss and cardiovascular instability at the discretion of intensive care staff. **Prospective registration status:** it is unclear whether the study was prospectively registered. **Ethical approval:** the study received local ethics committee approval. **Language**: the study is published in English. **Reason for awaiting classification status:** it is unclear how blood remaining in the CPB circuit was managed at the end of the procedure in the control group.

Narula 2015

Methods	Participants undergoing heart valve replacement were randomly assigned to one of two groups. The method of randomisation and allocation concealment is not described. The blinding status of study participants, personnel, and outcome assessors is not described.
Participants	50 participants undergoing heart valve replacement on cardiopulmonary bypass were randomised to one of the two groups: **Intraoperative autologous donation (IAD)group** (Autotransfusion): N = 25 **Control group**: N = 25 The authors do not comment on whether any differences existed between groups at baseline.
Interventions	**Intraoperative autologous donation (IAD)** group (Autotransfusion): participants had 15% of their estimated blood volume extracted and simultaneously replaced with 1:1 colloid. **Control group:** participants received standard care and were not subject to IAD.
Outcomes	**Outcomes reported**: thoracic fluid content (TFC), right atrial pressure, mean arterial pressure, peak and mean airway pressures and oxygenation index, exposure to banked blood transfusion, amount of allogeneic blood transfused, blood component therapy requirement, incidence of massive blood transfusion
Notes	**Transfusion protocol:** a transfusion protocol is not reported in the abstract. **Prospective registration status:** it is not clear whether the study was registered prospectively. **Ethical approval:** it is not clear whether the study received approval from an ethics committee or institutional review board. **Language:** the abstract is published in English.

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Narula 2015 *(Continued)*

	Reason for awaiting classification status: information for this study is available from a published conference abstract only. There is insufficient information to determine whether the study meets eligibility criteria for inclusion.

NCT00950547

Methods	Participants undergoing cardiac surgery were randomised to one of two groups. The method of randomisation and allocation concealment is not described. The study was not blinded.
Participants	350 participants were randomised to one of two groups: **Group 1** (Autotransfusion): N = 175 **Group 2** (Control): N = 175 All participants scheduled for cardiac surgery were eligible. There were no exclusion criteria. The study therefore included a mixed population of emergency and elective cases, paediatric and adult cases. No subgroup data are available for adult patients undergoing elective cardiac surgery.
Interventions	**Group 1** (Autotransfusion): participants received a CardioPAT cell saver device which remained by their bedside during their ICU stay. **Group 2** (Control): participants did not receive any cell saver device. Chest drains were inserted as per standard care, with no possibility to reinfuse lost blood.
Outcomes	**Outcomes reported**: number of transfusions per participant within 10 days of surgery, mortality within 30 days of surgery
Notes	**Transfusion protocol:** a transfusion protocol is not reported. **Prospective registration status:** the study was prospectively registered on clinicaltrials.gov. **Ethical approval:** it is unclear whether the study was approved by an ethics committee or institutional review board. **Language:** the trial registration is published in English. **Reason for awaiting classification status:** the study includes a mixed population of emergency and elective cases, paediatric and adult cases. No subgroup data are available for adult patients undergoing elective cardiac surgery.

NCT01468129

Methods	Participants scheduled for one-stage bilateral total hip arthroplasty were randomised to one of two groups. The method of randomisation and allocation concealment is not described. The blinding status of study participants, personnel, and outcome assessors is not described.
Participants	Participants aged 21 years and over scheduled for one-stage bilateral total hip arthroplasty were randomised to one of two groups: **Cell Saver** (Autotransfusion) group **Non cell saver** (Control) group
Interventions	**Cell saver group** (Autotransfusion) group: participants underwent one-stage bilateral total hip arthroplasty with cell saver

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NCT01468129 *(Continued)*

	Non cell saver (Control) group: participants underwent one-stage bilateral total hip arthroplasty without cell saver
Outcomes	**Outcomes reported**: there are no outcomes available for this study
Notes	**Transfusion protocol:** it is unclear whether there was a transfusion protocol. **Prospective registration status:** it is unclear whether the study was registered prospectively or retrospectively from the trial registration information on clinicaltrials.gov. **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board. **Language**: information on the trial registration is published in English. **Reason for awaiting classification status:** this study has been identified within the clinicaltrials.gov registration database only. Study Start Date: November 2011 Primary Completion Date: December 2012 Last Update Posted: 9 November 2011 Recruitment status was: Recruiting Recruitment Status: Unknown The study has been completed for over two years; however, no publications or data are available. There is insufficient information available to determine whether the study meets eligibility criteria for inclusion.

NCT02058134

Methods	Participants undergoing open-heart surgery with cardiopulmonary bypass (CPB) with an increased risk of bleeding identified preoperatively were randomised to one of two groups. Randomisation was carried out with a 1:1 ratio and was stratified for the inclusion criteria. The method of allocation concealment is not described. The study was not blinded.
Participants	68 participants undergoing open-heart surgery with CPB for coronary artery disease, aortic stenosis, aortic insufficiency, mitral insufficiency, or aortic aneurysm were randomised to one of two groups: **Interventional group** (Autotransfusion) **Control group** A total of 68 participants were recruited prior to study termination.
Interventions	**Interventional group** (Autotransfusion): underwent heart surgery with intra- and postoperative use of the CardioPAT cell saver. The CardioPAT cell saver collects blood from the operative site and from the chest tubes; it washes and concentrates the red blood cells prior to retransfusion to the patient. The group also received identical blood-conserving strategies as the control group. **Control group**: underwent heart surgery with blood-conserving strategies that are currently standard routine at the host institution.
Outcomes	**Outcomes reported**: rate of allogeneic transfusion with red blood cells during hospital admission
Notes	**Transfusion protocol:** a transfusion protocol is not described within the trial registration.

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NCT02058134 *(Continued)*

	Prospective registration status: the trial was registered retrospectively on clinicaltrials.gov. **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board. **Language:** information available in the trial registration is published in English. **Reason for awaiting classification status:** the study was terminated prior to completion. The reason stated is 'due to other trials in the department'. Information available for this study is from the trial registration on clinicaltrials.gov. Insufficient information is available to determine whether the study meets eligibility criteria for inclusion.

Rainaldi 1998

Methods	Participants undergoing Caesarean section were randomly allocated to one of two groups. The method of randomisation is not described. The method of allocation concealment is not described. The blinding status of study participants, personnel, and outcome assessors is not described.
Participants	68 women undergoing Caesarean section were randomly allocated to one of two groups: **Group 1** (Autotransfusion): N = 34. Mean (range) age 33.6 (22 to 43). Mean (SD) body weight 73.3 (12.8) kg **Group 2** (Control): N = 34. Mean (range) age 31.9 (16 to 41). Mean (SD) body weight 71.6(10.5) kg The authors do not comment on whether there were any between-group differences at baseline. Participants included in the study underwent Caesarean section for both elective and emergency indications. No subgroup data are available for participants who underwent elective Caesarean section.
Interventions	**Group 1** (Autotransfusion): blood was salvaged intraoperatively using the Dideco machine (Mirandola, Modena, Italy). Blood salvage was started following extraction of the fetoplacental unit. Aspirated blood was mixed with anticoagulant solution and transferred to a reservoir via a 40-micron filter. It was then centrifuged and washed with isotonic solution. **Group 2** (Control): participants in the control group did not have cell salvage used.
Outcomes	**Outcomes reported**: exposure to homologous red blood cells (RBCs), amount of blood salvaged, mean packed cell volume of reinfused RBCs, mean postoperative haemoglobin concentrations 3 hours after surgery and on days 1, 2, 3 and 4, postoperative complications, duration of hospital stay
Notes	**Transfusion protocol:** a transfusion protocol is not described. **Prospective registration status:** it is not clear whether the study was prospectively registered. **Ethical approval:** the study was approved by the ethics committee of the hospital. **Language**: the study is published in English. **Reason for awaiting classification status:** participants included in the study underwent Caesarean section for both elective and emergency indications. No subgroup data are available for participants who underwent elective Caesarean section.

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Ritter 1994

Methods	A randomised, prospective study of participants undergoing primary total hip or total knee replacement over a six-month period. Method of randomisation and allocation concealment were not described.
Participants	415 participants undergoing primary total hip or total knee replacement were randomly allocated to one of two groups: **Drain group** (Autotransfusion group): n = 215 **No drain group** (Control group): n = 200 Demographic data were not reported.
Interventions	**Drain group**: autotransfusion group received unwashed, filtered autologous blood processed by the Solcotrans autotransfusion system. **No drain group**: control group had no drainage system.
Outcomes	**Outcomes reported*:*** number of participants transfused allogeneic blood, amount of transfused blood, adverse events, knee flexion
Notes	**Transfusion protocol:** allogeneic blood was transfused if the haemoglobin level fell below 9.0g/dL. **Prospective registration status:** it is not clear whether the study was prospectively registered. **Ethical approval:** it is not clear whether the study received ethical approval from an ethics committee or institutional review board. **Language**: the study is published in English. **Reason for awaiting classification status:** there is a lack of detail regarding the intervention and comparison methods.

Shen 2013

Methods	Participants undergoing spinal surgery for scoliosis were randomised to one of two groups. The method of randomisation and allocation concealment is not described. The blinding status of study participants, personnel, and outcome assessors is not described.
Participants	92 participants with scoliosis undergoing primary posterior spinal fusion with segmental spinal instrumentation were randomly allocated to one of two groups: **Intraoperative cell salvage** (Autotransfusion) **No intraoperative cell salvage** (Control) Demographic data for the population are not available, including the age profile of the participants. There is therefore insufficient information to determine whether the study meets eligibility criteria for inclusion. We contacted the authors to request additional information (16 November 2022).
Interventions	**Intraoperative cell salvage** (Autotransfusion): participants had a cell saver machine used for intraoperative blood salvage **No intraoperative cell salvage** (Control): participants did not have intraoperative blood salvage performed

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Shen 2013 *(Continued)*

Outcomes	**Outcomes reported**: perioperative haemoglobin and haematocrit levels, perioperative estimated blood loss, perioperative transfusions, incidence of transfusion-related complications
Notes	**Transfusion protocol:** use of a transfusion protocol is not reported. **Prospective registration status:** it is not clear whether the study was prospectively registered. **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board. **Language:** the conference abstract is published in English. **Reason for awaiting classification status:** demographic data for the population are not available, including the age profile of the participants. There is therefore insufficient information to determine whether the study meets eligibility criteria for inclusion. We contacted the authors to request additional information (16 November 2022).

Simpson 1994

Methods	Consecutive participants scheduled to undergo elective primary total joint arthroplasty were entered into a randomised controlled trial. Method of randomisation and allocation concealment was not described.
Participants	24 participants undergoing elective total joint arthroplasty were randomly assigned to one of two groups: **Study group** (Autotransfusion group): N = 12. M:F 5:7. Mean (range) age = 64.7 (53 to 76) **Control group**: N = 12. M:F 5:7. Mean (range) age 59.6 (41 to 76)
Interventions	**Study group**: cell salvage group had a Solcotrans drain inserted in the operating room and connected to the collection unit and placed under continuous suction (-20 cm H_2O) once wound closure was complete. Collection continued for 6 hours or until the unit was full. At that time, the amount of drainage was noted. If greater than 350 mL, the drainage was reinfused and a new Solcotrans unit connected. ACD-A (citrate-based anticoagulant) was used in each unit (40 mL). If the drainage was greater than 150 mL but less than 350 mL, the drainage was reinfused and a standard, spring-loaded, closed intermittent suction canister was connected. If the drainage was less than 150 mL, the drainage was not reinfused and collection continued, either in the Solcotrans canister or a closed suction drain. **Control group**: control group had drains inserted in the operating room that were connected to a standard, closed system, spring-loaded, intermittent suction device. All participants were entered into an autologous pre-donation programme; however, the pre-donation methodology is unclear. The study does not comment on the volume each individual pre-operatively donated and whether it was a standard amount for all participants (in both groups), which would influence whether they needed homologous blood. NB: drains for both participant groups were discontinued once drainage was less than 40 mL per 8-hour shift.
Outcomes	**Outcomes reported*:*** amount of blood collected by the cell saver, average collection times, blood loss, Hb and Hct levels, coagulation variables
Notes	**Transfusion protocol:** postoperative transfusions were given when the haemoglobin level was less than 10.0 g/dL or the haematocrit was less than 30%. **Prospective registration status:** it is unclear whether the study was prospectively registered.

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Simpson 1994 *(Continued)*

	Ethical approval: it is not clear whether the study was approved by a research ethics committee or institutional review board. **Language:** the study is published in English. **Reason for awaiting classification status:** there is a lack of detail regarding intervention and comparison methods.

Sintes 2009

Methods	Participants undergoing total knee arthroplasty were randomised in a prospective randomised study of postoperative blood salvage using a reinfusion drain. The method of randomisation and allocation concealment are not described. The blinding status of study participants, personnel, and outcome assessors is not described.
Participants	100 participants undergoing total knee arthroplasty with regional anaesthesia were randomised. There were 50 male and 50 female participants recruited to the study. No further demographic data are available.
Interventions	The intervention assessed was the use of the Redax Drentech Surgical postoperative blood recovery system. This is a wound drain used postoperatively which collects blood for reinfusion to the patient. The comparator and intervention groups are not clear.
Outcomes	**Outcomes reported**: mean haemoglobin concentration of recovered blood, requirement of additional transfusion of heterologous blood, mean haemoglobin concentrations, post-transfusion coagulation, volume transfused The abstract reports results of an interim analysis only.
Notes	**Transfusion protocol:** a transfusion protocol is not described in the abstract. **Prospective registration status:** it is not clear whether the study was registered prospectively. **Ethical approval:** it is not clear whether the study was approved by an ethics committee or institutional review board. **Language:** the abstract is published in English. **Reason for awaiting classification status:** there is a lack of detail regarding intervention and comparison methods.

Skoura 1997

Methods	Participants scheduled for elective or emergency orthopaedic or abdominal surgery with massive bleeding were randomly allocated to two groups. The method of randomisation and allocation concealment are not described. The blinding status of study participants, personnel, and outcome assessors is not described.
Participants	108 participants undergoing elective or emergency orthopaedic or abdominal surgery with massive bleeding were randomly allocated to one of two groups: **Group A** (Control group): N = 55 **Group B** (Autotransfusion group): N = 53

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Skoura 1997 *(Continued)*

	No further demographic data for each group are reported.
Interventions	**Group A** (Control group): participants were transfused with stored blood from the blood bank. **Group B** (Autotransfusion group): participants were transfused with autologous blood from the autotransfusion device (red cell saver).
Outcomes	**Outcomes reported:** haemoglobin level, haematocrit, prothrombin time, bilirubin level, number of platelets, mean arterial pressure, heart rate, values of blood gases, potassium, sodium, blood loss, amount of transfused blood
Notes	**Transfusion protocol:** a transfusion protocol is not reported. **Prospective registration status:** unclear if the study was prospectively registered. **Ethical approval:** unclear whether the study was approved by an ethics committee or institutional review board. **Language:** the abstract is published in English. **Reason for awaiting classification status:** this study is published as a conference abstract only. There is insufficient information regarding the mixture of elective and emergency surgery participants in the population to assess its eligibility for inclusion.

Srndic 2014

Methods	Participants undergoing coronary artery revascularisation using cardiopulmonary bypass were randomly allocated to one of three groups. The method of randomisation and allocation concealment is not described. The blinding status of study participants, personnel, and outcome assessors is not described.
Participants	72 participants undergoing coronary artery revascularisation were randomised to one of three groups: **MECC (Minimised extracorporeal circulation system)** **ECC (Extracorporeal circulation system) (Control)** **No-suction ECC (Autotransfusion)** The mean (SD) age across the entire population was 73 (5.3) years. The abstract states that participants were comparable for all preoperative variables between groups. No further demographic information is reported.
Interventions	**MECC (Minimised extracorporeal circulation system)**: participants underwent on-bypass coronary artery revascularisation. The bypass machine was primed with 550 mL and only cell saver suction was used. **ECC (Extracorporeal circulation system) (Control)**: participants underwent on-bypass coronary artery revascularisation. The bypass machine was primed with 1250 mL and only CPB suction was used. **No-suction ECC (Autotransfusion)**: participants underwent on-bypass coronary artery revascularisation. The bypass machine was primed with 1250 mL and only cell saver suction was used.
Outcomes	**Outcomes reported**: inflammatory parameters (interleukin 6 (IL-6), IL-10, tumour necrosis factor alpha (TNF-alpha) and polymorphonuclear (PNM) elastase) were performed preoperatively, intraoperatively and postoperatively; operation time; perfusion time

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Srndic 2014 *(Continued)*

Notes	**Transfusion protocol:** use of a transfusion protocol is not reported. **Prospective registration status:** unclear whether the study was prospectively registered. **Ethical approval:** unclear whether the study was approved by an ethics committee or institutional review board. **Language:** the abstract is published in English. **Reason for awaiting classification status:** insufficient information in the abstract to assess whether the study meets eligibility criteria for inclusion. The groups potentially eligible for inclusion are the ECC (control) versus No-suction ECC (autotransfusion) groups.

Stamenic 2009

Methods	Participants undergoing total hip arthroplasty were randomised into two groups. The method of randomisation and allocation is not described. The blinding status of study participants, personnel, and outcome assessors is not described.
Participants	40 participants were randomised to one of two groups: **Group 1** (Autotransfusion): N = 20. Ratio of primary:revision THA = 11:9 **Group 2** (Control) No further demographic information is available for each group, and it is not known whether there was baseline balance between groups following randomisation.
Interventions	**Group 1** (Autotransfusion): underwent postoperative cell salvage and autotransfusion using the Haemovac Autotransfusion System (Zimmer Company). **Group 2** (Control): did not undergo postoperative cell salvage and autotransfusion and, instead, received classic wound drainage postoperatively.
Outcomes	**Outcomes reported**: average time of blood collection and reinfusion, average amount of reinfusion blood, postoperative haemoglobin and haematocrit levels, coagulation status, incidence of complications
Notes	**Transfusion protocol:** use of a transfusion protocol is not reported **Prospective registration status:** unclear whether the study was registered prospectively **Ethical approval:** unclear whether the study was approved by an ethics committee or institutional review board **Language:** abstract is published in English **Reason for awaiting classification status:** study is published as an abstract only, and the abstract lacks the information needed to determine whether the study meets eligibility criteria for inclusion

Washington 2009

Methods	86 participants undergoing cardiac surgery were randomly assigned to either postoperative cell salvage or a control group. The details of the randomisation method and allocation concealment are not provided. The blinding status of study participants, personnel, and outcome assessors is not described.

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Washington 2009 *(Continued)*

Participants	86 participants (M:F 46:40; primary cardiac surgery n = 79; revision cardiac surgery N = 7) at high bleeding risk were enroled at three sites and randomised to one of the following treatment groups: **Test/CardioPAT group** (autotransfusion group) **Control group** No further demographic data are available for either group.
Interventions	**Test/CardioPAT group:** participants in the Test/CardioPAT group (autologous group) used the CardioPAT postoperatively. **Control group**: participants in the control group did not use cell salvage postoperatively. The abstract does not describe how blood remaining in the bypass machine at the end of the procedures was managed.
Outcomes	**Outcomes reported:** allogeneic transfusion rate, mean number of allogeneic RBC units transfused postoperatively, number of participants who received salvaged blood
Notes	**Transfusion protocol:** site-specific haemoglobin- and haematocrit-based transfusion triggers – these were compatible across all three sites. **Prospective registration status:** study was not prospectively registered with a trials registry but was published prior to 2010. **Ethical approval:** no information available regarding approval received from research ethics committee or institutional review board **Language:** study is published in English **Reason for awaiting classification status:** insufficient information regarding the reinfusion of blood remaining in the CPB circuit. The age of the participant population is unclear.

Wiefferink 2007

Methods	Randomised controlled trial was conducted to investigate the influence of processing both shed mediastinal blood and residual cardiopulmonary bypass (CPB) blood in participants undergoing isolated primary elective myocardial re-vascularisation. Participants were randomly allocated to intervention or control using sealed, opaque, sequentially-numbered envelopes. The sequence of allocations was obtained from a computer-generated random number list. Clinicians in the ICU were blinded to the group.
Participants	30 participants undergoing isolated primary elective myocardial revascularisation were randomly allocated to one of two groups: **Group B** (Autotransfusion group): n = 15; M/F = 13/2; mean (SD) age = 62 (11.0) years **Group A** (Control group): n = 15; M/F = 11/4; mean (SD) age = 66 (8.0) years
Interventions	**Group B**: autotransfusion group had their mediastinal and residual CPB blood processed by a continuous autotransfusion system (C.A.T.S. Fresenius, HemoCare) before reinfusion using the quality wash protocol. **Group A**: control group did not receive autotransfusion. It is unclear whether control group had residual bypass blood processed or not prior to re-transfusion.
Outcomes	**Outcomes reported**: number of participants transfused allogeneic blood, plasma D-dimer levels.

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Wiefferink 2007 *(Continued)*

Notes	**Transfusion protocol:** study does not describe a transfusion protocol **Prospective registration status:** unclear whether the study was prospectively registered **Ethical approval:** study was approved by the local ethical and research council **Language:** study was published in English **Reason for awaiting classification status:** unclear whether the control group had residual CPB circuit blood processed prior to re-transfusion

Yu 2022

Methods	Participants undergoing Caesarean section and blood transfusion were randomised to two groups. Randomisation was performed using a random number table; however, there are repeated mentions of the study being a prospective cohort and one mention of it being cross-sectional in the text. No further information available on how allocation concealment was performed and maintained. The study is described as single-blind; however, the authors do not state to whom this status refers.
Participants	87 participants undergoing Caesarean section and blood transfusion were randomly allocated to one of two groups: **Observation group (Autotransfusion)**: N = 43. Mean age (SD) 35.21 (7.85). Mean (SD) BMI 22.57 (2.25) **Control group**: N = 44. Mean (SD) age 34.64 (8.02). Mean (SD) BMI 22.39 (2.82) There was no baseline imbalance reported between groups following randomisation. It is not clear whether cell salvage was performed for elective or emergency indications.
Interventions	**Observation group (Autotransfusion)**: participants undergoing lower segment Caesarean section (LSCS) were treated with intraoperative cell salvage (IOCS). The Cell Saver type five blood recovery system was used (American Blood Technology Company). The recovery system was pre-washed with 200 mL of normal saline containing 50,000 IU of heparin sodium, and the blood recovery system turned on 10 minutes before surgery. After the amniotic fluid was exhausted and the foetus was delivered, the blood in the surgical field was sucked into the blood storage tank using a negative-pressure suction device. The salvaged blood was then mixed with 50 IU/mL heparin sodium normal saline in a volume ratio of 1:5, and filtered, washed, separated, cleaned, then entered the collection tank. Autotransfusion was performed through a white blood cell filter based on the condition of the participant. **Control group**: participants in the control group undergoing LSCS were treated with traditional allogeneic blood transfusion.
Outcomes	**Outcomes reported**: red blood cell count, platelet volume, fibrinogen value, coagulation status, adverse reactions
Notes	**Transfusion protocol:** red blood cells were transfused when haemoglobin level was < 80 g/L and/or the RBC ratio was < 0.21. Autologous blood was transfused after abdominal closure if the amount of blood lost was less than 20% of the body blood volume. If the amount of blood lost was ≥ 20% of total body blood volume, autologous blood was transfused immediately and allogeneic blood was then used if the participant's vital signs could not be maintained after intraoperative autologous blood transfusion. **Prospective registration status:** unclear if the study was prospectively registered **Ethical approval:** study was approved by the ethics committee of the host institution

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Yu 2022 *(Continued)*	**Language:** study is published in English **Reason for awaiting classification status:** unclear whether the study is a randomised controlled trial. The study participants were randomly allocated to groups and the method of randomisation is described. However, there are repeated mentions of the study being a prospective cohort and one mention of it being cross-sectional in the text. It is unclear whether participants were undergoing Caesarean section for emergency or elective indications. We contacted the authors for clarification (5 December 2022), but have received no response.

ABT: autologous blood transfusion; **ACD-A:** anticoagulant citrate dextrose solution; **AE:** adverse event; **ASA:** American Society of Anesthesiologists; **BMI:** body mass index; **CABG:** coronary artery bypass graft; **CPB:** cardiopulmonary bypass; **DVT:** deep vein thrombosis; **F:** female; **FFP:** fresh frozen plasma; **Hb:** haemoglobin; **Hct:** haematocrit; **ICU:** intensive care unit; **IQR:** interquartile range; **ITT:** intention-to-treat; **LOS:** length of stay; **M:** male; **MACE:** major adverse cardiac events; **PAT:** postoperative autologous transfusion; **PE:** pulmonary embolism; **PJI:** prosthetic joint infection; **RBC:** red blood cell; **SBP:** systolic blood pressure; **SD:** standard deviation; **THA/THR:** total hip arthroplasty/total hip replacement; **TKA/TKR:** total knee arthroplasty/total knee replacement; **TXA:** tranexamic acid

Characteristics of ongoing studies *[ordered by study ID]*

ChiCTR1800018118

Study name	A multicenter prospective randomised controlled trial for the safety of intraoperative salvaged blood in spinal metastasis surgery
Methods	Participants between 18 and 85 years of age undergoing spinal metastasis surgery will be randomised to one of two groups. Computer-generated randomisation will be used. The method, performance, and maintenance of allocation concealment is not described. The blinding status of study participants, personnel, and outcome assessors is not reported.
Participants	The target recruitment number is N = 480. Participants will be randomised to one of two groups: **Group 1** (Control group): N = 240 **Group 2** (Autotransfusion group): N = 240 **Inclusion criteria** • Metastatic tumours of the spine from epithelial origin • Spinal instability; and/or spinal nerve compression, progressive neurological impairment; and/or refractory pain ineffective after conservative treatment • Modified Tokuhashi score ≥ 9 • Age < 75 years • Intraoperative Hb < 90 g/L **Exclusion criteria** • Metastatic tumours of the spinal cord from non-epithelial origin • Spinal primary tumours • Expected lifetime less than 6 months • Cardiopulmonary dysfunction **Note:** age range is described as both 18 to 85 years, and under 75 years, which is contradictory.
Interventions	**Group 1** (Control group) **Group 2** (Autotransfusion group)
Outcomes	Occurrence of new lesions, incidence of transfusion-related adverse reactions
Starting date	Recruiting time: 1 October 2018 to 30 June 2021

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ChiCTR1800018118 *(Continued)*

	Study time: 1 October 2018 to 31 July 2021
Contact information	Zhou Jian: zhou.jian1@zs-hospital.sh.cn Dong Jian: 15921743533@163.com
Notes	**Transfusion protocol:** a transfusion protocol is not described **Prospective registration status:** study was registered prospectively on the Chinese Clinical Trials Registry (date of registration 31 August 2018) **Ethical approval:** study has been approved by the ethics committee of Zhongshan Hospital, Fudan University (B2018-130R) **Language:** information on the Chinese Clinical Trials Registry entry is available in Chinese and English

DRKS00021914

Study name	Haemodynamic relevance of cardiotomy suction blood for the systemic vascular resistance and requirement of catecholamines
Methods	Participants between 50 and 80 years undergoing primary isolated coronary artery bypass grafting (CABG) under cardiopulmonary bypass (CPB) will be randomised to one of two groups. The method of randomisation is not described. The method of allocation concealment is not described. Study participants and data analysts will be blinded to intervention.
Participants	Participants undergoing primary isolated coronary artery bypass grafting (CABG) under cardiopulmonary bypass (CPB) between ages 50 and 80 years will be randomly allocated to one of two groups. The target sample size is N = 40. **Arm 1 (Cardiotomy suction blood)** (Control group) **Arm 2 (Cell saver blood)** (Intervention group) **Inclusion criteria** • Atherosclerotic heart disease • 50 to 80 years • Isolated CABG with planned more than three grafts • Normal haemoglobin level • Ejection fraction more than 30% • Normal creatinine and glomerular filtration rate (GRF) **Exclusion criteria** • Vasoplegic conditions including sepsis, anaphylactic reactions, haemorrhagic shock, or presence of a peripheral vascular disease • Emergency operations, preoperative mechanical circulatory support, combined procedures, or "redos" (revisions). Need for vasoactive substances other than adrenaline, noradrenaline, or dobutamine • Need for a transfusion during the intraoperative measurement interval • In case of an intraoperative complication with a significant bleeding of more than 1200 mL, the participant will be excluded from the study
Interventions	**Arm 1 (Cardiotomy suction blood)** (Control): the collected cardiotomy suction blood will be retransfused unprocessed

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DRKS00021914 *(Continued)*

	Arm 2 (Cell saver blood) (Intervention): the collected cardiotomy suction blood will be processed by a cell saver prior to re-transfusion
Outcomes	Systemic vascular resistance, consumption of sympathomimetics, renal function, blood loss
Starting date	Date of first enrolment: 01 June 2020
Contact information	Mr. Dr. med. Aschraf El-Essawi: aschraf.el-essawi at med.uni-goettingen.de
Notes	**Transfusion protocol:** a transfusion protocol is not reported **Prospective registration status:** trial has been prospectively registered on the German Clinical Trials Register (DRKS) (Date of registration 04 June 2020) **Ethical approval:** study has been approved by an ethics Committee Nr.: 30/09/18, Ethik-Kommission der Medizinischen Fakultät der Georg-August-Universität Göttingen **Language**: information available in the DRKS is available in German and English

NCT02595385 (CONSERVE)

Study name	CONSERVE
Methods	Adult participants aged between 18 and 80 years undergoing single procedure cardiac surgery will be randomised to one of four groups. The method of randomisation and allocation concealment is not described. The study is described as triple-blinded (participants, investigators, and outcome assessors all blinded to intervention allocation).
Participants	Adult participants between 18 and 80 years of age undergoing single procedure cardiac surgery will be randomly allocated to one of four groups (below). The target recruitment number is N = 240. **Retrograde autologous prime alone (RAP)** **Cell salvage alone (CS)** **RAP and CS** **No intervention (Control)** **Inclusion criteria** • Under 80 years of age • Undergoing single procedure surgery • Be on single antiplatelet therapy • To have stopped warfarin preoperatively with an international normalised ratio (INR) of < 1.5 • Have stable coronary disease • Have good left ventricular function **Exclusion criteria** • "Redo procedures" (revisions) • Emergency surgery • Be on dual antiplatelet therapy • Have preoperative kidney dysfunction with an estimated glomerular filtration rate (eGFR) < 60 mL/min • Have postoperative drainage > 200 mL per hour or require re-exploration for bleeding
Interventions	**RAP alone:** retrograde autologous prime of the bypass circuit. To remove 500 to 900 mL of fluid. **Cell salvage alone**: reinfusion of shed blood during the operation

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NCT02595385 (CONSERVE) *(Continued)*

	RAP and cell salvage: RAP and CS used in combination **Control group**: no intervention
Outcomes	Number of units of packed red blood cells transfused, adverse reaction to RAP measured by systolic blood pressure (BP) < 90 mmHg during initiation of bypass
Starting date	February 2015 Estimated study completion date: August 2016 (not updated since November 2015)
Contact information	Contact: Alison Murphy 028 9063 6349 alison.murphy@belfasttrust.hscni.net Contact: Christine Fawsett 028 92 603107 info.orecni@hscni.net
Notes	**Transfusion protocol:** a transfusion protocol is not described **Prospective registration status:** study was prospectively registered on ClinicalTrials.gov (date of registration 03 November 2015) **Ethical approval:** unclear whether the study has been approved by an ethics committee or institutional review board **Language:** information available on ClinicalTrials.gov is in English

NCT03429790

Study name	Cell salvage during Caesarean section (CSCS)
Methods	Adult participants aged over 18 years and undergoing elective or emergency Caesarean section with an identifiable increased risk of haemorrhage will be randomised to one of two groups. The method of randomisation and allocation concealment is not described. The study is described as single-blinded (outcome assessor).
Participants	Adult participants aged over 18 years and undergoing elective or emergency Caesarean section with an identifiable increased risk of haemorrhage will be randomly allocated to one of two groups. The estimated enrolment is N = 120. **Experimental group (intraoperative cell salvage)** **Active comparator (control group)** **Inclusion criteria** • 18 years of age or older • Delivery by elective or emergency Caesarean section with an identifiable increased risk of haemorrhage • Ability to provide informed consent • Participants need blood transfusion **Exclusion criteria**

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NCT03429790 *(Continued)*

	• Hb < 70g/L before operation • History of blood transfusion • RH blood type • Sickle cell disease • Contraindications for intraoperative blood recycling, in the opinion of the obstetrician, anaesthesiologist, or both • Prothrombin time (PT) and activated partial thromboplastin time (APTT) are 1.5 times longer than normal or above, or platelets are less than 50 * 109/L preoperatively • Cultural or social beliefs contraindicating blood transfusion • Significant antibodies making it difficult to find cross-matched blood for transfusion • Participation in another clinical trial within 3 months prior to selection • Inability to provide informed consent
Interventions	**Experimental group (intraoperative cell salvage):** participants will receive intraoperative cell salvage, which collects the participant's blood lost during an operation, processes it, and returns it to their own circulation. Allogeneic blood transfusion will also be given to participants if needed. **Active comparator (control group):** allogeneic blood transfusion will be given to participants if needed.
Outcomes	**Outcomes reported**: blood loss, postoperative haematocrit (Hct) on days 1 and 5, postoperative haemoglobin (HB) concentration on days 1 and 5, postoperative prothrombin time (PT) on days 1 and 5, postoperative activated partial thromboplastin time (APTT) on days 1 and 5, total intraoperative and postoperative blood transfusion, length of hospital stay, first mobilisation
Starting date	1 November 2018 Estimated study completion date: 31 December 2020
Contact information	Contact: Ting LI, M.D. 00447570150148 liting1021@aliyun.com Contact: Li Zhang 008615258775159 zhangli3366@126.com
Notes	**Transfusion protocol:** transfusion will be indicated if Hb concentration falls below 70g/L. If Hb is between 70 and 100 g/L, blood transfusion may be given according to the blood transfusion program and doctor's determination. **Prospective registration status:** study was prospectively registered on ClinicalTrials.gov (date of registration: 12 February 2018) **Ethical approval:** unclear whether the study has been approved by an ethics committee or institutional review board. **Language**: information available on ClinicalTrials.gov is available in English **Status**: Last update posted: 9 October 2018 Recruitment status was: not yet recruiting Recruitment status: unknown Trial registration only. Require more information to assess for inclusion

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NCT04574128

Study name	Retransfusion or not of cardiotomy blood
Methods	Non-inferiority randomised controlled trial of participants undergoing coronary artery bypass grafting (CABG). Adults aged 18 and over will be randomised to one of two groups. The method of randomisation and allocation concealment is not described. The trial is described as double-blinded (participants and care providers). The person that controls the heart and lung machine is not masked. Other members of the surgical team are masked.
Participants	Participants will be adults aged over 18 years undergoing elective CABG. The estimated enrolment number is 40 participants across two groups: **Experimental arm** (Autotransfusion group): N = 20 **No intervention arm** (Control group): N = 20 **Inclusion criteria** • 18+ years • Elective CABG **Exclusion criteria** • Anaemia, infection, massive bleeding, CABG off-pump
Interventions	**Experimental arm** (Autotransfusion group): re-transfusion of cardiotomy blood **No intervention arm** (Control group): no re-transfusion of cardiotomy blood
Outcomes	Blood loss, measured according to haemoglobin concentration and blood volume (mL)
Starting date	1 October 2020 Estimated study completion date: 30 December 2022
Contact information	Contact: Camilla Wistrand, PhD +460707686938 camilla.wistrand@regionorebrolan.se
Notes	**Transfusion protocol:** a transfusion protocol is not described **Prospective registration status:** study was prospectively registered on ClinicalTrials.gov (date of registration: 05 October 2020) **Ethical approval:** not known whether the study has been approved by an ethics committee or institutional review board **Language:** information available on ClinicalTrials.gov is in English **Status**: Last update posted: 5 October 2020 Recruitment status: not yet recruiting

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NCT04922307 (RESTRICT)

Study name	RESTRICT
Methods	Adult participants aged over 18 years undergoing radical nephrectomy for locally advanced kidney cancer will be randomised to one of two groups. The method of randomisation and allocation concealment is not described. The study will be single-blinded (participant).
Participants	Adult participants aged over 18 years undergoing radical nephrectomy for locally advanced kidney cancer will be randomly allocated to one of two groups. The estimated enrolment number is 240. **Experimental group (blood-sparing protocol)** (Autotransfusion group): N = 120 **Active comparator group (standard blood replacement)** (Control group): N = 120 **Inclusion criteria** • Renal masses ≥ cT2 (by any conventional imaging) • N1 or M1 disease is allowed if they are deemed surgical candidates (including cytoreductive nephrectomy) • Male and female patients • 18 and older • Ejection fraction (EF) ≥ 45% by echocardiogram (ECHO) Adequate organ function as defined by: • Haemoglobin ≥ 9 g/dL. Pre-operative allogenic blood transfusion is allowed • Platelets ≥ 100.000/µl • Albumin ≥ 2.5 g/dL • Aspartate aminotransferase (AST) and alanine transaminase (ALT) ≤ 75 U/L or total bilirubin ≤ 2.0 mg/dL • White blood cell (WBC) within institutional normal limits • Prothrombin time (PT) within institutional normal limits • International normalised ratio (INR) < 1.5 and partial thromboplastin time (PTT) normal • Consent and compliance with all aspects of the study protocol **Exclusion criteria** • Males and females younger than 18 years • Non-surgical candidate • Unstable angina
Interventions	**Experimental group (blood-sparing protocol)** (Autotransfusion group): the intervention group will undergo radical nephrectomy with blood-sparing techniques. Blood-sparing techniques will include acute normovolaemic haemodilution (ANH), Cell Saver (intraoperative) and/or veno-venous bypass. **Active comparator group (standard blood replacement)** (Control group): the control group will undergo radical nephrectomy without blood-sparing techniques (i.e. standard care). Participants who need blood transfusion will received cross-matched allogeneic blood products.
Outcomes	Number of units of allogeneic blood transfusions, number of complications, grade of complications, kidney cancer recurrence, overall survival, quality of life (Functional Assessment of Cancer Therapy-Kidney Symptom Index (FSKI-19))
Starting date	10 June 2021 Estimated primary completion date: 15 June 2024 Estimated study completion date: 15 June 2026

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NCT04922307 (RESTRICT) *(Continued)*

Contact information	Principal Investigator: Kelvin Moses, Vanderbilt University Medical Center No contact information provided
Notes	**Transfusion protocol:** use of a transfusion protocol is not reported **Prospective registration status:** study was prospectively registered on ClinicalTrials.gov (date of registration: 10 June 2021) **Ethical approval:** not known whether the study has been approved by an ethics committee or institutional review board **Language**: information available on ClinicalTrials.gov is in English **Status:** Last update posted: 31 August 2022 Recruitment status: suspended (funding)

NCT05612477

Study name	SOLT
Methods	Single-centre randomised pilot study of adults aged over 18 years undergoing liver transplantation for hepatocellular carcinoma (HCC). The method of randomisation and allocation concealment is not described. The study is described as double-blind (investigator and outcome assessor).
Participants	Adults aged over 18 years undergoing liver transplantation for hepatocellular carcinoma (HCC) will be randomly allocated to one of two groups. The estimated enrolment number is 30 participants. **Experimental arm** (Autotransfusion group) **No intervention arm** (Control group) **Inclusion criteria** • 18 years or older • Listed for a liver transplant • Diagnosis of hepatocellular carcinoma **Exclusion criteria** • Malignancy other than HCC, such as mixed cholangiocarcinoma-hepatocellular carcinoma, cholangiocarcinoma, and metastatic colorectal cancer. Patients who had a preoperative diagnosis of HCC but a postoperative diagnosis of any of the above will be analysed separately. • Pediatric participants (age <18 years at the time of screening) • Participants undergoing re-transplantation • Multi-organ transplantation
Interventions	**Experimental arm** (Autotransfusion group): participants in the experimental group will have blood collected from the surgical field, washed, processed and re-transfused **No intervention arm** (Control group): participants in the control group will have their salvaged and washed red blood cells discarded
Outcomes	Feasability - accrual (how many participants who consent to the trial will experience enough blood loss during surgery to be randomisable according to the study design); feasability - enrolment (whether it is possible to meet enrolment goals within the study period); safety - HCC recurrence

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NCT05612477 *(Continued)*

Starting date	07 November 2022
Contact information	Contact: Erin Winter, BSc 416-340-4800 ext 6093 erin.winter@uhn.ca Contact: Gonzalo Sapisochin, MD, PhD 416-340-4800
Notes	**Transfusion protocol:** use of a transfusion protocol is not reported **Prospective registration status:** study was registered prospectively on ClinicalTrials.gov (date of registration 10 November 2022) **Ethical approval:** not known whether the study has been approved by an ethics committee or institutional review board **Language:** information available on ClinicalTrials.gov is in English **Status:** Last update posted: 10 November 2022 Not yet recruiting

Hb: haemoglobin

DATA AND ANALYSES

Comparison 1. All surgeries

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1.1 Transfusions	82	12520	Risk Ratio (M-H, Random, 95% CI)	0.65 [0.59, 0.72]
1.1.1 CV (vascular)	4	266	Risk Ratio (M-H, Random, 95% CI)	0.61 [0.32, 1.15]
1.1.2 CV (no bypass)	3	169	Risk Ratio (M-H, Random, 95% CI)	0.82 [0.69, 0.97]
1.1.3 CV (with bypass)	25	2676	Risk Ratio (M-H, Random, 95% CI)	0.81 [0.73, 0.89]
1.1.4 Obstetrics	1	1349	Risk Ratio (M-H, Random, 95% CI)	0.82 [0.39, 1.74]
1.1.5 Orthopaedic (hip)	14	1641	Risk Ratio (M-H, Random, 95% CI)	0.52 [0.37, 0.72]
1.1.6 Orthopaedic (knee)	21	2214	Risk Ratio (M-H, Random, 95% CI)	0.47 [0.35, 0.65]
1.1.7 Orthopaedic (spinal)	3	194	Risk Ratio (M-H, Random, 95% CI)	0.44 [0.31, 0.63]
1.1.8 Orthopaedic (mixed)	11	4011	Risk Ratio (M-H, Random, 95% CI)	0.64 [0.45, 0.90]
1.2 Transfusions (sensitivity: registration)	58	6353	Risk Ratio (M-H, Random, 95% CI)	0.62 [0.55, 0.70]

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Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1.2.1 CV (vascular)	4	266	Risk Ratio (M-H, Random, 95% CI)	0.61 [0.32, 1.15]
1.2.2 CV (no bypass)	3	169	Risk Ratio (M-H, Random, 95% CI)	0.82 [0.69, 0.97]
1.2.3 CV (with bypass)	20	1756	Risk Ratio (M-H, Random, 95% CI)	0.79 [0.70, 0.89]
1.2.4 Obstetrics	1	1349	Risk Ratio (M-H, Random, 95% CI)	0.82 [0.39, 1.74]
1.2.5 Orthopaedic (hip)	7	585	Risk Ratio (M-H, Random, 95% CI)	0.47 [0.27, 0.80]
1.2.6 Orthopaedic (knee)	13	1210	Risk Ratio (M-H, Random, 95% CI)	0.40 [0.26, 0.60]
1.2.7 Orthopaedic (spinal)	2	145	Risk Ratio (M-H, Random, 95% CI)	0.54 [0.34, 0.85]
1.2.8 Orthopaedic (mixed)	8	873	Risk Ratio (M-H, Random, 95% CI)	0.53 [0.39, 0.72]
1.3 Transfusions (sensitivity: low risk of bias (ROB))	17	6398	Risk Ratio (M-H, Random, 95% CI)	0.74 [0.61, 0.89]
1.3.1 CV (vascular)	1	100	Risk Ratio (M-H, Random, 95% CI)	0.92 [0.70, 1.19]
1.3.2 CV (no bypass)	1	61	Risk Ratio (M-H, Random, 95% CI)	0.59 [0.19, 1.81]
1.3.3 CV (with bypass)	5	1344	Risk Ratio (M-H, Random, 95% CI)	0.82 [0.70, 0.97]
1.3.4 Obstetrics	1	1349	Risk Ratio (M-H, Random, 95% CI)	0.82 [0.39, 1.74]
1.3.5 Orthopaedic (hip)	1	200	Risk Ratio (M-H, Random, 95% CI)	0.36 [0.26, 0.51]
1.3.6 Orthopaedic (knee)	4	544	Risk Ratio (M-H, Random, 95% CI)	0.66 [0.29, 1.50]
1.3.7 Orthopaedic (spinal)	1	50	Risk Ratio (M-H, Random, 95% CI)	0.50 [0.05, 5.17]
1.3.8 Orthopaedic (mixed)	3	2750	Risk Ratio (M-H, Random, 95% CI)	0.74 [0.35, 1.59]
1.4 Transfusions (subgroup: timing)	82	12520	Risk Ratio (M-H, Random, 95% CI)	0.66 [0.59, 0.72]
1.4.1 Intraoperative	20	3193	Risk Ratio (M-H, Random, 95% CI)	0.70 [0.60, 0.82]
1.4.2 Postoperative	52	5710	Risk Ratio (M-H, Random, 95% CI)	0.58 [0.50, 0.68]
1.4.3 Intra- and postoperative	13	3617	Risk Ratio (M-H, Random, 95% CI)	0.84 [0.71, 1.00]
1.5 Transfusions (subgroup: transfusion threshold)	82	12520	Risk Ratio (M-H, Random, 95% CI)	0.65 [0.59, 0.72]
1.5.1 Restrictive (Hb ≦ 80 g/L)	27	5967	Risk Ratio (M-H, Random, 95% CI)	0.72 [0.61, 0.85]
1.5.2 Liberal (Hb > 80 g/L)	35	3461	Risk Ratio (M-H, Random, 95% CI)	0.59 [0.50, 0.69]

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Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1.5.3 No threshold/protocol reported	20	3092	Risk Ratio (M-H, Random, 95% CI)	0.64 [0.49, 0.83]

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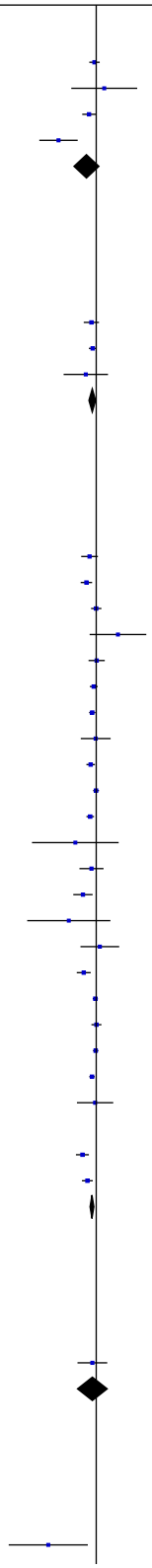
Analysis 1.1. Comparison 1: All surgeries, Outcome 1: Transfusions

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Risk Ratio M-H, Random, 95% CI
1.1.1 CV (vascular)						
Clagett 1999	33	50	36	50	2.1%	0.92 [0.70 , 1.19]
Kelley-Patteson 1993	3	18	2	18	0.3%	1.50 [0.28 , 7.93]
Mercer 2004	21	40	31	41	1.9%	0.69 [0.49 , 0.98]
Spark 1997	3	23	26	26	0.7%	0.15 [0.06 , 0.39]
Subtotal (95% CI)		**131**		**135**	**5.0%**	**0.61 [0.32 , 1.15]**
Total events:	60		95			
Heterogeneity: Tau² = 0.27; Chi² = 16.47, df = 3 (P = 0.0009); I² = 82%						
Test for overall effect: Z = 1.53 (P = 0.12)						
1.1.2 CV (no bypass)						
Damgaard 2006	17	30	21	29	1.8%	0.78 [0.53 , 1.15]
Goel 2007	20	24	25	25	2.2%	0.84 [0.69 , 1.01]
Murphy 2005	4	30	7	31	0.6%	0.59 [0.19 , 1.81]
Subtotal (95% CI)		**84**		**85**	**4.6%**	**0.82 [0.69 , 0.97]**
Total events:	41		53			
Heterogeneity: Tau² = 0.00; Chi² = 0.70, df = 2 (P = 0.71); I² = 0%						
Test for overall effect: Z = 2.31 (P = 0.02)						
1.1.3 CV (with bypass)						
Axford 1994	10	16	14	16	1.7%	0.71 [0.47 , 1.09]
Dalrymple-Hay 1999	28	56	46	56	2.0%	0.61 [0.46 , 0.81]
Eng 1990	17	20	17	20	2.1%	1.00 [0.77 , 1.30]
Gäbel 2013a	6	15	2	15	0.4%	3.00 [0.72 , 12.55]
Klein 2008	31	102	33	111	1.7%	1.02 [0.68 , 1.54]
Koopman-van Gemert 1993a	15	17	20	20	2.2%	0.88 [0.72 , 1.07]
Lepore 1989	50	67	62	68	2.3%	0.82 [0.70 , 0.96]
Marberg 2010	10	39	10	38	1.0%	0.97 [0.46 , 2.07]
Martin 2000	54	98	73	100	2.2%	0.75 [0.61 , 0.94]
Page 1989	42	48	45	51	2.3%	0.99 [0.86 , 1.15]
Parrot 1991	32	44	22	22	2.2%	0.74 [0.61 , 0.89]
Pleym 2005	1	23	3	24	0.2%	0.35 [0.04 , 3.11]
Reyes 2011	12	34	13	29	1.3%	0.79 [0.43 , 1.45]
Schmidt 1996	15	53	31	56	1.5%	0.51 [0.31 , 0.83]
Schönberger 1993	1	20	4	20	0.2%	0.25 [0.03 , 2.05]
Scrascia 2012	6	17	5	17	0.7%	1.20 [0.45 , 3.19]
Shen 2016	22	53	39	50	1.9%	0.53 [0.37 , 0.76]
Shirvani 1991	20	21	21	21	2.3%	0.95 [0.84 , 1.09]
Thurer 1979	37	54	40	59	2.1%	1.01 [0.79 , 1.30]
Unsworth 1996	63	71	31	34	2.3%	0.97 [0.85 , 1.11]
Vermeijden 2015	173	364	207	352	2.3%	0.81 [0.70 , 0.93]
Ward 1993	6	18	6	17	0.8%	0.94 [0.38 , 2.36]
Westerberg 2004	0	12	0	17		Not estimable
Xie 2015	27	72	52	69	1.9%	0.50 [0.36 , 0.69]
Zhao 2003	19	30	30	30	2.1%	0.64 [0.49 , 0.84]
Subtotal (95% CI)		**1364**		**1312**	**39.8%**	**0.81 [0.73 , 0.89]**
Total events:	697		826			
Heterogeneity: Tau² = 0.03; Chi² = 64.51, df = 23 (P < 0.00001); I² = 64%						
Test for overall effect: Z = 4.38 (P < 0.0001)						
1.1.4 Obstetrics						
Khan 2017 (SALVO)	12	665	15	684	1.0%	0.82 [0.39 , 1.74]
Subtotal (95% CI)		**665**		**684**	**1.0%**	**0.82 [0.39 , 1.74]**
Total events:	12		15			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.51 (P = 0.61)						
1.1.5 Orthopaedic (hip)						
Ayers 1995	1	67	15	89	0.2%	0.09 [0.01 , 0.65]



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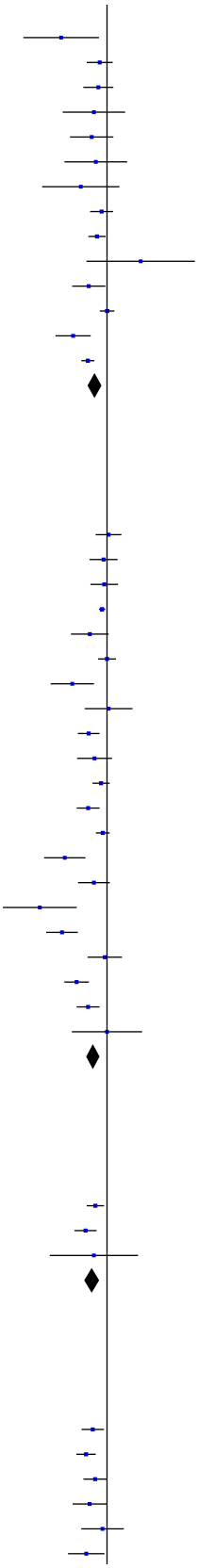
Analysis 1.1. (Continued)

1.1.5 Orthopaedic (hip)						
Ayers 1995	1	67	15	89	0.2%	0.09 [0.01 , 0.65]
Cheung 2010	9	53	25	100	1.1%	0.68 [0.34 , 1.35]
Elawad 1991	6	19	10	20	0.9%	0.63 [0.29 , 1.40]
Horstmann 2012	2	50	4	50	0.3%	0.50 [0.10 , 2.61]
Horstmann 2013	4	102	9	102	0.6%	0.44 [0.14 , 1.40]
Horstmann 2014a	2	56	4	62	0.3%	0.55 [0.11 , 2.91]
Kleinert 2012	1	40	8	80	0.2%	0.25 [0.03 , 1.93]
Lorentz 1991	8	16	10	15	1.3%	0.75 [0.41 , 1.38]
Menges 1992	8	14	12	12	1.6%	0.59 [0.37 , 0.93]
Rollo 1995	5	75	0	40	0.1%	5.93 [0.34 , 104.67]
Smith 2007	6	76	17	82	0.8%	0.38 [0.16 , 0.92]
Teetzman 2014	29	74	34	87	1.8%	1.00 [0.68 , 1.48]
Tripkovic 2008	4	30	24	30	0.8%	0.17 [0.07 , 0.42]
Zhao 2016	31	127	49	73	1.9%	0.36 [0.26 , 0.51]
Subtotal (95% CI)		**799**		**842**	**12.0%**	**0.52 [0.37 , 0.72]**
Total events:	116		221			
Heterogeneity: Tau² = 0.18; Chi² = 30.62, df = 13 (P = 0.004); I² = 58%						
Test for overall effect: Z = 3.91 (P < 0.0001)						
1.1.6 Orthopaedic (knee)						
Abuzakuk 2007	13	52	12	52	1.1%	1.08 [0.55 , 2.15]
Adalberth 1998	8	24	10	25	1.0%	0.83 [0.40 , 1.75]
Amin 2008	12	92	13	86	1.1%	0.86 [0.42 , 1.79]
Blatsoukas 2010	99	163	67	85	2.3%	0.77 [0.65 , 0.91]
Cheng 2005	4	26	13	34	0.7%	0.40 [0.15 , 1.09]
Cip 2013	23	70	23	70	1.6%	1.00 [0.62 , 1.61]
Dramis 2006	3	32	10	17	0.6%	0.16 [0.05 , 0.50]
Dutton 2012	4	23	4	25	0.5%	1.09 [0.31 , 3.85]
Heddle 1992	10	39	27	40	1.3%	0.38 [0.21 , 0.68]
Horstmann 2014b	6	59	11	56	0.8%	0.52 [0.21 , 1.31]
Laszczyca 2015	15	38	34	63	1.6%	0.73 [0.46 , 1.15]
Majkowski 1991	7	20	19	20	1.3%	0.37 [0.20 , 0.68]
Munteanu 2009	24	50	30	50	1.8%	0.80 [0.55 , 1.15]
Newman 1997	3	35	28	35	0.6%	0.11 [0.04 , 0.32]
Rosencher 1994	6	20	6	10	0.9%	0.50 [0.22 , 1.16]
Sait 1999	1	60	35	60	0.2%	0.03 [0.00 , 0.20]
Šarkanoviü 2013	5	55	56	57	0.9%	0.09 [0.04 , 0.21]
Schnurr 2018	8	100	9	100	0.8%	0.89 [0.36 , 2.21]
Shenolikar 1997	8	50	40	50	1.2%	0.20 [0.10 , 0.38]
Thomas 2001	12	115	33	116	1.3%	0.37 [0.20 , 0.67]
Touzopoulos 2021	2	20	2	20	0.3%	1.00 [0.16 , 6.42]
Subtotal (95% CI)		**1143**		**1071**	**21.8%**	**0.47 [0.35 , 0.65]**
Total events:	273		482			
Heterogeneity: Tau² = 0.37; Chi² = 105.05, df = 20 (P < 0.00001); I² = 81%						
Test for overall effect: Z = 4.66 (P < 0.00001)						
1.1.7 Orthopaedic (spinal)						
Djurasovic 2018	16	48	29	47	1.6%	0.54 [0.34 , 0.86]
NCT01251042	8	26	22	23	1.3%	0.32 [0.18 , 0.58]
Riou 1994	1	25	2	25	0.2%	0.50 [0.05 , 5.17]
Subtotal (95% CI)		**99**		**95**	**3.1%**	**0.44 [0.31 , 0.63]**
Total events:	25		53			
Heterogeneity: Tau² = 0.00; Chi² = 1.88, df = 2 (P = 0.39); I² = 0%						
Test for overall effect: Z = 4.46 (P < 0.00001)						
1.1.8 Orthopaedic (mixed)						
Atay 2010	10	37	23	40	1.3%	0.47 [0.26 , 0.85]
Gannon 1991	16	124	45	115	1.5%	0.33 [0.20 , 0.55]
Healy 1994	14	75	15	43	1.2%	0.54 [0.29 , 1.00]
Koopman-van Gemert 1993b	5	29	13	30	0.8%	0.40 [0.16 , 0.97]
Mauerhan 1993	5	57	6	54	0.6%	0.79 [0.26 , 2.44]
Moonen 2007	5	80	15	80	0.7%	0.33 [0.13 , 0.87]



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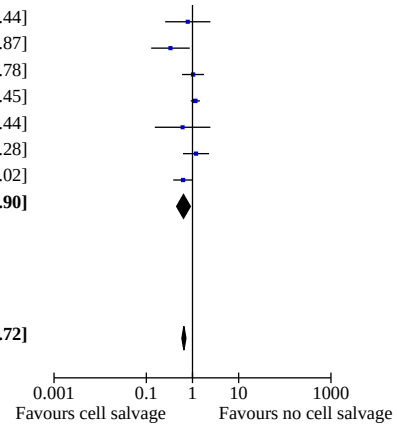
Analysis 1.1. (Continued)

Mauerhan 1993	5	57	6	54	0.6%	0.79 [0.26 , 2.44]
Moonen 2007	5	80	15	80	0.7%	0.33 [0.13 , 0.87]
So-Osman 2006	22	47	10	22	1.4%	1.03 [0.59 , 1.78]
So-Osman 2014	183	1481	103	961	2.2%	1.15 [0.92 , 1.45]
Springer 2016	3	60	5	61	0.4%	0.61 [0.15 , 2.44]
Thomassen 2014	29	385	12	190	1.2%	1.19 [0.62 , 2.28]
Zhang 2008	10	20	16	20	1.5%	0.63 [0.38 , 1.02]
Subtotal (95% CI)		**2395**		**1616**	**12.8%**	**0.64 [0.45 , 0.90]**
Total events:	302		263			
Heterogeneity: Tau² = 0.21; Chi² = 35.09, df = 10 (P = 0.0001); I² = 72%						
Test for overall effect: Z = 2.58 (P = 0.010)						
Total (95% CI)		**6680**		**5840**	**100.0%**	**0.65 [0.59 , 0.72]**
Total events:	1526		2008			
Heterogeneity: Tau² = 0.10; Chi² = 328.43, df = 80 (P < 0.00001); I² = 76%						
Test for overall effect: Z = 8.48 (P < 0.00001)						
Test for subgroup differences: Chi² = 25.72, df = 7 (P = 0.0006), I² = 72.8%						



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Analysis 1.2. Comparison 1: All surgeries, Outcome 2: Transfusions (sensitivity: registration)

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Risk Ratio M-H, Random, 95% CI
1.2.1 CV (vascular)						
Clagett 1999	33	50	36	50	2.7%	0.92 [0.70 , 1.19]
Kelley-Patteson 1993	3	18	2	18	0.5%	1.50 [0.28 , 7.93]
Mercer 2004	21	40	31	41	2.5%	0.69 [0.49 , 0.98]
Spark 1997	3	23	26	26	1.1%	0.15 [0.06 , 0.39]
Subtotal (95% CI)		**131**		**135**	**6.7%**	**0.61 [0.32 , 1.15]**
Total events:	60		95			
Heterogeneity: Tau² = 0.27; Chi² = 16.47, df = 3 (P = 0.0009); I² = 82%						
Test for overall effect: Z = 1.53 (P = 0.12)						
1.2.2 CV (no bypass)						
Damgaard 2006	17	30	21	29	2.4%	0.78 [0.53 , 1.15]
Goel 2007	20	24	25	25	2.8%	0.84 [0.69 , 1.01]
Murphy 2005	4	30	7	31	0.9%	0.59 [0.19 , 1.81]
Subtotal (95% CI)		**84**		**85**	**6.1%**	**0.82 [0.69 , 0.97]**
Total events:	41		53			
Heterogeneity: Tau² = 0.00; Chi² = 0.70, df = 2 (P = 0.71); I² = 0%						
Test for overall effect: Z = 2.31 (P = 0.02)						
1.2.3 CV (with bypass)						
Axford 1994	10	16	14	16	2.3%	0.71 [0.47 , 1.09]
Dalrymple-Hay 1999	28	56	46	56	2.6%	0.61 [0.46 , 0.81]
Eng 1990	17	20	17	20	2.7%	1.00 [0.77 , 1.30]
Klein 2008	31	102	33	111	2.3%	1.02 [0.68 , 1.54]
Koopman-van Gemert 1993a	15	17	20	20	2.8%	0.88 [0.72 , 1.07]
Lepore 1989	50	67	62	68	2.9%	0.82 [0.70 , 0.96]
Martin 2000	54	98	73	100	2.8%	0.75 [0.61 , 0.94]
Page 1989	42	48	45	51	2.9%	0.99 [0.86 , 1.15]
Parrot 1991	32	44	22	22	2.8%	0.74 [0.61 , 0.89]
Pleym 2005	1	23	3	24	0.3%	0.35 [0.04 , 3.11]
Schmidt 1996	15	53	31	56	2.1%	0.51 [0.31 , 0.83]
Schönberger 1993	1	20	4	20	0.3%	0.25 [0.03 , 2.05]
Shen 2016	22	53	39	50	2.4%	0.53 [0.37 , 0.76]
Shirvani 1991	20	21	21	21	2.9%	0.95 [0.84 , 1.09]
Thurer 1979	37	54	40	59	2.7%	1.01 [0.79 , 1.30]
Unsworth 1996	63	71	31	34	2.9%	0.97 [0.85 , 1.11]
Ward 1993	6	18	6	17	1.2%	0.94 [0.38 , 2.36]
Westerberg 2004	0	12	0	17		Not estimable
Xie 2015	27	72	52	69	2.5%	0.50 [0.36 , 0.69]
Zhao 2003	19	30	30	30	2.6%	0.64 [0.49 , 0.84]
Subtotal (95% CI)		**895**		**861**	**43.9%**	**0.79 [0.70 , 0.89]**
Total events:	490		589			
Heterogeneity: Tau² = 0.04; Chi² = 66.47, df = 18 (P < 0.00001); I² = 73%						
Test for overall effect: Z = 4.03 (P < 0.0001)						
1.2.4 Obstetrics						
Khan 2017 (SALVO)	12	665	15	684	1.5%	0.82 [0.39 , 1.74]
Subtotal (95% CI)		**665**		**684**	**1.5%**	**0.82 [0.39 , 1.74]**
Total events:	12		15			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.51 (P = 0.61)						
1.2.5 Orthopaedic (hip)						
Ayers 1995	1	67	15	89	0.4%	0.09 [0.01 , 0.65]
Elawad 1991	6	19	10	20	1.4%	0.63 [0.29 , 1.40]
Lorentz 1991	8	16	10	15	1.8%	0.75 [0.41 , 1.38]
Menges 1992	8	14	12	12	2.2%	0.59 [0.37 , 0.93]
Rollo 1995	5	75	0	40	0.2%	5.93 [0.34 , 104.67]
Smith 2007	6	76	17	82	1.2%	0.38 [0.16 , 0.92]

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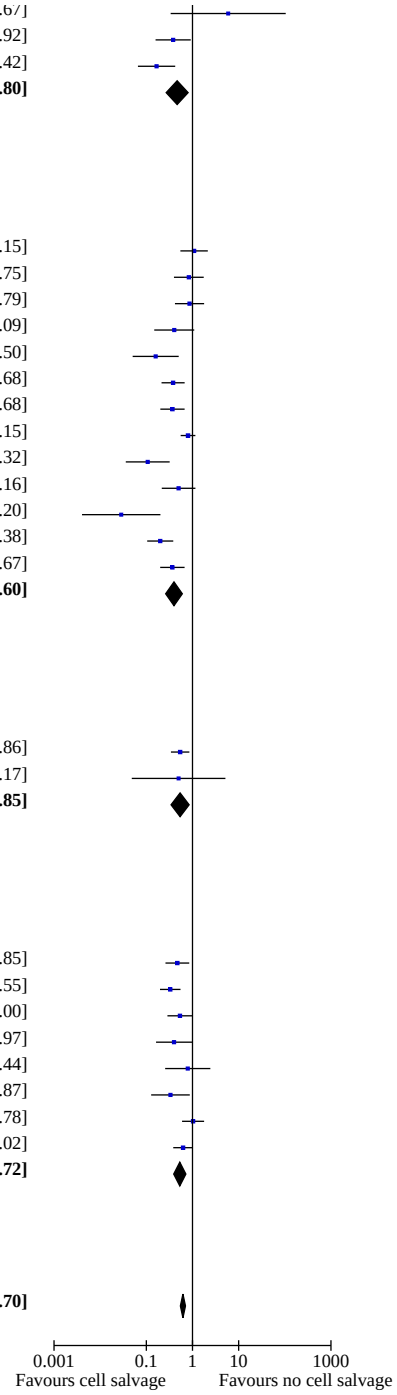
Analysis 1.2. (Continued)

Rollo 1995	5	75	0	40	0.2%	5.93 [0.34 , 104.67]
Smith 2007	6	76	17	82	1.2%	0.38 [0.16 , 0.92]
Tripkovic 2008	4	30	24	30	1.1%	0.17 [0.07 , 0.42]
Subtotal (95% CI)		**297**		**288**	**8.2%**	**0.47 [0.27 , 0.80]**
Total events:	38		88			
Heterogeneity: Tau² = 0.29; Chi² = 15.92, df = 6 (P = 0.01); I² = 62%						
Test for overall effect: Z = 2.75 (P = 0.006)						
1.2.6 Orthopaedic (knee)						
Abuzakuk 2007	13	52	12	52	1.6%	1.08 [0.55 , 2.15]
Adalberth 1998	8	24	10	25	1.5%	0.83 [0.40 , 1.75]
Amin 2008	12	92	13	86	1.5%	0.86 [0.42 , 1.79]
Cheng 2005	4	26	13	34	1.0%	0.40 [0.15 , 1.09]
Dramis 2006	3	32	10	17	0.9%	0.16 [0.05 , 0.50]
Heddle 1992	10	39	27	40	1.9%	0.38 [0.21 , 0.68]
Majkowski 1991	7	20	19	20	1.8%	0.37 [0.20 , 0.68]
Munteanu 2009	24	50	30	50	2.4%	0.80 [0.55 , 1.15]
Newman 1997	3	35	28	35	0.9%	0.11 [0.04 , 0.32]
Rosencher 1994	6	20	6	10	1.3%	0.50 [0.22 , 1.16]
Sait 1999	1	60	35	60	0.4%	0.03 [0.00 , 0.20]
Shenolikar 1997	8	50	40	50	1.7%	0.20 [0.10 , 0.38]
Thomas 2001	12	115	33	116	1.8%	0.37 [0.20 , 0.67]
Subtotal (95% CI)		**615**		**595**	**18.5%**	**0.40 [0.26 , 0.60]**
Total events:	111		276			
Heterogeneity: Tau² = 0.41; Chi² = 51.07, df = 12 (P < 0.00001); I² = 77%						
Test for overall effect: Z = 4.36 (P < 0.0001)						
1.2.7 Orthopaedic (spinal)						
Djurasovic 2018	16	48	29	47	2.2%	0.54 [0.34 , 0.86]
Riou 1994	1	25	2	25	0.3%	0.50 [0.05 , 5.17]
Subtotal (95% CI)		**73**		**72**	**2.4%**	**0.54 [0.34 , 0.85]**
Total events:	17		31			
Heterogeneity: Tau² = 0.00; Chi² = 0.00, df = 1 (P = 0.95); I² = 0%						
Test for overall effect: Z = 2.69 (P = 0.007)						
1.2.8 Orthopaedic (mixed)						
Atay 2010	10	37	23	40	1.8%	0.47 [0.26 , 0.85]
Gannon 1991	16	124	45	115	2.0%	0.33 [0.20 , 0.55]
Healy 1994	14	75	15	43	1.7%	0.54 [0.29 , 1.00]
Koopman-van Gemert 1993b	5	29	13	30	1.2%	0.40 [0.16 , 0.97]
Mauerhan 1993	5	57	6	54	0.9%	0.79 [0.26 , 2.44]
Moonen 2007	5	80	15	80	1.1%	0.33 [0.13 , 0.87]
So-Osman 2006	22	47	10	22	1.9%	1.03 [0.59 , 1.78]
Zhang 2008	10	20	16	20	2.1%	0.63 [0.38 , 1.02]
Subtotal (95% CI)		**469**		**404**	**12.7%**	**0.53 [0.39 , 0.72]**
Total events:	87		143			
Heterogeneity: Tau² = 0.07; Chi² = 11.74, df = 7 (P = 0.11); I² = 40%						
Test for overall effect: Z = 4.10 (P < 0.0001)						
Total (95% CI)		**3229**		**3124**	**100.0%**	**0.62 [0.55 , 0.70]**
Total events:	856		1290			
Heterogeneity: Tau² = 0.14; Chi² = 302.16, df = 56 (P < 0.00001); I² = 81%						
Test for overall effect: Z = 7.40 (P < 0.00001)						
Test for subgroup differences: Chi² = 20.88, df = 7 (P = 0.004), I² = 66.5%						



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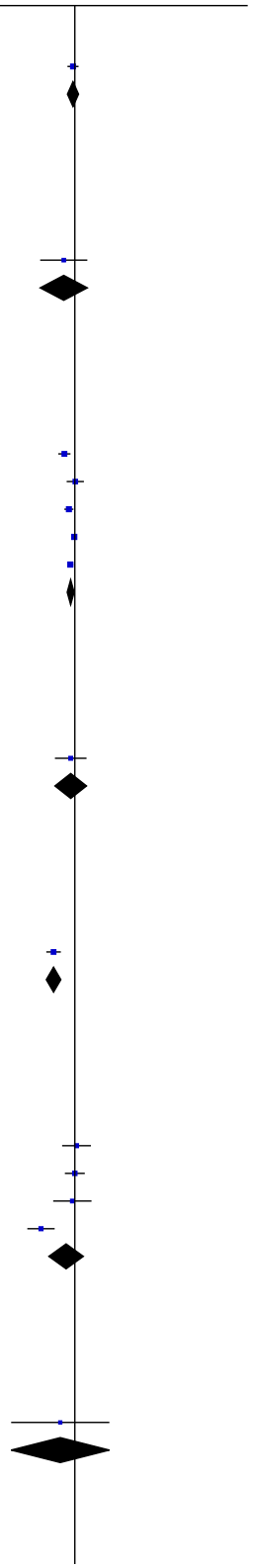
Analysis 1.3. Comparison 1: All surgeries, Outcome 3: Transfusions (sensitivity: low risk of bias (ROB))

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Risk Ratio M-H, Random, 95% CI
1.3.1 CV (vascular)						
Clagett 1999	33	50	36	50	8.1%	0.92 [0.70 , 1.19]
Subtotal (95% CI)		**50**		**50**	**8.1%**	**0.92 [0.70 , 1.19]**
Total events:	33		36			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.65 (P = 0.52)						
1.3.2 CV (no bypass)						
Murphy 2005	4	30	7	31	2.1%	0.59 [0.19 , 1.81]
Subtotal (95% CI)		**30**		**31**	**2.1%**	**0.59 [0.19 , 1.81]**
Total events:	4		7			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.92 (P = 0.36)						
1.3.3 CV (with bypass)						
Dalrymple-Hay 1999	28	56	46	56	7.9%	0.61 [0.46 , 0.81]
Klein 2008	31	102	33	111	6.6%	1.02 [0.68 , 1.54]
Martin 2000	54	98	73	100	8.6%	0.75 [0.61 , 0.94]
Unsworth 1996	63	71	31	34	9.3%	0.97 [0.85 , 1.11]
Vermeijden 2015	173	364	207	352	9.2%	0.81 [0.70 , 0.93]
Subtotal (95% CI)		**691**		**653**	**41.5%**	**0.82 [0.70 , 0.97]**
Total events:	349		390			
Heterogeneity: $Tau^2 = 0.02$; $Chi^2 = 12.69$, df = 4 (P = 0.01); $I^2 = 68\%$						
Test for overall effect: Z = 2.37 (P = 0.02)						
1.3.4 Obstetrics						
Khan 2017 (SALVO)	12	665	15	684	3.7%	0.82 [0.39 , 1.74]
Subtotal (95% CI)		**665**		**684**	**3.7%**	**0.82 [0.39 , 1.74]**
Total events:	12		15			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.51 (P = 0.61)						
1.3.5 Orthopaedic (hip)						
Zhao 2016	31	127	49	73	7.3%	0.36 [0.26 , 0.51]
Subtotal (95% CI)		**127**		**73**	**7.3%**	**0.36 [0.26 , 0.51]**
Total events:	31		49			
Heterogeneity: Not applicable						
Test for overall effect: Z = 5.74 (P < 0.00001)						
1.3.6 Orthopaedic (knee)						
Abuzakuk 2007	13	52	12	52	4.2%	1.08 [0.55 , 2.15]
Cip 2013	23	70	23	70	5.9%	1.00 [0.62 , 1.61]
Schnurr 2018	8	100	9	100	2.9%	0.89 [0.36 , 2.21]
Shenolikar 1997	8	50	40	50	4.4%	0.20 [0.10 , 0.38]
Subtotal (95% CI)		**272**		**272**	**17.4%**	**0.66 [0.29 , 1.50]**
Total events:	52		84			
Heterogeneity: $Tau^2 = 0.58$; $Chi^2 = 18.72$, df = 3 (P = 0.0003); $I^2 = 84\%$						
Test for overall effect: Z = 0.99 (P = 0.32)						
1.3.7 Orthopaedic (spinal)						
Riou 1994	1	25	2	25	0.6%	0.50 [0.05 , 5.17]
Subtotal (95% CI)		**25**		**25**	**0.6%**	**0.50 [0.05 , 5.17]**
Total events:	1		2			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.58 (P = 0.56)						



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Analysis 1.3. (Continued)

Test for overall effect: Z = 0.58 (P = 0.56)

1.3.8 Orthopaedic (mixed)

Gannon 1991	16	124	45	115	5.6%	0.33 [0.20 , 0.55]
So-Osman 2006	22	47	10	22	5.2%	1.03 [0.59 , 1.78]
So-Osman 2014	183	1481	103	961	8.5%	1.15 [0.92 , 1.45]
Subtotal (95% CI)		**1652**		**1098**	**19.3%**	**0.74 [0.35 , 1.59]**
Total events:	221		158			

Heterogeneity: Tau² = 0.40; Chi² = 19.36, df = 2 (P < 0.0001); I² = 90%

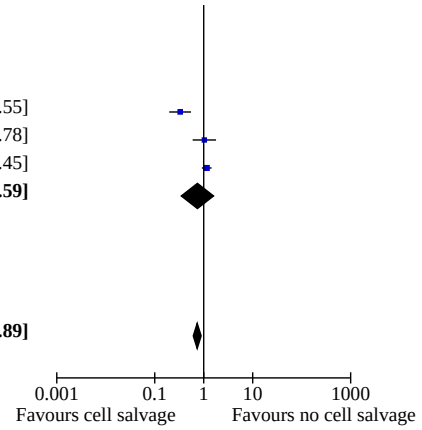
Test for overall effect: Z = 0.76 (P = 0.44)

Total (95% CI)		**3512**		**2886**	**100.0%**	**0.74 [0.61 , 0.89]**
Total events:	703		741			

Heterogeneity: Tau² = 0.09; Chi² = 77.36, df = 16 (P < 0.00001); I² = 79%

Test for overall effect: Z = 3.25 (P = 0.001)

Test for subgroup differences: Chi² = 20.66, df = 7 (P = 0.004), I² = 66.1%



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Analysis 1.4. Comparison 1: All surgeries, Outcome 4: Transfusions (subgroup: timing)

Study or Subgroup	Cell salvage Events	Total	No cell salvage Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
1.4.1 Intraoperative						
Clagett 1999	33	50	36	50	2.0%	0.92 [0.70 , 1.19]
Djurasovic 2018	16	48	29	47	1.5%	0.54 [0.34 , 0.86]
Elawad 1991	6	19	10	20	0.9%	0.63 [0.29 , 1.40]
Gäbel 2013a	6	15	2	15	0.4%	3.00 [0.72 , 12.55]
Goel 2007	20	24	25	25	2.1%	0.84 [0.69 , 1.01]
Kelley-Patteson 1993	3	18	2	18	0.3%	1.50 [0.28 , 7.93]
Khan 2017 (SALVO)	12	665	15	684	1.0%	0.82 [0.39 , 1.74]
Menges 1992	8	14	12	12	1.5%	0.59 [0.37 , 0.93]
Mercer 2004	21	40	31	41	1.8%	0.69 [0.49 , 0.98]
Murphy 2005	4	30	7	31	0.6%	0.59 [0.19 , 1.81]
NCT01251042	8	26	22	23	1.3%	0.32 [0.18 , 0.58]
Page 1989	42	48	45	51	2.2%	0.99 [0.86 , 1.15]
Parrot 1991	19	22	11	11	2.1%	0.88 [0.72 , 1.09]
Reyes 2011	12	34	13	29	1.2%	0.79 [0.43 , 1.45]
Scrascia 2012	6	17	5	17	0.7%	1.20 [0.45 , 3.19]
Shen 2016	22	53	39	50	1.8%	0.53 [0.37 , 0.76]
Spark 1997	3	23	26	26	0.7%	0.15 [0.06 , 0.39]
Vermeijden 2015	173	364	207	352	2.2%	0.81 [0.70 , 0.93]
Xie 2015	27	72	52	69	1.8%	0.50 [0.36 , 0.69]
Zhang 2008	10	20	16	20	1.5%	0.63 [0.38 , 1.02]
Subtotal (95% CI)		**1602**		**1591**	**27.7%**	**0.70 [0.60 , 0.82]**
Total events:	451		605			
Heterogeneity: Tau² = 0.06; Chi² = 64.20, df = 19 (P < 0.00001); I² = 70%						
Test for overall effect: Z = 4.47 (P < 0.00001)						
1.4.2 Postoperative						
Abuzakuk 2007	13	52	12	52	1.1%	1.08 [0.55 , 2.15]
Adalberth 1998	8	24	10	25	1.0%	0.83 [0.40 , 1.75]
Amin 2008	12	92	13	86	1.0%	0.86 [0.42 , 1.79]
Atay 2010	10	37	23	40	1.3%	0.47 [0.26 , 0.85]
Axford 1994	10	16	14	16	1.6%	0.71 [0.47 , 1.09]
Ayers 1995	1	67	15	89	0.2%	0.09 [0.01 , 0.65]
Blatsoukas 2010	42	71	33	42	2.0%	0.75 [0.59 , 0.97]
Cheng 2005	4	26	13	34	0.7%	0.40 [0.15 , 1.09]
Cheung 2010	9	53	25	100	1.1%	0.68 [0.34 , 1.35]
Dalrymple-Hay 1999	28	56	46	56	1.9%	0.61 [0.46 , 0.81]
Damgaard 2006	17	30	21	29	1.7%	0.78 [0.53 , 1.15]
Dramis 2006	3	32	10	17	0.5%	0.16 [0.05 , 0.50]
Dutton 2012	4	23	4	25	0.5%	1.09 [0.31 , 3.85]
Eng 1990	17	20	17	20	2.0%	1.00 [0.77 , 1.30]
Gannon 1991	16	124	45	115	1.4%	0.33 [0.20 , 0.55]
Healy 1994	14	75	15	43	1.2%	0.54 [0.29 , 1.00]
Heddle 1992	10	39	27	40	1.3%	0.38 [0.21 , 0.68]
Horstmann 2012	2	50	4	50	0.3%	0.50 [0.10 , 2.61]
Horstmann 2014b	6	59	11	56	0.8%	0.52 [0.21 , 1.31]
Kleinert 2012	1	40	8	80	0.2%	0.25 [0.03 , 1.93]
Laszczyca 2015	15	38	34	63	1.5%	0.73 [0.46 , 1.15]
Lepore 1989	50	67	62	68	2.2%	0.82 [0.70 , 0.96]
Majkowski 1991	7	20	19	20	1.2%	0.37 [0.20 , 0.68]
Marberg 2010	10	39	10	38	1.0%	0.97 [0.46 , 2.07]
Martin 2000	54	98	73	100	2.1%	0.75 [0.61 , 0.94]
Mauerhan 1993	5	57	6	54	0.6%	0.79 [0.26 , 2.44]
Moonen 2007	5	80	15	80	0.7%	0.33 [0.13 , 0.87]
Munteanu 2009	24	50	30	50	1.8%	0.80 [0.55 , 1.15]
Newman 1997	3	35	28	35	0.6%	0.11 [0.04 , 0.32]
Pleym 2005	1	23	3	24	0.2%	0.35 [0.04 , 3.11]
Riou 1994	1	25	2	25	0.2%	0.50 [0.05 , 5.17]
Rollo 1995	4	40	0	20	0.1%	4.61 [0.26 , 81.63]

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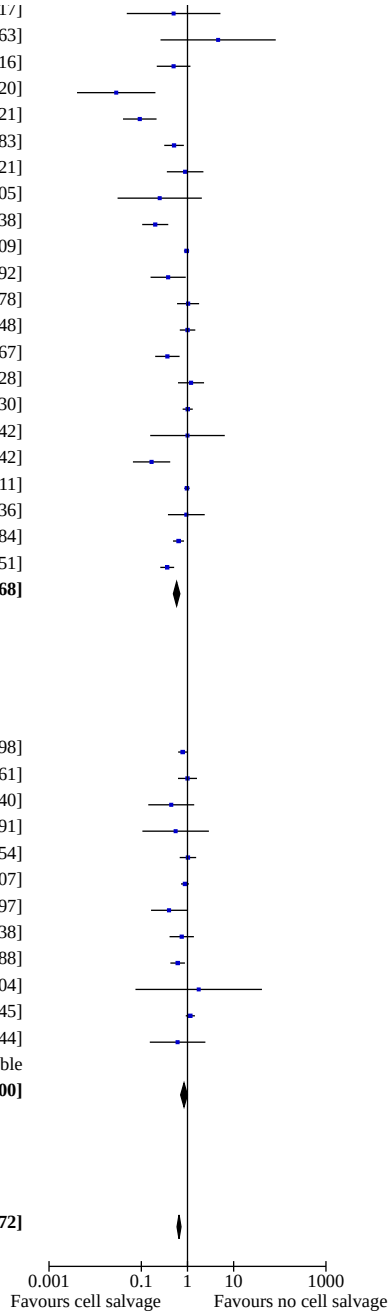
Analysis 1.4. (Continued)

Riou 1994	1	25	2	25	0.2%	0.50 [0.05 , 5.17]
Rollo 1995	4	40	0	20	0.1%	4.61 [0.26 , 81.63]
Rosencher 1994	6	20	6	10	0.9%	0.50 [0.22 , 1.16]
Sait 1999	1	60	35	60	0.2%	0.03 [0.00 , 0.20]
Šarkanoviü 2013	5	55	56	57	0.9%	0.09 [0.04 , 0.21]
Schmidt 1996	15	53	31	56	1.5%	0.51 [0.31 , 0.83]
Schnurr 2018	8	100	9	100	0.8%	0.89 [0.36 , 2.21]
Schönberger 1993	1	20	4	20	0.2%	0.25 [0.03 , 2.05]
Shenolikar 1997	8	50	40	50	1.1%	0.20 [0.10 , 0.38]
Shirvani 1991	20	21	21	21	2.2%	0.95 [0.84 , 1.09]
Smith 2007	6	76	17	82	0.8%	0.38 [0.16 , 0.92]
So-Osman 2006	22	47	10	22	1.3%	1.03 [0.59 , 1.78]
Teetzman 2014	29	74	34	87	1.7%	1.00 [0.68 , 1.48]
Thomas 2001	12	115	33	116	1.2%	0.37 [0.20 , 0.67]
Thomassen 2014	29	385	12	190	1.1%	1.19 [0.62 , 2.28]
Thurer 1979	37	54	40	59	2.0%	1.01 [0.79 , 1.30]
Touzopoulos 2021	2	20	2	20	0.2%	1.00 [0.16 , 6.42]
Tripkovic 2008	4	30	24	30	0.7%	0.17 [0.07 , 0.42]
Unsworth 1996	63	71	31	34	2.2%	0.97 [0.85 , 1.11]
Ward 1993	6	18	6	17	0.8%	0.94 [0.38 , 2.36]
Zhao 2003	19	30	30	30	2.0%	0.64 [0.49 , 0.84]
Zhao 2016	31	127	49	73	1.8%	0.36 [0.26 , 0.51]
Subtotal (95% CI)		**2984**		**2726**	**57.7%**	**0.58 [0.50 , 0.68]**
Total events:	730		1138			
Heterogeneity: Tau² = 0.20; Chi² = 296.51, df = 51 (P < 0.00001); I² = 83%						
Test for overall effect: Z = 6.66 (P < 0.00001)						
1.4.3 Intra- and postoperative						
Blatsoukas 2010	57	92	34	43	2.1%	0.78 [0.63 , 0.98]
Cip 2013	23	70	23	70	1.5%	1.00 [0.62 , 1.61]
Horstmann 2013	4	102	9	102	0.6%	0.44 [0.14 , 1.40]
Horstmann 2014a	2	56	4	62	0.3%	0.55 [0.11 , 2.91]
Klein 2008	31	102	33	111	1.7%	1.02 [0.68 , 1.54]
Koopman-van Gemert 1993a	15	17	20	20	2.1%	0.88 [0.72 , 1.07]
Koopman-van Gemert 1993b	5	29	13	30	0.8%	0.40 [0.16 , 0.97]
Lorentz 1991	8	16	10	15	1.2%	0.75 [0.41 , 1.38]
Parrot 1991	13	22	11	11	1.8%	0.61 [0.43 , 0.88]
Rollo 1995	1	35	0	20	0.1%	1.75 [0.07 , 41.04]
So-Osman 2014	183	1481	103	961	2.1%	1.15 [0.92 , 1.45]
Springer 2016	3	60	5	61	0.4%	0.61 [0.15 , 2.44]
Westerberg 2004	0	12	0	17		Not estimable
Subtotal (95% CI)		**2094**		**1523**	**14.6%**	**0.84 [0.71 , 1.00]**
Total events:	345		265			
Heterogeneity: Tau² = 0.03; Chi² = 18.53, df = 11 (P = 0.07); I² = 41%						
Test for overall effect: Z = 2.01 (P = 0.04)						
Total (95% CI)		**6680**		**5840**	**100.0%**	**0.66 [0.59 , 0.72]**
Total events:	1526		2008			
Heterogeneity: Tau² = 0.11; Chi² = 334.08, df = 83 (P < 0.00001); I² = 75%						
Test for overall effect: Z = 8.51 (P < 0.00001)						
Test for subgroup differences: Chi² = 9.83, df = 2 (P = 0.007), I² = 79.7%						



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Analysis 1.5. Comparison 1: All surgeries, Outcome 5: Transfusions (subgroup: transfusion threshold)

Study or Subgroup	Cell salvage Events	Total	No cell salvage Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
1.5.1 Restrictive (Hb # 80 g/L)						
Amin 2008	12	92	13	86	1.1%	0.86 [0.42 , 1.79]
Atay 2010	10	37	23	40	1.3%	0.47 [0.26 , 0.85]
Cip 2013	23	70	23	70	1.6%	1.00 [0.62 , 1.61]
Djurasovic 2018	16	48	29	47	1.6%	0.54 [0.34 , 0.86]
Gäbel 2013a	6	15	2	15	0.4%	3.00 [0.72 , 12.55]
Horstmann 2012	2	50	4	50	0.3%	0.50 [0.10 , 2.61]
Horstmann 2013	4	102	9	102	0.6%	0.44 [0.14 , 1.40]
Horstmann 2014a	2	56	4	62	0.3%	0.55 [0.11 , 2.91]
Horstmann 2014b	6	59	11	56	0.8%	0.52 [0.21 , 1.31]
Kelley-Patteson 1993	3	18	2	18	0.3%	1.50 [0.28 , 7.93]
Klein 2008	31	102	33	111	1.7%	1.02 [0.68 , 1.54]
Kleinert 2012	1	40	8	80	0.2%	0.25 [0.03 , 1.93]
Laszczyca 2015	15	38	34	63	1.6%	0.73 [0.46 , 1.15]
Marberg 2010	10	39	10	38	1.0%	0.97 [0.46 , 2.07]
Martin 2000	54	98	73	100	2.2%	0.75 [0.61 , 0.94]
Mercer 2004	21	40	31	41	1.9%	0.69 [0.49 , 0.98]
Munteanu 2009	24	50	30	50	1.8%	0.80 [0.55 , 1.15]
Murphy 2005	4	30	7	31	0.6%	0.59 [0.19 , 1.81]
Schnurr 2018	8	100	9	100	0.8%	0.89 [0.36 , 2.21]
Shen 2016	22	53	39	50	1.9%	0.53 [0.37 , 0.76]
Smith 2007	6	76	17	82	0.8%	0.38 [0.16 , 0.92]
So-Osman 2006	22	47	10	22	1.4%	1.03 [0.59 , 1.78]
So-Osman 2014	183	1481	103	961	2.2%	1.15 [0.92 , 1.45]
Thomassen 2014	29	385	12	190	1.2%	1.19 [0.62 , 2.28]
Ward 1993	6	18	6	17	0.8%	0.94 [0.38 , 2.36]
Xie 2015	27	72	52	69	1.9%	0.50 [0.36 , 0.69]
Zhao 2016	31	127	49	73	1.9%	0.36 [0.26 , 0.51]
Subtotal (95% CI)		**3343**		**2624**	**32.0%**	**0.72 [0.61 , 0.85]**
Total events:	578		643			
Heterogeneity: Tau² = 0.09; Chi² = 63.11, df = 26 (P < 0.0001); I² = 59%						
Test for overall effect: Z = 3.92 (P < 0.0001)						
1.5.2 Liberal (Hb > 80 g/L)						
Abuzakuk 2007	13	52	12	52	1.1%	1.08 [0.55 , 2.15]
Adalberth 1998	8	24	10	25	1.0%	0.83 [0.40 , 1.75]
Axford 1994	10	16	14	16	1.7%	0.71 [0.47 , 1.09]
Blatsoukas 2010	99	163	67	85	2.3%	0.77 [0.65 , 0.91]
Cheng 2005	4	26	13	34	0.7%	0.40 [0.15 , 1.09]
Clagett 1999	33	50	36	50	2.1%	0.92 [0.70 , 1.19]
Dalrymple-Hay 1999	28	56	46	56	2.0%	0.61 [0.46 , 0.81]
Damgaard 2006	17	30	21	29	1.8%	0.78 [0.53 , 1.15]
Dramis 2006	3	32	10	17	0.6%	0.16 [0.05 , 0.50]
Elawad 1991	6	19	10	20	0.9%	0.63 [0.29 , 1.40]
Eng 1990	17	20	17	20	2.1%	1.00 [0.77 , 1.30]
Gannon 1991	16	124	45	115	1.5%	0.33 [0.20 , 0.55]
Goel 2007	20	24	25	25	2.2%	0.84 [0.69 , 1.01]
Heddle 1992	10	39	27	40	1.3%	0.38 [0.21 , 0.68]
Koopman-van Gemert 1993a	15	17	20	20	2.2%	0.88 [0.72 , 1.07]
Koopman-van Gemert 1993b	5	29	13	30	0.8%	0.40 [0.16 , 0.97]
Lorentz 1991	8	16	10	15	1.3%	0.75 [0.41 , 1.38]
Majkowski 1991	7	20	19	20	1.3%	0.37 [0.20 , 0.68]
Menges 1992	8	14	12	12	1.6%	0.59 [0.37 , 0.93]
Moonen 2007	5	80	15	80	0.7%	0.33 [0.13 , 0.87]
Page 1989	42	48	45	51	2.3%	0.99 [0.86 , 1.15]
Parrot 1991	32	44	22	22	2.2%	0.74 [0.61 , 0.89]
Riou 1994	1	25	2	25	0.2%	0.50 [0.05 , 5.17]
Rosencher 1994	6	20	6	10	0.9%	0.50 [0.22 , 1.16]
Šarkanoviü 2013	5	55	56	57	0.9%	0.09 [0.04 , 0.21]
Schmidt 1996	15	53	21	56	1.5%	0.51 [0.31 , 0.83]

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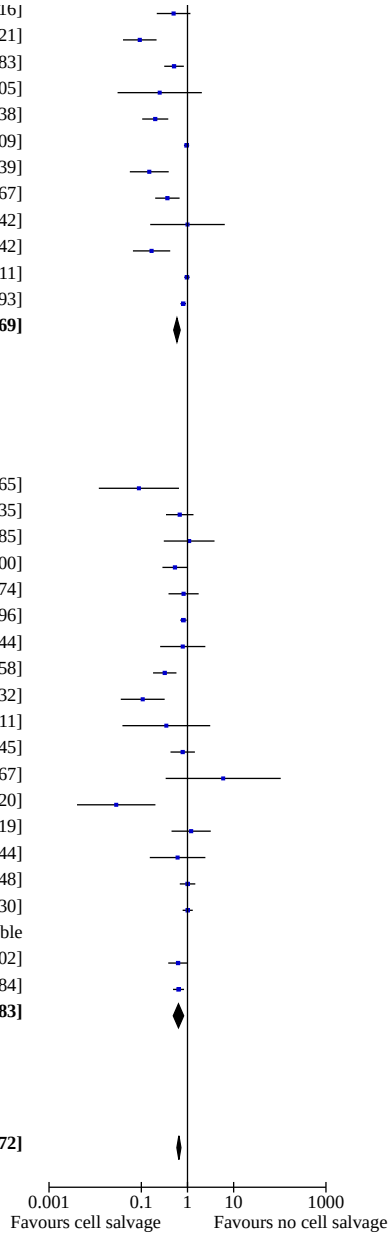
Analysis 1.5. (Continued)

Rosencher 1994	6	20	6	10	0.9%	0.50 [0.22 , 1.16]
Šarkanoviü 2013	5	55	56	57	0.9%	0.09 [0.04 , 0.21]
Schmidt 1996	15	53	31	56	1.5%	0.51 [0.31 , 0.83]
Schönberger 1993	1	20	4	20	0.2%	0.25 [0.03 , 2.05]
Shenolikar 1997	8	50	40	50	1.2%	0.20 [0.10 , 0.38]
Shirvani 1991	20	21	21	21	2.3%	0.95 [0.84 , 1.09]
Spark 1997	3	23	26	26	0.7%	0.15 [0.06 , 0.39]
Thomas 2001	12	115	33	116	1.3%	0.37 [0.20 , 0.67]
Touzopoulos 2021	2	20	2	20	0.3%	1.00 [0.16 , 6.42]
Tripkovic 2008	4	30	24	30	0.8%	0.17 [0.07 , 0.42]
Unsworth 1996	63	71	31	34	2.3%	0.97 [0.85 , 1.11]
Vermeijden 2015	173	364	207	352	2.3%	0.81 [0.70 , 0.93]
Subtotal (95% CI)		**1810**		**1651**	**48.7%**	**0.59 [0.50 , 0.69]**
Total events:	719		992			
Heterogeneity: Tau² = 0.15; Chi² = 253.65, df = 34 (P < 0.00001); I² = 87%						
Test for overall effect: Z = 6.43 (P < 0.00001)						
1.5.3 No threshold/protocol reported						
Ayers 1995	1	67	15	89	0.2%	0.09 [0.01 , 0.65]
Cheung 2010	9	53	25	100	1.1%	0.68 [0.34 , 1.35]
Dutton 2012	4	23	4	25	0.5%	1.09 [0.31 , 3.85]
Healy 1994	14	75	15	43	1.2%	0.54 [0.29 , 1.00]
Khan 2017 (SALVO)	12	665	15	684	1.0%	0.82 [0.39 , 1.74]
Lepore 1989	50	67	62	68	2.3%	0.82 [0.70 , 0.96]
Mauerhan 1993	5	57	6	54	0.6%	0.79 [0.26 , 2.44]
NCT01251042	8	26	22	23	1.3%	0.32 [0.18 , 0.58]
Newman 1997	3	35	28	35	0.6%	0.11 [0.04 , 0.32]
Pleym 2005	1	23	3	24	0.2%	0.35 [0.04 , 3.11]
Reyes 2011	12	34	13	29	1.3%	0.79 [0.43 , 1.45]
Rollo 1995	5	75	0	40	0.1%	5.93 [0.34 , 104.67]
Sait 1999	1	60	35	60	0.2%	0.03 [0.00 , 0.20]
Scrascia 2012	6	17	5	17	0.7%	1.20 [0.45 , 3.19]
Springer 2016	3	60	5	61	0.4%	0.61 [0.15 , 2.44]
Teetzman 2014	29	74	34	87	1.8%	1.00 [0.68 , 1.48]
Thurer 1979	37	54	40	59	2.1%	1.01 [0.79 , 1.30]
Westerberg 2004	0	12	0	17		Not estimable
Zhang 2008	10	20	16	20	1.5%	0.63 [0.38 , 1.02]
Zhao 2003	19	30	30	30	2.1%	0.64 [0.49 , 0.84]
Subtotal (95% CI)		**1527**		**1565**	**19.3%**	**0.64 [0.49 , 0.83]**
Total events:	229		373			
Heterogeneity: Tau² = 0.16; Chi² = 64.34, df = 18 (P < 0.00001); I² = 72%						
Test for overall effect: Z = 3.42 (P = 0.0006)						
Total (95% CI)		**6680**		**5840**	**100.0%**	**0.65 [0.59 , 0.72]**
Total events:	1526		2008			
Heterogeneity: Tau² = 0.10; Chi² = 328.43, df = 80 (P < 0.00001); I² = 76%						
Test for overall effect: Z = 8.48 (P < 0.00001)						
Test for subgroup differences: Chi² = 2.83, df = 2 (P = 0.24), I² = 29.2%						



Comparison 2. Cancer (subgroup: timing)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
2.1 Mortality	2	79	Risk Ratio (M-H, Random, 95% CI)	0.56 [0.11, 2.80]
2.1.1 Intraoperative	2	79	Risk Ratio (M-H, Random, 95% CI)	0.56 [0.11, 2.80]
2.2 Blood loss (mL)	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
2.2.1 Intraoperative	1		Mean Difference (IV, Random, 95% CI)	Totals not selected

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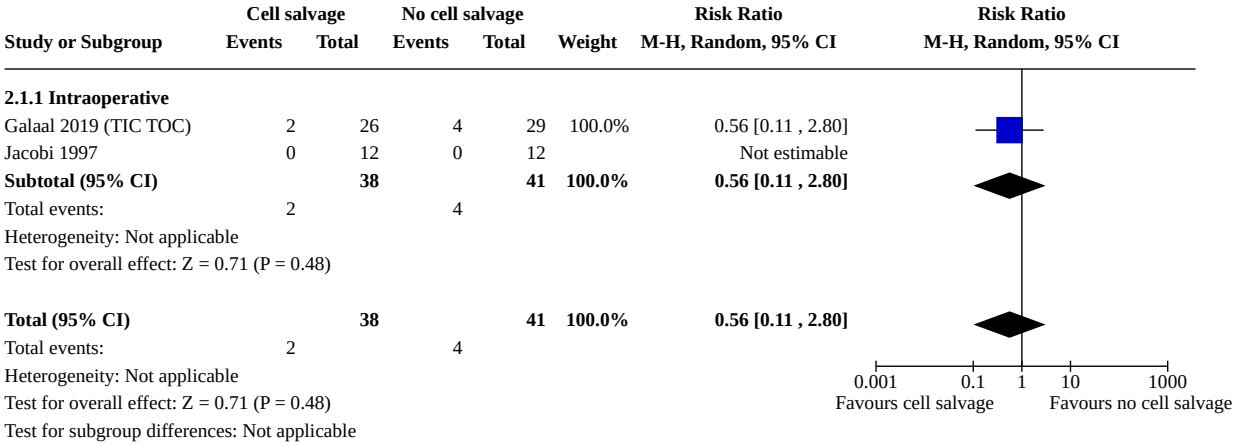
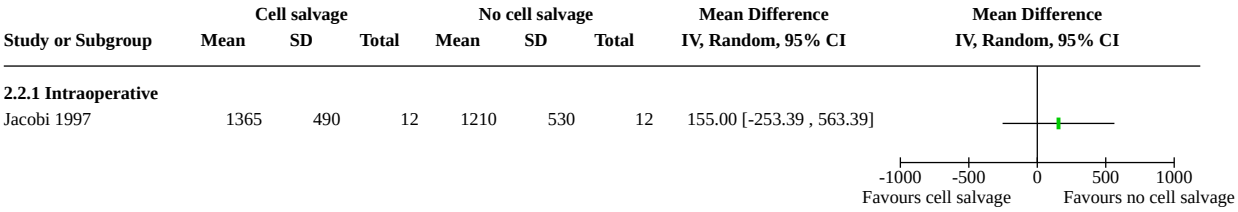
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
2.3 Infection	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
2.3.1 Intraoperative	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
2.4 Deep vein thrombosis (DVT)	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
2.4.1 Intraoperative	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected

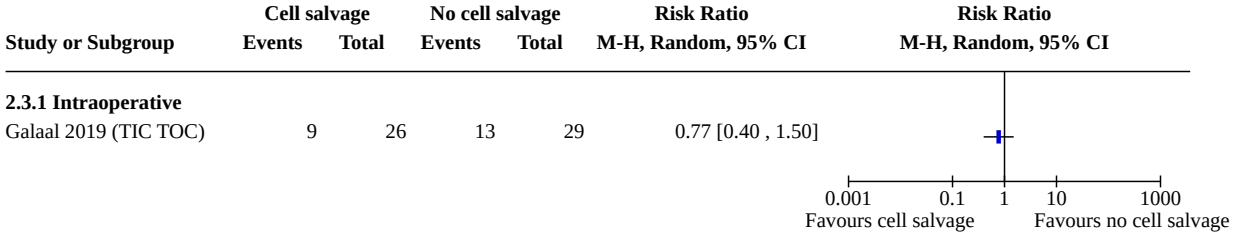
Analysis 2.1. Comparison 2: Cancer (subgroup: timing), Outcome 1: Mortality



Analysis 2.2. Comparison 2: Cancer (subgroup: timing), Outcome 2: Blood loss (mL)



Analysis 2.3. Comparison 2: Cancer (subgroup: timing), Outcome 3: Infection



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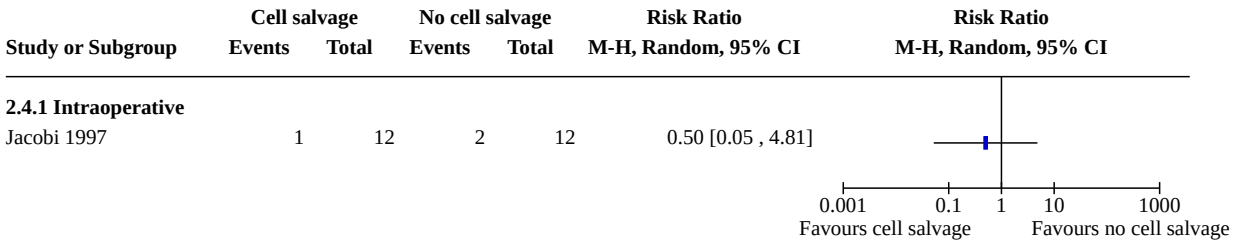
Analysis 2.4. Comparison 2: Cancer (subgroup: timing), Outcome 4: Deep vein thrombosis (DVT)



Comparison 3. Cancer (subgroup: transfusion threshold)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
3.1 Mortality	2	79	Risk Ratio (M-H, Random, 95% CI)	0.56 [0.11, 2.80]
3.1.1 No threshold/protocol reported	2	79	Risk Ratio (M-H, Random, 95% CI)	0.56 [0.11, 2.80]
3.2 Blood loss (mL)	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
3.2.1 No threshold/protocol reported	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
3.3 Infection	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
3.3.1 No threshold/protocol reported	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
3.4 Deep vein thrombosis (DVT)	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
3.4.1 No threshold/protocol reported	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected

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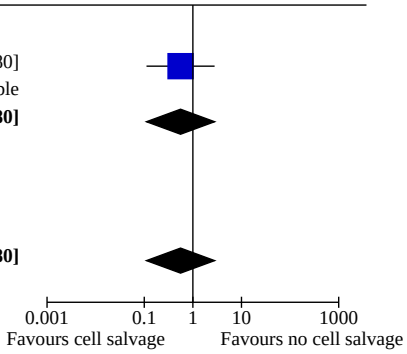
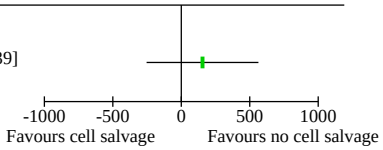
Analysis 3.1. Comparison 3: Cancer (subgroup: transfusion threshold), Outcome 1: Mortality

Study or Subgroup	Cell salvage Events	Total	No cell salvage Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
3.1.1 No threshold/protocol reported						
Galaal 2019 (TIC TOC)	2	26	4	29	100.0%	0.56 [0.11 , 2.80]
Jacobi 1997	0	12	0	12		Not estimable
Subtotal (95% CI)		**38**		**41**	**100.0%**	**0.56 [0.11 , 2.80]**
Total events:	2		4			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.71 (P = 0.48)						
Total (95% CI)		**38**		**41**	**100.0%**	**0.56 [0.11 , 2.80]**
Total events:	2		4			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.71 (P = 0.48)						
Test for subgroup differences: Not applicable						



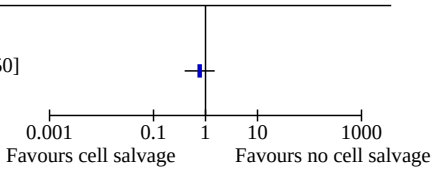
Analysis 3.2. Comparison 3: Cancer (subgroup: transfusion threshold), Outcome 2: Blood loss (mL)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Mean Difference IV, Random, 95% CI
3.2.1 No threshold/protocol reported							
Jacobi 1997	1365	490	12	1210	530	12	155.00 [-253.39 , 563.39]



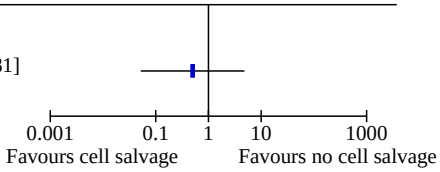
Analysis 3.3. Comparison 3: Cancer (subgroup: transfusion threshold), Outcome 3: Infection

Study or Subgroup	Cell salvage Events	Total	No cell salvage Events	Total	Risk Ratio M-H, Random, 95% CI
3.3.1 No threshold/protocol reported					
Galaal 2019 (TIC TOC)	9	26	13	29	0.77 [0.40 , 1.50]



Analysis 3.4. Comparison 3: Cancer (subgroup: transfusion threshold), Outcome 4: Deep vein thrombosis (DVT)

Study or Subgroup	Cell salvage Events	Total	No cell salvage Events	Total	Risk Ratio M-H, Random, 95% CI
3.4.1 No threshold/protocol reported					
Jacobi 1997	1	12	2	12	0.50 [0.05 , 4.81]



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Comparison 4. Cardiovascular (vascular) (subgroup: timing)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
4.1 Transfusions	4	266	Risk Ratio (M-H, Random, 95% CI)	0.61 [0.32, 1.15]
4.1.1 Intraoperative	4	266	Risk Ratio (M-H, Random, 95% CI)	0.61 [0.32, 1.15]
4.2 Volume of transfusion (units) (PPR)	3	186	Mean Difference (IV, Random, 95% CI)	0.03 [-0.32, 0.37]
4.2.1 Intraoperative	3	186	Mean Difference (IV, Random, 95% CI)	0.03 [-0.32, 0.37]
4.3 Volume of transfusion (units) (PPT)	2	74	Mean Difference (IV, Random, 95% CI)	0.05 [-0.64, 0.74]
4.3.1 Intraoperative	2	74	Mean Difference (IV, Random, 95% CI)	0.05 [-0.64, 0.74]
4.4 Mortality	6	384	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.19 [0.39, 3.65]
4.4.1 Intraoperative	6	384	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.19 [0.39, 3.65]
4.5 Blood loss (mL)	3	186	Mean Difference (IV, Random, 95% CI)	106.19 [-117.45, 329.83]
4.5.1 Intraoperative	3	186	Mean Difference (IV, Random, 95% CI)	106.19 [-117.45, 329.83]
4.6 Reoperation for bleeding	2	100	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.08 [0.07, 17.40]
4.6.1 Intraoperative	2	100	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.08 [0.07, 17.40]
4.7 Infection	2	117	Risk Ratio (M-H, Random, 95% CI)	0.23 [0.03, 1.98]
4.7.1 Intraoperative	2	117	Risk Ratio (M-H, Random, 95% CI)	0.23 [0.03, 1.98]
4.8 Wound complication	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
4.8.1 Intraoperative	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
4.9 Thrombosis (VTE)	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
4.9.1 Intraoperative	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
4.10 DVT	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
4.10.1 Intraoperative	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
4.11 PE	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
4.11.1 Intraoperative	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
4.12 MI	3	203	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.76 [0.17, 3.41]
4.12.1 Intraoperative	3	203	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.76 [0.17, 3.41]

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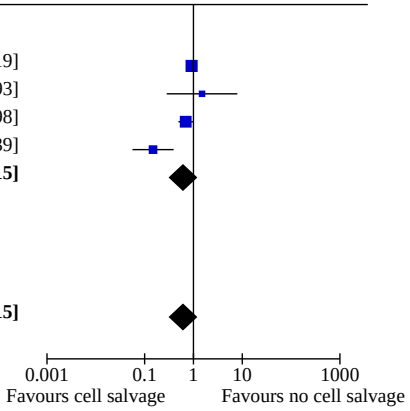
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
4.13 CVA (stroke)	1		Peto Odds Ratio (Peto, Fixed, 95% CI)	Totals not selected
4.13.1 Intraoperative	1		Peto Odds Ratio (Peto, Fixed, 95% CI)	Totals not selected
4.14 Hospital LOS (days)	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
4.14.1 Intraoperative	1		Mean Difference (IV, Random, 95% CI)	Totals not selected

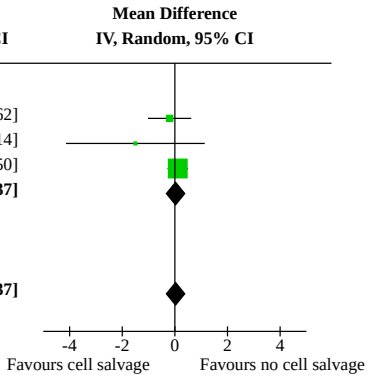
Analysis 4.1. Comparison 4: Cardiovascular (vascular) (subgroup: timing), Outcome 1: Transfusions

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Risk Ratio M-H, Random, 95% CI
4.1.1 Intraoperative						
Clagett 1999	33	50	36	50	35.5%	0.92 [0.70 , 1.19]
Kelley-Patteson 1993	3	18	2	18	10.4%	1.50 [0.28 , 7.93]
Mercer 2004	21	40	31	41	34.1%	0.69 [0.49 , 0.98]
Spark 1997	3	23	26	26	20.0%	0.15 [0.06 , 0.39]
Subtotal (95% CI)		**131**		**135**	**100.0%**	**0.61 [0.32 , 1.15]**
Total events:	60		95			
Heterogeneity: Tau² = 0.27; Chi² = 16.47, df = 3 (P = 0.0009); I² = 82%						
Test for overall effect: Z = 1.53 (P = 0.12)						
Total (95% CI)		**131**		**135**	**100.0%**	**0.61 [0.32 , 1.15]**
Total events:	60		95			
Heterogeneity: Tau² = 0.27; Chi² = 16.47, df = 3 (P = 0.0009); I² = 82%						
Test for overall effect: Z = 1.53 (P = 0.12)						
Test for subgroup differences: Not applicable						



Analysis 4.2. Comparison 4: Cardiovascular (vascular) (subgroup: timing), Outcome 2: Volume of transfusion (units) (PPR)

Study or Subgroup	Cell salvage Mean	Cell salvage SD	Cell salvage Total	No cell salvage Mean	No cell salvage SD	No cell salvage Total	Weight	Mean Difference IV, Random, 95% CI
4.2.1 Intraoperative								
Clagett 1999	2.1	2.1	50	2.3	2.1	50	17.9%	-0.20 [-1.02 , 0.62]
Davies 1987	4	3.4	25	5.5	5.8	25	1.7%	-1.50 [-4.14 , 1.14]
Kelley-Patteson 1993	0.28	0.67	18	0.17	0.51	18	80.3%	0.11 [-0.28 , 0.50]
Subtotal (95% CI)			**93**			**93**	**100.0%**	**0.03 [-0.32 , 0.37]**
Heterogeneity: Tau² = 0.00; Chi² = 1.76, df = 2 (P = 0.42); I² = 0%								
Test for overall effect: Z = 0.15 (P = 0.88)								
Total (95% CI)			**93**			**93**	**100.0%**	**0.03 [-0.32 , 0.37]**
Heterogeneity: Tau² = 0.00; Chi² = 1.76, df = 2 (P = 0.42); I² = 0%								
Test for overall effect: Z = 0.15 (P = 0.88)								
Test for subgroup differences: Not applicable								



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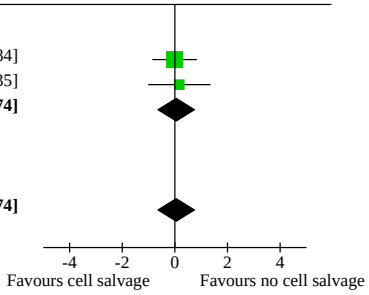
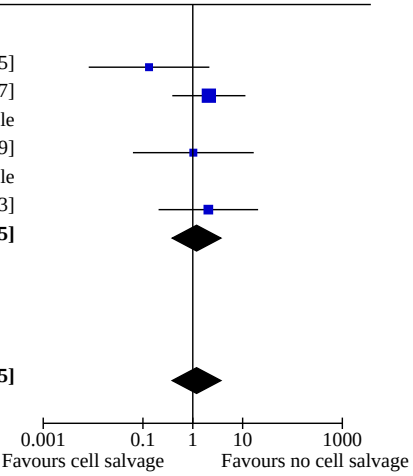
Analysis 4.3. Comparison 4: Cardiovascular (vascular) (subgroup: timing), Outcome 3: Volume of transfusion (units) (PPT)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
4.3.1 Intraoperative								
Clagett 1999	3.18	1.79	33	3.19	1.8	36	66.1%	-0.01 [-0.86 , 0.84]
Kelley-Patteson 1993	1.67	0.58	3	1.5	0.71	2	33.9%	0.17 [-1.01 , 1.35]
Subtotal (95% CI)			**36**			**38**	**100.0%**	**0.05 [-0.64 , 0.74]**
Heterogeneity: Tau² = 0.00; Chi² = 0.06, df = 1 (P = 0.81); I² = 0%								
Test for overall effect: Z = 0.15 (P = 0.88)								
Total (95% CI)			**36**			**38**	**100.0%**	**0.05 [-0.64 , 0.74]**
Heterogeneity: Tau² = 0.00; Chi² = 0.06, df = 1 (P = 0.81); I² = 0%								
Test for overall effect: Z = 0.15 (P = 0.88)								
Test for subgroup differences: Not applicable								



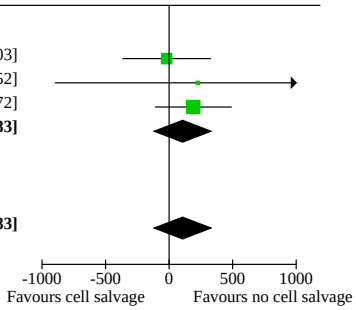
Analysis 4.4. Comparison 4: Cardiovascular (vascular) (subgroup: timing), Outcome 4: Mortality

Study or Subgroup	Cell salvage Events	Total	No cell salvage Events	Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
4.4.1 Intraoperative						
Clagett 1999	0	50	2	50	16.2%	0.13 [0.01 , 2.15]
Davies 1987	4	25	2	25	44.0%	2.10 [0.39 , 11.37]
Kelley-Patteson 1993	0	18	0	18		Not estimable
Mercer 2004	1	40	1	41	16.1%	1.03 [0.06 , 16.69]
Spark 1997	0	23	0	27		Not estimable
Thompson 1990	2	33	1	34	23.7%	2.05 [0.21 , 20.43]
Subtotal (95% CI)		**189**		**195**	**100.0%**	**1.19 [0.39 , 3.65]**
Total events:	7		6			
Heterogeneity: Chi² = 3.05, df = 3 (P = 0.38); I² = 1%						
Test for overall effect: Z = 0.31 (P = 0.76)						
Total (95% CI)		**189**		**195**	**100.0%**	**1.19 [0.39 , 3.65]**
Total events:	7		6			
Heterogeneity: Chi² = 3.05, df = 3 (P = 0.38); I² = 1%						
Test for overall effect: Z = 0.31 (P = 0.76)						
Test for subgroup differences: Not applicable						



Analysis 4.5. Comparison 4: Cardiovascular (vascular) (subgroup: timing), Outcome 5: Blood loss (mL)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
4.5.1 Intraoperative								
Clagett 1999	981	983	50	1000	787	50	41.1%	-19.00 [-368.03 , 330.03]
Davies 1987	3224	2392	25	2999	1579	25	4.0%	225.00 [-898.52 , 1348.52]
Kelley-Patteson 1993	842.78	554.19	18	651.67	345.14	18	55.0%	191.11 [-110.50 , 492.72]
Subtotal (95% CI)			**93**			**93**	**100.0%**	**106.19 [-117.45 , 329.83]**
Heterogeneity: Tau² = 0.00; Chi² = 0.84, df = 2 (P = 0.66); I² = 0%								
Test for overall effect: Z = 0.93 (P = 0.35)								
Total (95% CI)			**93**			**93**	**100.0%**	**106.19 [-117.45 , 329.83]**
Heterogeneity: Tau² = 0.00; Chi² = 0.84, df = 2 (P = 0.66); I² = 0%								
Test for overall effect: Z = 0.93 (P = 0.35)								
Test for subgroup differences: Not applicable								



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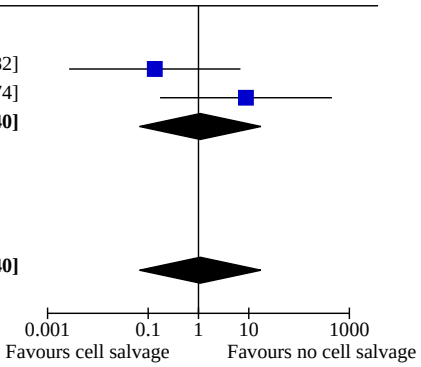
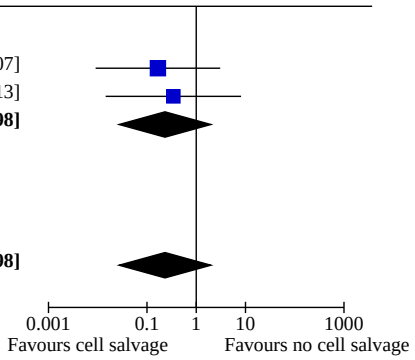
Analysis 4.6. Comparison 4: Cardiovascular (vascular) (subgroup: timing), Outcome 6: Reoperation for bleeding

Study or Subgroup	Cell salvage Events	Total	No cell salvage Events	Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
4.6.1 Intraoperative						
Davies 1987	0	25	1	25	50.2%	0.14 [0.00 , 6.82]
Spark 1997	1	23	0	27	49.8%	8.79 [0.17 , 448.74]
Subtotal (95% CI)		**48**		**52**	**100.0%**	**1.08 [0.07 , 17.40]**
Total events:	1		1			
Heterogeneity: Chi² = 2.17, df = 1 (P = 0.14); I² = 54%						
Test for overall effect: Z = 0.06 (P = 0.95)						
Total (95% CI)		**48**		**52**	**100.0%**	**1.08 [0.07 , 17.40]**
Total events:	1		1			
Heterogeneity: Chi² = 2.17, df = 1 (P = 0.14); I² = 54%						
Test for overall effect: Z = 0.06 (P = 0.95)						
Test for subgroup differences: Not applicable						



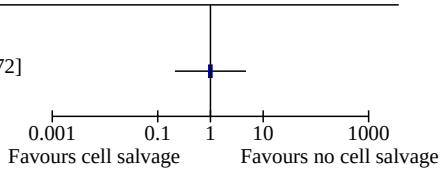
Analysis 4.7. Comparison 4: Cardiovascular (vascular) (subgroup: timing), Outcome 7: Infection

Study or Subgroup	Cell salvage Events	Total	No cell salvage Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
4.7.1 Intraoperative						
Spark 1997	0	23	3	27	54.2%	0.17 [0.01 , 3.07]
Thompson 1990	0	33	1	34	45.8%	0.34 [0.01 , 8.13]
Subtotal (95% CI)		**56**		**61**	**100.0%**	**0.23 [0.03 , 1.98]**
Total events:	0		4			
Heterogeneity: Tau² = 0.00; Chi² = 0.11, df = 1 (P = 0.74); I² = 0%						
Test for overall effect: Z = 1.34 (P = 0.18)						
Total (95% CI)		**56**		**61**	**100.0%**	**0.23 [0.03 , 1.98]**
Total events:	0		4			
Heterogeneity: Tau² = 0.00; Chi² = 0.11, df = 1 (P = 0.74); I² = 0%						
Test for overall effect: Z = 1.34 (P = 0.18)						
Test for subgroup differences: Not applicable						



Analysis 4.8. Comparison 4: Cardiovascular (vascular) (subgroup: timing), Outcome 8: Wound complication

Study or Subgroup	Cell salvage Events	Total	No cell salvage Events	Total	Risk Ratio M-H, Random, 95% CI
4.8.1 Intraoperative					
Clagett 1999	3	50	3	50	1.00 [0.21 , 4.72]



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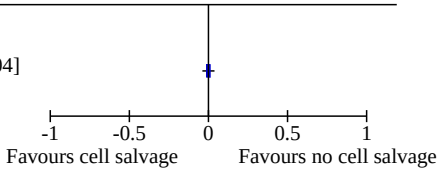
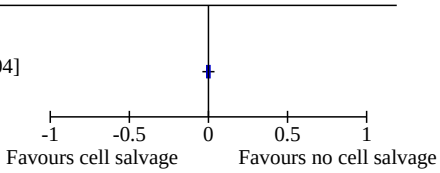
Analysis 4.9. Comparison 4: Cardiovascular (vascular) (subgroup: timing), Outcome 9: Thrombosis (VTE)

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Risk Difference M-H, Random, 95% CI
4.9.1 Intraoperative					
Clagett 1999	0	50	0	50	0.00 [-0.04 , 0.04]



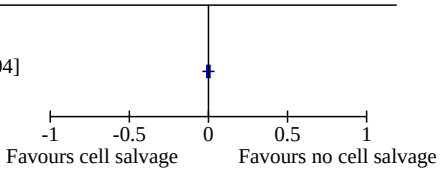
Analysis 4.10. Comparison 4: Cardiovascular (vascular) (subgroup: timing), Outcome 10: DVT

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Risk Difference M-H, Random, 95% CI
4.10.1 Intraoperative					
Clagett 1999	0	50	0	50	0.00 [-0.04 , 0.04]



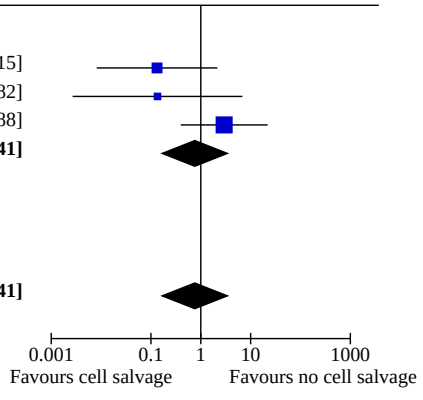
Analysis 4.11. Comparison 4: Cardiovascular (vascular) (subgroup: timing), Outcome 11: PE

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Risk Difference M-H, Random, 95% CI
4.11.1 Intraoperative					
Clagett 1999	0	50	0	50	0.00 [-0.04 , 0.04]



Analysis 4.12. Comparison 4: Cardiovascular (vascular) (subgroup: timing), Outcome 12: MI

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
4.12.1 Intraoperative						
Clagett 1999	0	50	2	50	29.1%	0.13 [0.01 , 2.15]
Kelley-Patteson 1993	0	18	1	18	14.7%	0.14 [0.00 , 6.82]
Thompson 1990	3	33	1	34	56.2%	2.94 [0.40 , 21.88]
Subtotal (95% CI)		**101**		**102**	**100.0%**	**0.76 [0.17 , 3.41]**
Total events:	3		4			
Heterogeneity: Chi² = 4.00, df = 2 (P = 0.14); I² = 50%						
Test for overall effect: Z = 0.36 (P = 0.72)						
Total (95% CI)		**101**		**102**	**100.0%**	**0.76 [0.17 , 3.41]**
Total events:	3		4			
Heterogeneity: Chi² = 4.00, df = 2 (P = 0.14); I² = 50%						
Test for overall effect: Z = 0.36 (P = 0.72)						
Test for subgroup differences: Not applicable						



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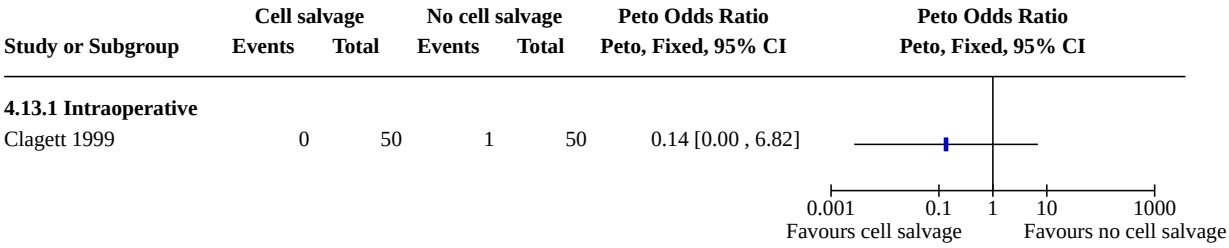
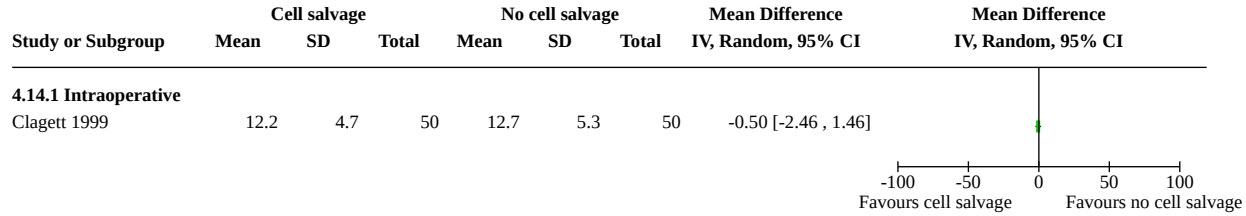
Analysis 4.13. Comparison 4: Cardiovascular (vascular) (subgroup: timing), Outcome 13: CVA (stroke)



Analysis 4.14. Comparison 4: Cardiovascular (vascular) (subgroup: timing), Outcome 14: Hospital LOS (days)



Comparison 5. Cardiovascular (vascular) (subgroup: transfusion threshold)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
5.1 Transfusions	4	266	Risk Ratio (M-H, Random, 95% CI)	0.61 [0.32, 1.15]
5.1.1 Restrictive (Hb ≦ 80 g/L)	2	117	Risk Ratio (M-H, Random, 95% CI)	0.72 [0.51, 1.00]
5.1.2 Liberal (Hb > 80 g/L)	2	149	Risk Ratio (M-H, Random, 95% CI)	0.39 [0.05, 3.20]
5.2 Volume of transfusion (units) (PPR)	3	186	Mean Difference (IV, Random, 95% CI)	0.03 [-0.32, 0.37]
5.2.1 Restrictive (Hb ≦ 80 g/L)	1	36	Mean Difference (IV, Random, 95% CI)	0.11 [-0.28, 0.50]
5.2.2 Liberal (Hb > 80 g/L)	2	150	Mean Difference (IV, Random, 95% CI)	-0.32 [-1.10, 0.47]
5.3 Volume of transfusion (units) (PPT)	2	74	Mean Difference (IV, Random, 95% CI)	0.05 [-0.64, 0.74]
5.3.1 Restrictive (Hb ≦ 80 g/L)	1	5	Mean Difference (IV, Random, 95% CI)	0.17 [-1.01, 1.35]
5.3.2 Liberal (Hb > 80 g/L)	1	69	Mean Difference (IV, Random, 95% CI)	-0.01 [-0.86, 0.84]
5.4 Mortality	6	384	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.19 [0.39, 3.65]
5.4.1 Restrictive (Hb ≦ 80 g/L)	2	117	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.03 [0.06, 16.69]

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Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
5.4.2 Liberal (Hb > 80 g/L)	4	267	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.23 [0.36, 4.16]
5.5 Blood loss (mL)	3	186	Mean Difference (IV, Random, 95% CI)	106.19 [-117.45, 329.83]
5.5.1 Restrictive (Hb ≦ 80 g/L)	1	36	Mean Difference (IV, Random, 95% CI)	191.11 [-110.50, 492.72]
5.5.2 Liberal (Hb > 80 g/L)	2	150	Mean Difference (IV, Random, 95% CI)	2.48 [-330.84, 335.80]
5.6 Reoperation for bleeding	2	100	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.08 [0.07, 17.40]
5.6.1 Liberal (Hb > 80 g/L)	2	100	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.08 [0.07, 17.40]
5.7 Infection	2	117	Risk Ratio (M-H, Random, 95% CI)	0.23 [0.03, 1.98]
5.7.1 Liberal (Hb > 80 g/L)	2	117	Risk Ratio (M-H, Random, 95% CI)	0.23 [0.03, 1.98]
5.8 Wound complication	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
5.8.1 Liberal (Hb > 80 g/L)	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
5.9 Thrombosis (VTE)	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
5.9.1 Liberal (Hb > 80 g/L)	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
5.10 DVT	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
5.10.1 Liberal (Hb > 80 g/L)	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
5.11 PE	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
5.11.1 Liberal (Hb > 80 g/L)	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
5.12 MI	3	203	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.76 [0.17, 3.41]
5.12.1 Restrictive (Hb ≦ 80 g/L)	1	36	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.14 [0.00, 6.82]
5.12.2 Liberal (Hb > 80 g/L)	2	167	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.02 [0.20, 5.20]
5.13 CVA (stroke)	1		Peto Odds Ratio (Peto, Fixed, 95% CI)	Totals not selected
5.13.1 Liberal (Hb > 80 g/L)	1		Peto Odds Ratio (Peto, Fixed, 95% CI)	Totals not selected
5.14 Hospital LOS (days)	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
5.14.1 Liberal (Hb > 80 g/L)	1		Mean Difference (IV, Random, 95% CI)	Totals not selected

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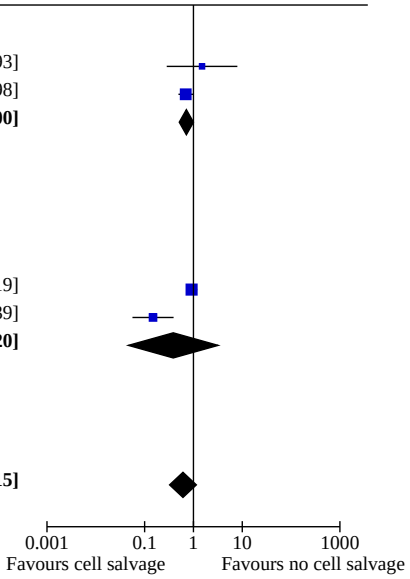
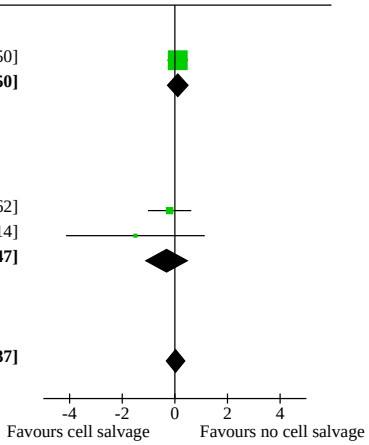
Analysis 5.1. Comparison 5: Cardiovascular (vascular) (subgroup: transfusion threshold), Outcome 1: Transfusions

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Risk Ratio M-H, Random, 95% CI
5.1.1 Restrictive (Hb # 80 g/L)						
Kelley-Patteson 1993	3	18	2	18	10.4%	1.50 [0.28 , 7.93]
Mercer 2004	21	40	31	41	34.1%	0.69 [0.49 , 0.98]
Subtotal (95% CI)		**58**		**59**	**44.5%**	**0.72 [0.51 , 1.00]**
Total events:	24		33			
Heterogeneity: Tau² = 0.00; Chi² = 0.84, df = 1 (P = 0.36); I² = 0%						
Test for overall effect: Z = 1.95 (P = 0.05)						
5.1.2 Liberal (Hb > 80 g/L)						
Clagett 1999	33	50	36	50	35.5%	0.92 [0.70 , 1.19]
Spark 1997	3	23	26	26	20.0%	0.15 [0.06 , 0.39]
Subtotal (95% CI)		**73**		**76**	**55.5%**	**0.39 [0.05 , 3.20]**
Total events:	36		62			
Heterogeneity: Tau² = 2.20; Chi² = 17.76, df = 1 (P < 0.0001); I² = 94%						
Test for overall effect: Z = 0.88 (P = 0.38)						
Total (95% CI)		**131**		**135**	**100.0%**	**0.61 [0.32 , 1.15]**
Total events:	60		95			
Heterogeneity: Tau² = 0.27; Chi² = 16.47, df = 3 (P = 0.0009); I² = 82%						
Test for overall effect: Z = 1.53 (P = 0.12)						
Test for subgroup differences: Chi² = 0.32, df = 1 (P = 0.57), I² = 0%						



Analysis 5.2. Comparison 5: Cardiovascular (vascular) (subgroup: transfusion threshold), Outcome 2: Volume of transfusion (units) (PPR)

Study or Subgroup	Cell salvage Mean	Cell salvage SD	Cell salvage Total	No cell salvage Mean	No cell salvage SD	No cell salvage Total	Weight	Mean Difference IV, Random, 95% CI
5.2.1 Restrictive (Hb # 80 g/L)								
Kelley-Patteson 1993	0.28	0.67	18	0.17	0.51	18	80.3%	0.11 [-0.28 , 0.50]
Subtotal (95% CI)			**18**			**18**	**80.3%**	**0.11 [-0.28 , 0.50]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.55 (P = 0.58)								
5.2.2 Liberal (Hb > 80 g/L)								
Clagett 1999	2.1	2.1	50	2.3	2.1	50	17.9%	-0.20 [-1.02 , 0.62]
Davies 1987	4	3.4	25	5.5	5.8	25	1.7%	-1.50 [-4.14 , 1.14]
Subtotal (95% CI)			**75**			**75**	**19.7%**	**-0.32 [-1.10 , 0.47]**
Heterogeneity: Tau² = 0.00; Chi² = 0.85, df = 1 (P = 0.36); I² = 0%								
Test for overall effect: Z = 0.79 (P = 0.43)								
Total (95% CI)			**93**			**93**	**100.0%**	**0.03 [-0.32 , 0.37]**
Heterogeneity: Tau² = 0.00; Chi² = 1.76, df = 2 (P = 0.42); I² = 0%								
Test for overall effect: Z = 0.15 (P = 0.88)								
Test for subgroup differences: Chi² = 0.91, df = 1 (P = 0.34), I² = 0%								



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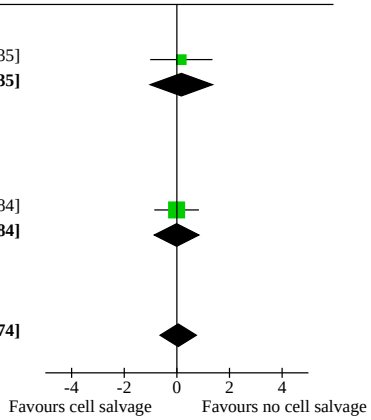
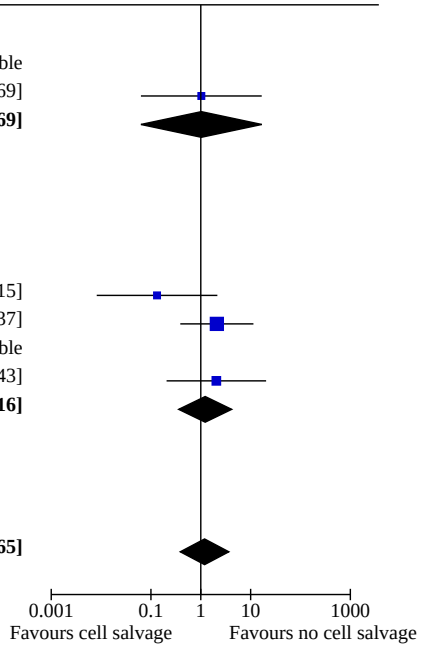
Analysis 5.3. Comparison 5: Cardiovascular (vascular) (subgroup: transfusion threshold), Outcome 3: Volume of transfusion (units) (PPT)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
5.3.1 Restrictive (Hb # 80 g/L)								
Kelley-Patteson 1993	1.67	0.58	3	1.5	0.71	2	33.9%	0.17 [-1.01 , 1.35]
Subtotal (95% CI)			**3**			**2**	**33.9%**	**0.17 [-1.01 , 1.35]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.28 (P = 0.78)								
5.3.2 Liberal (Hb > 80 g/L)								
Clagett 1999	3.18	1.79	33	3.19	1.8	36	66.1%	-0.01 [-0.86 , 0.84]
Subtotal (95% CI)			**33**			**36**	**66.1%**	**-0.01 [-0.86 , 0.84]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.02 (P = 0.98)								
Total (95% CI)			**36**			**38**	**100.0%**	**0.05 [-0.64 , 0.74]**
Heterogeneity: Tau² = 0.00; Chi² = 0.06, df = 1 (P = 0.81); I² = 0%								
Test for overall effect: Z = 0.15 (P = 0.88)								
Test for subgroup differences: Chi² = 0.06, df = 1 (P = 0.81), I² = 0%								



Analysis 5.4. Comparison 5: Cardiovascular (vascular) (subgroup: transfusion threshold), Outcome 4: Mortality

Study or Subgroup	Cell salvage Events	Total	No cell salvage Events	Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
5.4.1 Restrictive (Hb # 80 g/L)						
Kelley-Patteson 1993	0	18	0	18		Not estimable
Mercer 2004	1	40	1	41	16.1%	1.03 [0.06 , 16.69]
Subtotal (95% CI)		**58**		**59**	**16.1%**	**1.03 [0.06 , 16.69]**
Total events:	1		1			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.02 (P = 0.99)						
5.4.2 Liberal (Hb > 80 g/L)						
Clagett 1999	0	50	2	50	16.2%	0.13 [0.01 , 2.15]
Davies 1987	4	25	2	25	44.0%	2.10 [0.39 , 11.37]
Spark 1997	0	23	0	27		Not estimable
Thompson 1990	2	33	1	34	23.7%	2.05 [0.21 , 20.43]
Subtotal (95% CI)		**131**		**136**	**83.9%**	**1.23 [0.36 , 4.16]**
Total events:	6		5			
Heterogeneity: Chi² = 3.03, df = 2 (P = 0.22); I² = 34%						
Test for overall effect: Z = 0.33 (P = 0.74)						
Total (95% CI)		**189**		**195**	**100.0%**	**1.19 [0.39 , 3.65]**
Total events:	7		6			
Heterogeneity: Chi² = 3.05, df = 3 (P = 0.38); I² = 1%						
Test for overall effect: Z = 0.31 (P = 0.76)						
Test for subgroup differences: Chi² = 0.01, df = 1 (P = 0.91), I² = 0%						



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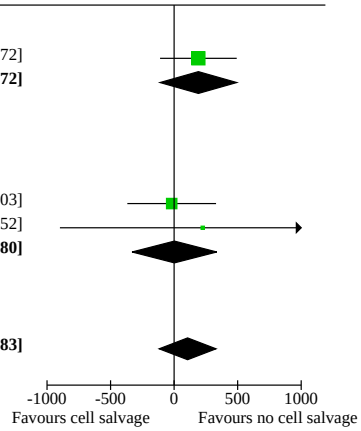
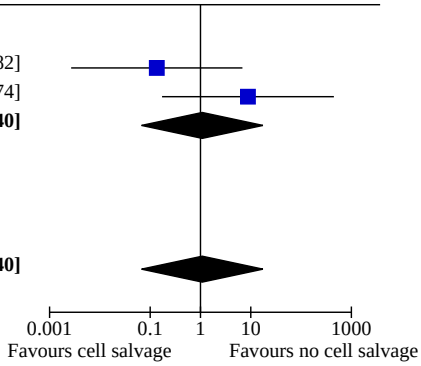
Analysis 5.5. Comparison 5: Cardiovascular (vascular) (subgroup: transfusion threshold), Outcome 5: Blood loss (mL)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
5.5.1 Restrictive (Hb # 80 g/L)								
Kelley-Patteson 1993	842.78	554.19	18	651.67	345.14	18	55.0%	191.11 [-110.50 , 492.72]
Subtotal (95% CI)			**18**			**18**	**55.0%**	**191.11 [-110.50 , 492.72]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 1.24 (P = 0.21)								
5.5.2 Liberal (Hb > 80 g/L)								
Clagett 1999	981	983	50	1000	787	50	41.1%	-19.00 [-368.03 , 330.03]
Davies 1987	3224	2392	25	2999	1579	25	4.0%	225.00 [-898.52 , 1348.52]
Subtotal (95% CI)			**75**			**75**	**45.0%**	**2.48 [-330.84 , 335.80]**
Heterogeneity: Tau² = 0.00; Chi² = 0.17, df = 1 (P = 0.68); I² = 0%								
Test for overall effect: Z = 0.01 (P = 0.99)								
Total (95% CI)			**93**			**93**	**100.0%**	**106.19 [-117.45 , 329.83]**
Heterogeneity: Tau² = 0.00; Chi² = 0.84, df = 2 (P = 0.66); I² = 0%								
Test for overall effect: Z = 0.93 (P = 0.35)								
Test for subgroup differences: Chi² = 0.68, df = 1 (P = 0.41), I² = 0%								



Analysis 5.6. Comparison 5: Cardiovascular (vascular) (subgroup: transfusion threshold), Outcome 6: Reoperation for bleeding

Study or Subgroup	Cell salvage Events	Total	No cell salvage Events	Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
5.6.1 Liberal (Hb > 80 g/L)						
Davies 1987	0	25	1	25	50.2%	0.14 [0.00 , 6.82]
Spark 1997	1	23	0	27	49.8%	8.79 [0.17 , 448.74]
Subtotal (95% CI)		**48**		**52**	**100.0%**	**1.08 [0.07 , 17.40]**
Total events:	1		1			
Heterogeneity: Chi² = 2.17, df = 1 (P = 0.14); I² = 54%						
Test for overall effect: Z = 0.06 (P = 0.95)						
Total (95% CI)		**48**		**52**	**100.0%**	**1.08 [0.07 , 17.40]**
Total events:	1		1			
Heterogeneity: Chi² = 2.17, df = 1 (P = 0.14); I² = 54%						
Test for overall effect: Z = 0.06 (P = 0.95)						
Test for subgroup differences: Not applicable						



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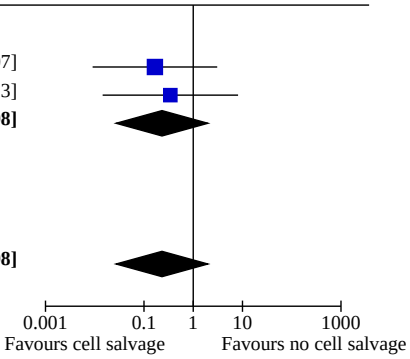
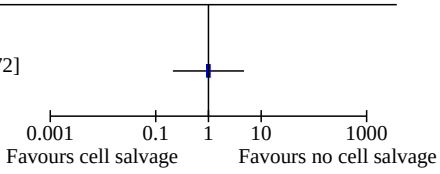
Analysis 5.7. Comparison 5: Cardiovascular (vascular) (subgroup: transfusion threshold), Outcome 7: Infection

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Risk Ratio M-H, Random, 95% CI
5.7.1 Liberal (Hb > 80 g/L)						
Spark 1997	0	23	3	27	54.2%	0.17 [0.01 , 3.07]
Thompson 1990	0	33	1	34	45.8%	0.34 [0.01 , 8.13]
Subtotal (95% CI)		**56**		**61**	**100.0%**	**0.23 [0.03 , 1.98]**
Total events:	0		4			
Heterogeneity: Tau² = 0.00; Chi² = 0.11, df = 1 (P = 0.74); I² = 0%						
Test for overall effect: Z = 1.34 (P = 0.18)						
Total (95% CI)		**56**		**61**	**100.0%**	**0.23 [0.03 , 1.98]**
Total events:	0		4			
Heterogeneity: Tau² = 0.00; Chi² = 0.11, df = 1 (P = 0.74); I² = 0%						
Test for overall effect: Z = 1.34 (P = 0.18)						
Test for subgroup differences: Not applicable						



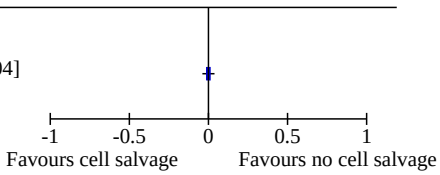
Analysis 5.8. Comparison 5: Cardiovascular (vascular) (subgroup: transfusion threshold), Outcome 8: Wound complication

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Risk Ratio M-H, Random, 95% CI
5.8.1 Liberal (Hb > 80 g/L)					
Clagett 1999	3	50	3	50	1.00 [0.21 , 4.72]



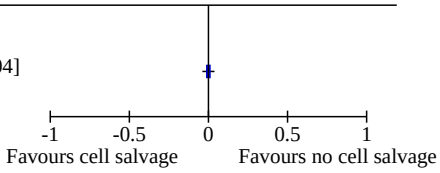
Analysis 5.9. Comparison 5: Cardiovascular (vascular) (subgroup: transfusion threshold), Outcome 9: Thrombosis (VTE)

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Risk Difference M-H, Random, 95% CI
5.9.1 Liberal (Hb > 80 g/L)					
Clagett 1999	0	50	0	50	0.00 [-0.04 , 0.04]



Analysis 5.10. Comparison 5: Cardiovascular (vascular) (subgroup: transfusion threshold), Outcome 10: DVT

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Risk Difference M-H, Random, 95% CI
5.10.1 Liberal (Hb > 80 g/L)					
Clagett 1999	0	50	0	50	0.00 [-0.04 , 0.04]



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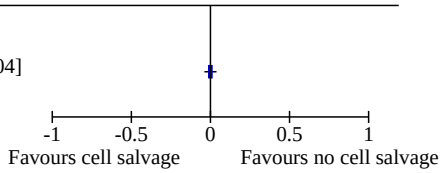
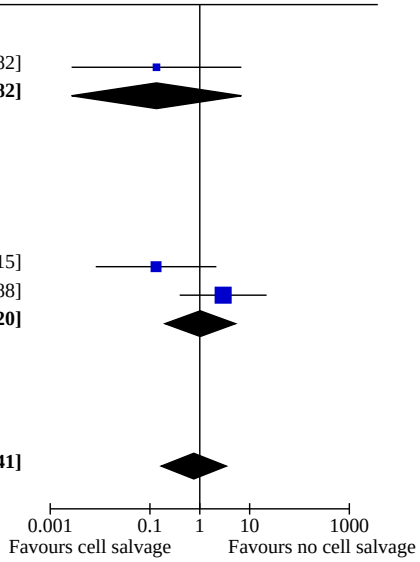
Analysis 5.11. Comparison 5: Cardiovascular (vascular) (subgroup: transfusion threshold), Outcome 11: PE

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Risk Difference M-H, Random, 95% CI
5.11.1 Liberal (Hb > 80 g/L)					
Clagett 1999	0	50	0	50	0.00 [-0.04 , 0.04]



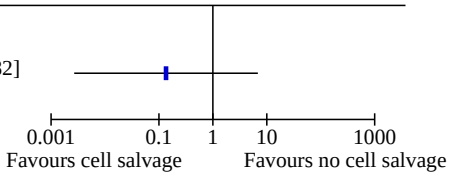
Analysis 5.12. Comparison 5: Cardiovascular (vascular) (subgroup: transfusion threshold), Outcome 12: MI

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
5.12.1 Restrictive (Hb # 80 g/L)						
Kelley-Patteson 1993	0	18	1	18	14.7%	0.14 [0.00 , 6.82]
Subtotal (95% CI)		**18**		**18**	**14.7%**	**0.14 [0.00 , 6.82]**
Total events:	0		1			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.00 (P = 0.32)						
5.12.2 Liberal (Hb > 80 g/L)						
Clagett 1999	0	50	2	50	29.1%	0.13 [0.01 , 2.15]
Thompson 1990	3	33	1	34	56.2%	2.94 [0.40 , 21.88]
Subtotal (95% CI)		**83**		**84**	**85.3%**	**1.02 [0.20 , 5.20]**
Total events:	3		3			
Heterogeneity: Chi² = 3.13, df = 1 (P = 0.08); I² = 68%						
Test for overall effect: Z = 0.02 (P = 0.98)						
Total (95% CI)		**101**		**102**	**100.0%**	**0.76 [0.17 , 3.41]**
Total events:	3		4			
Heterogeneity: Chi² = 4.00, df = 2 (P = 0.14); I² = 50%						
Test for overall effect: Z = 0.36 (P = 0.72)						
Test for subgroup differences: Chi² = 0.87, df = 1 (P = 0.35), I² = 0%						



Analysis 5.13. Comparison 5: Cardiovascular (vascular) (subgroup: transfusion threshold), Outcome 13: CVA (stroke)

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Peto Odds Ratio Peto, Fixed, 95% CI
5.13.1 Liberal (Hb > 80 g/L)					
Clagett 1999	0	50	1	50	0.14 [0.00 , 6.82]



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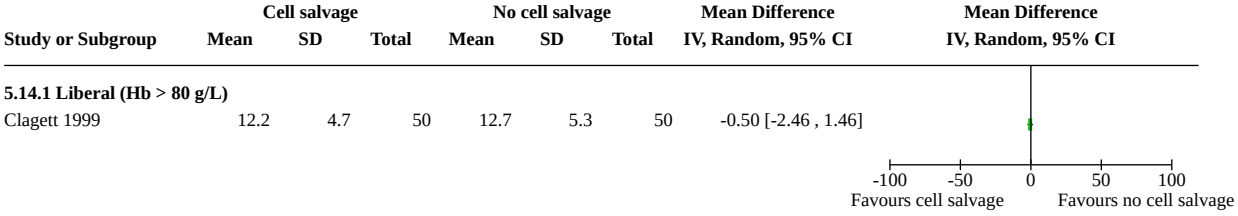
Analysis 5.14. Comparison 5: Cardiovascular (vascular) (subgroup: transfusion threshold), Outcome 14: Hospital LOS (days)



Comparison 6. Cardiovascular (no bypass) (subgroup: timing)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
6.1 Transfusions	3	169	Risk Ratio (M-H, Random, 95% CI)	0.82 [0.69, 0.97]
6.1.1 Intraoperative	2	110	Risk Ratio (M-H, Random, 95% CI)	0.83 [0.69, 1.00]
6.1.2 Postoperative	1	59	Risk Ratio (M-H, Random, 95% CI)	0.78 [0.53, 1.15]
6.2 Volume of transfusion (units) (PPR)	5	312	Mean Difference (IV, Random, 95% CI)	-0.90 [-1.78, -0.01]
6.2.1 Intraoperative	4	270	Mean Difference (IV, Random, 95% CI)	-0.69 [-1.64, 0.25]
6.2.2 Postoperative	1	42	Mean Difference (IV, Random, 95% CI)	-2.30 [-4.13, -0.47]
6.3 Volume of transfusion (units) (PPT)	2	56	Mean Difference (IV, Random, 95% CI)	0.13 [-0.80, 1.07]
6.3.1 Intraoperative	2	56	Mean Difference (IV, Random, 95% CI)	0.13 [-0.80, 1.07]
6.4 Mortality	4	209	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.13 [0.01, 2.07]
6.4.1 Intraoperative	3	0	Peto Odds Ratio (Peto, Fixed, 95% CI)	Not estimable
6.4.2 Postoperative	1	59	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.13 [0.01, 2.07]
6.5 Blood loss (mL)	3	131	Mean Difference (IV, Random, 95% CI)	-62.55 [-195.34, 70.24]
6.5.1 Intraoperative	2	89	Mean Difference (IV, Random, 95% CI)	-23.31 [-195.59, 148.96]
6.5.2 Postoperative	1	42	Mean Difference (IV, Random, 95% CI)	-120.00 [-328.45, 88.45]
6.6 Reoperation for bleeding	2	108	Risk Ratio (M-H, Random, 95% CI)	0.32 [0.04, 2.92]
6.6.1 Intraoperative	1	0	Risk Ratio (M-H, Random, 95% CI)	Not estimable
6.6.2 Postoperative	1	59	Risk Ratio (M-H, Random, 95% CI)	0.32 [0.04, 2.92]
6.7 Infection	2	110	Peto Odds Ratio (Peto, Fixed, 95% CI)	2.06 [0.21, 20.61]

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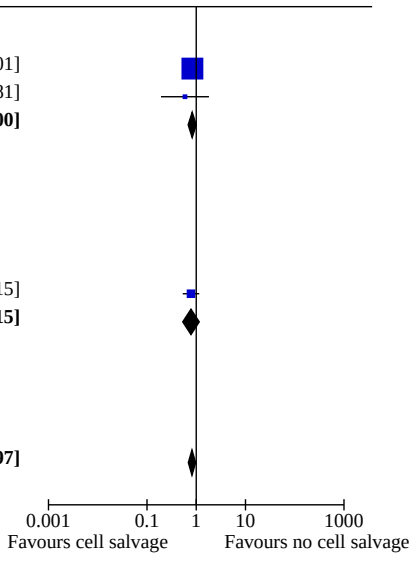
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
6.7.1 Intraoperative	2	110	Peto Odds Ratio (Peto, Fixed, 95% CI)	2.06 [0.21, 20.61]
6.8 Wound complication	3	169	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.00 [0.06, 15.98]
6.8.1 Intraoperative	2	110	Peto Odds Ratio (Peto, Fixed, 95% CI)	7.64 [0.15, 385.21]
6.8.2 Postoperative	1	59	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.13 [0.00, 6.59]
6.9 MI	2	120	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.98 [0.20, 19.32]
6.9.1 Intraoperative	1	61	Peto Odds Ratio (Peto, Fixed, 95% CI)	7.91 [0.48, 129.46]
6.9.2 Postoperative	1	59	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.13 [0.00, 6.59]
6.10 CVA (stroke)	3	160	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.98 [0.06, 15.72]
6.10.1 Intraoperative	2	101	Peto Odds Ratio (Peto, Fixed, 95% CI)	7.39 [0.15, 372.38]
6.10.2 Postoperative	1	59	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.13 [0.00, 6.59]
6.11 Hospital LOS (days)	2	160	Mean Difference (IV, Random, 95% CI)	-1.34 [-3.62, 0.95]
6.11.1 Intraoperative	2	160	Mean Difference (IV, Random, 95% CI)	-1.34 [-3.62, 0.95]

Analysis 6.1. Comparison 6: Cardiovascular (no bypass) (subgroup: timing), Outcome 1: Transfusions

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Risk Ratio M-H, Random, 95% CI
6.1.1 Intraoperative						
Goel 2007	20	24	25	25	78.4%	0.84 [0.69 , 1.01]
Murphy 2005	4	30	7	31	2.3%	0.59 [0.19 , 1.81]
Subtotal (95% CI)		**54**		**56**	**80.7%**	**0.83 [0.69 , 1.00]**
Total events:	24		32			
Heterogeneity: Tau² = 0.00; Chi² = 0.69, df = 1 (P = 0.40); I² = 0%						
Test for overall effect: Z = 1.96 (P = 0.05)						
6.1.2 Postoperative						
Damgaard 2006	17	30	21	29	19.3%	0.78 [0.53 , 1.15]
Subtotal (95% CI)		**30**		**29**	**19.3%**	**0.78 [0.53 , 1.15]**
Total events:	17		21			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.25 (P = 0.21)						
Total (95% CI)		**84**		**85**	**100.0%**	**0.82 [0.69 , 0.97]**
Total events:	41		53			
Heterogeneity: Tau² = 0.00; Chi² = 0.70, df = 2 (P = 0.71); I² = 0%						
Test for overall effect: Z = 2.31 (P = 0.02)						
Test for subgroup differences: Chi² = 0.07, df = 1 (P = 0.80), I² = 0%						



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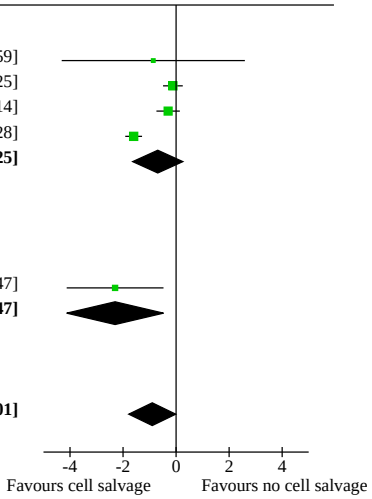
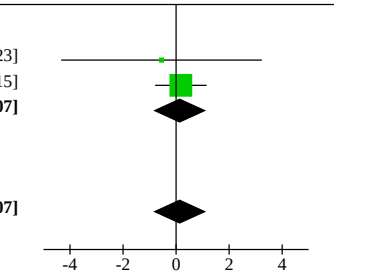
Analysis 6.2. Comparison 6: Cardiovascular (no bypass) (subgroup: timing), Outcome 2: Volume of transfusion (units) (PPR)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
6.2.1 Intraoperative								
Goel 2007	1.54	5.88	24	2.4	6.45	25	5.4%	-0.86 [-4.31 , 2.59]
Murphy 2005	0.23	0.63	30	0.35	0.84	31	27.3%	-0.12 [-0.49 , 0.25]
Niranjan 2006	0.47	0.61	20	0.77	0.8	20	26.8%	-0.30 [-0.74 , 0.14]
Zhao 2017	2.47	0.79	60	4.07	0.97	60	27.7%	-1.60 [-1.92 , -1.28]
Subtotal (95% CI)			**134**			**136**	**87.1%**	**-0.69 [-1.64 , 0.25]**
Heterogeneity: Tau² = 0.71; Chi² = 42.28, df = 3 (P < 0.00001); I² = 93%								
Test for overall effect: Z = 1.43 (P = 0.15)								
6.2.2 Postoperative								
Zhao 1996	3.6	2.4	22	5.9	3.48	20	12.9%	-2.30 [-4.13 , -0.47]
Subtotal (95% CI)			**22**			**20**	**12.9%**	**-2.30 [-4.13 , -0.47]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 2.47 (P = 0.01)								
Total (95% CI)			**156**			**156**	**100.0%**	**-0.90 [-1.78 , -0.01]**
Heterogeneity: Tau² = 0.71; Chi² = 44.77, df = 4 (P < 0.00001); I² = 91%								
Test for overall effect: Z = 1.99 (P = 0.05)								
Test for subgroup differences: Chi² = 2.35, df = 1 (P = 0.12), I² = 57.5%								



Analysis 6.3. Comparison 6: Cardiovascular (no bypass) (subgroup: timing), Outcome 3: Volume of transfusion (units) (PPT)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
6.3.1 Intraoperative								
Goel 2007	1.85	6.42	20	2.4	6.45	25	6.2%	-0.55 [-4.33 , 3.23]
Murphy 2005	1.75	0.5	4	1.57	1.13	7	93.8%	0.18 [-0.79 , 1.15]
Subtotal (95% CI)			**24**			**32**	**100.0%**	**0.13 [-0.80 , 1.07]**
Heterogeneity: Tau² = 0.00; Chi² = 0.13, df = 1 (P = 0.71); I² = 0%								
Test for overall effect: Z = 0.28 (P = 0.78)								
Total (95% CI)			**24**			**32**	**100.0%**	**0.13 [-0.80 , 1.07]**
Heterogeneity: Tau² = 0.00; Chi² = 0.13, df = 1 (P = 0.71); I² = 0%								
Test for overall effect: Z = 0.28 (P = 0.78)								
Test for subgroup differences: Not applicable								



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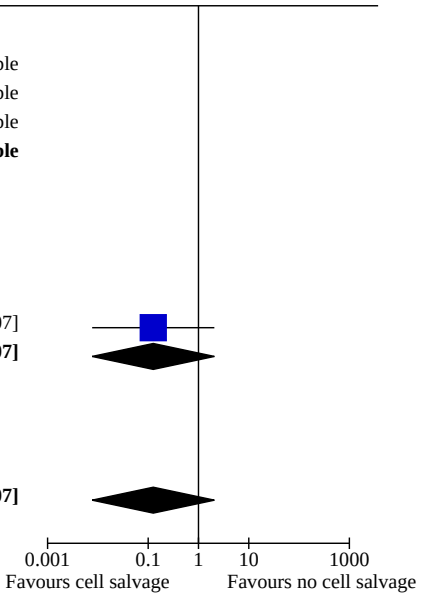
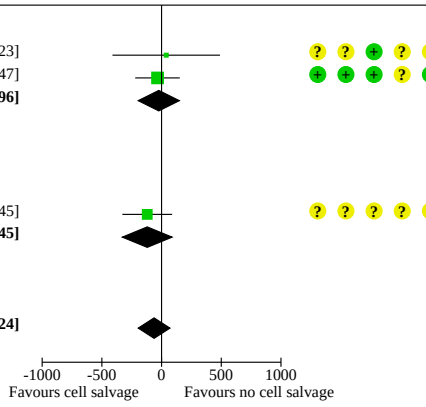
Analysis 6.4. Comparison 6: Cardiovascular (no bypass) (subgroup: timing), Outcome 4: Mortality

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
6.4.1 Intraoperative						
Goel 2007	0	24	0	25		Not estimable
Murphy 2005	0	30	0	31		Not estimable
Niranjan 2006	0	20	0	20		Not estimable
Subtotal (95% CI)		**0**		**0**		**Not estimable**
Total events:	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Not applicable						
6.4.2 Postoperative						
Damgaard 2006	0	30	2	29	100.0%	0.13 [0.01 , 2.07]
Subtotal (95% CI)		**30**		**29**	**100.0%**	**0.13 [0.01 , 2.07]**
Total events:	0		2			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.45 (P = 0.15)						
Total (95% CI)		**104**		**105**	**100.0%**	**0.13 [0.01 , 2.07]**
Total events:	0		2			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.45 (P = 0.15)						
Test for subgroup differences: Not applicable						



Analysis 6.5. Comparison 6: Cardiovascular (no bypass) (subgroup: timing), Outcome 5: Blood loss (mL)

Study or Subgroup	Cell salvage Mean	Cell salvage SD	Cell salvage Total	No cell salvage Mean	No cell salvage SD	No cell salvage Total	Weight	Mean Difference IV, Random, 95% CI	Risk of Bias A B C D E
6.5.1 Intraoperative									
Goel 2007	355	960.2	24	316	599	25	8.7%	39.00 [-411.23 , 489.23]	? ? + ? ?
Niranjan 2006	869	286	20	903	315	20	50.7%	-34.00 [-220.47 , 152.47]	+ + + ? +
Subtotal (95% CI)			**44**			**45**	**59.4%**	**-23.31 [-195.59 , 148.96]**	
Heterogeneity: Tau² = 0.00; Chi² = 0.09, df = 1 (P = 0.77); I² = 0%									
Test for overall effect: Z = 0.27 (P = 0.79)									
6.5.2 Postoperative									
Zhao 1996	550	300	22	670	380	20	40.6%	-120.00 [-328.45 , 88.45]	? ? ? ? ?
Subtotal (95% CI)			**22**			**20**	**40.6%**	**-120.00 [-328.45 , 88.45]**	
Heterogeneity: Not applicable									
Test for overall effect: Z = 1.13 (P = 0.26)									
Total (95% CI)			**66**			**65**	**100.0%**	**-62.55 [-195.34 , 70.24]**	
Heterogeneity: Tau² = 0.00; Chi² = 0.58, df = 2 (P = 0.75); I² = 0%									
Test for overall effect: Z = 0.92 (P = 0.36)									
Test for subgroup differences: Chi² = 0.49, df = 1 (P = 0.48), I² = 0%									



Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Incomplete outcome data (attrition bias)
(D) Selective reporting (reporting bias)
(E) Other bias

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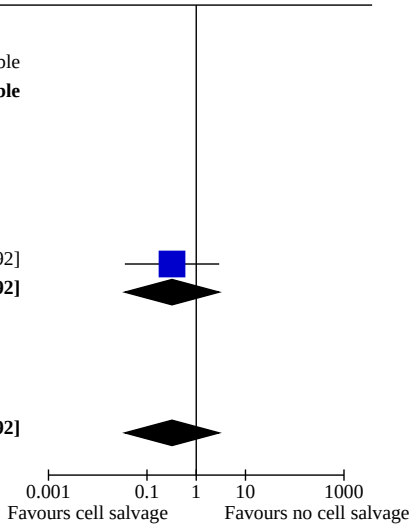
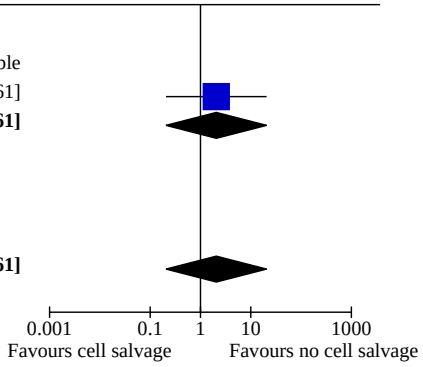
Analysis 6.6. Comparison 6: Cardiovascular (no bypass) (subgroup: timing), Outcome 6: Reoperation for bleeding

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Risk Ratio M-H, Random, 95% CI
6.6.1 Intraoperative						
Goel 2007	0	24	0	25		Not estimable
Subtotal (95% CI)		**0**		**0**		**Not estimable**
Total events:	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Not applicable						
6.6.2 Postoperative						
Damgaard 2006	1	30	3	29	100.0%	0.32 [0.04 , 2.92]
Subtotal (95% CI)		**30**		**29**	**100.0%**	**0.32 [0.04 , 2.92]**
Total events:	1		3			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.01 (P = 0.31)						
Total (95% CI)		**54**		**54**	**100.0%**	**0.32 [0.04 , 2.92]**
Total events:	1		3			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.01 (P = 0.31)						
Test for subgroup differences: Not applicable						



Analysis 6.7. Comparison 6: Cardiovascular (no bypass) (subgroup: timing), Outcome 7: Infection

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
6.7.1 Intraoperative						
Goel 2007	0	24	0	25		Not estimable
Murphy 2005	2	30	1	31	100.0%	2.06 [0.21 , 20.61]
Subtotal (95% CI)		**54**		**56**	**100.0%**	**2.06 [0.21 , 20.61]**
Total events:	2		1			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.62 (P = 0.54)						
Total (95% CI)		**54**		**56**	**100.0%**	**2.06 [0.21 , 20.61]**
Total events:	2		1			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.62 (P = 0.54)						
Test for subgroup differences: Not applicable						



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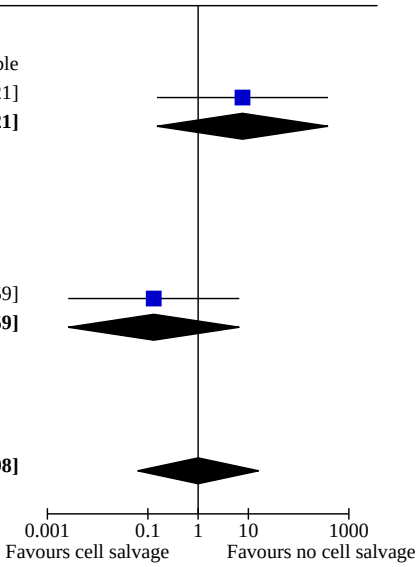
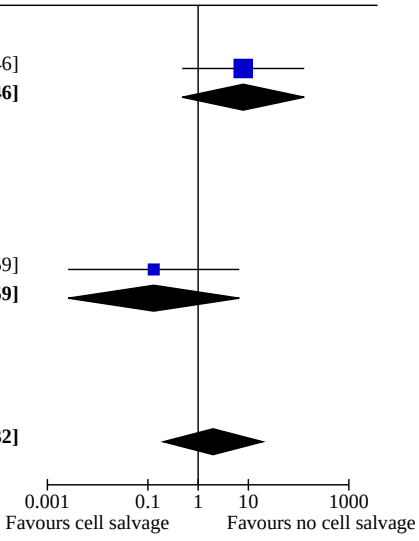
Analysis 6.8. Comparison 6: Cardiovascular (no bypass) (subgroup: timing), Outcome 8: Wound complication

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
6.8.1 Intraoperative						
Goel 2007	0	24	0	25		Not estimable
Murphy 2005	1	30	0	31	50.0%	7.64 [0.15 , 385.21]
Subtotal (95% CI)		**54**		**56**	**50.0%**	**7.64 [0.15 , 385.21]**
Total events:	1		0			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.02 (P = 0.31)						
6.8.2 Postoperative						
Damgaard 2006	0	30	1	29	50.0%	0.13 [0.00 , 6.59]
Subtotal (95% CI)		**30**		**29**	**50.0%**	**0.13 [0.00 , 6.59]**
Total events:	0		1			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.02 (P = 0.31)						
Total (95% CI)		**84**		**85**	**100.0%**	**1.00 [0.06 , 15.98]**
Total events:	1		1			
Heterogeneity: Chi² = 2.07, df = 1 (P = 0.15); I² = 52%						
Test for overall effect: Z = 0.00 (P = 1.00)						
Test for subgroup differences: Chi² = 2.07, df = 1 (P = 0.15), I² = 51.6%						



Analysis 6.9. Comparison 6: Cardiovascular (no bypass) (subgroup: timing), Outcome 9: MI

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
6.9.1 Intraoperative						
Murphy 2005	2	30	0	31	66.3%	7.91 [0.48 , 129.46]
Subtotal (95% CI)		**30**		**31**	**66.3%**	**7.91 [0.48 , 129.46]**
Total events:	2		0			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.45 (P = 0.15)						
6.9.2 Postoperative						
Damgaard 2006	0	30	1	29	33.7%	0.13 [0.00 , 6.59]
Subtotal (95% CI)		**30**		**29**	**33.7%**	**0.13 [0.00 , 6.59]**
Total events:	0		1			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.02 (P = 0.31)						
Total (95% CI)		**60**		**60**	**100.0%**	**1.98 [0.20 , 19.32]**
Total events:	2		1			
Heterogeneity: Chi² = 2.79, df = 1 (P = 0.09); I² = 64%						
Test for overall effect: Z = 0.59 (P = 0.56)						
Test for subgroup differences: Chi² = 2.79, df = 1 (P = 0.09), I² = 64.1%						



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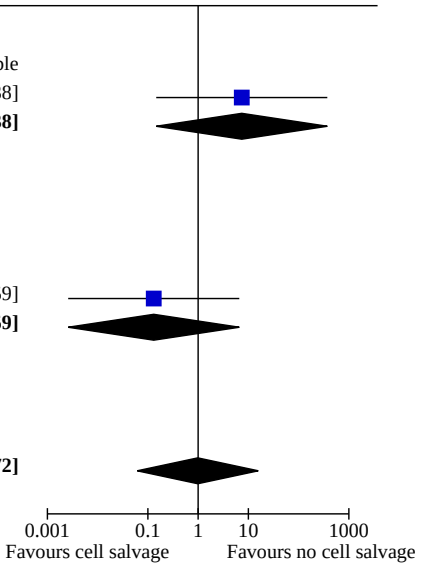
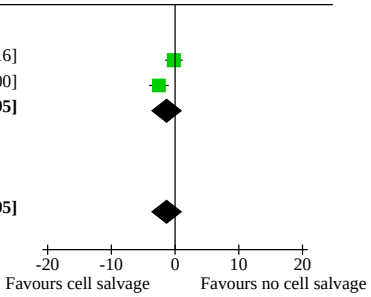
Analysis 6.10. Comparison 6: Cardiovascular (no bypass) (subgroup: timing), Outcome 10: CVA (stroke)

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
6.10.1 Intraoperative						
Murphy 2005	0	30	0	31		Not estimable
Niranjan 2006	1	20	0	20	50.0%	7.39 [0.15 , 372.38]
Subtotal (95% CI)		**50**		**51**	**50.0%**	**7.39 [0.15 , 372.38]**
Total events:	1		0			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.00 (P = 0.32)						
6.10.2 Postoperative						
Damgaard 2006	0	30	1	29	50.0%	0.13 [0.00 , 6.59]
Subtotal (95% CI)		**30**		**29**	**50.0%**	**0.13 [0.00 , 6.59]**
Total events:	0		1			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.02 (P = 0.31)						
Total (95% CI)		**80**		**80**	**100.0%**	**0.98 [0.06 , 15.72]**
Total events:	1		1			
Heterogeneity: Chi² = 2.03, df = 1 (P = 0.15); I² = 51%						
Test for overall effect: Z = 0.01 (P = 0.99)						
Test for subgroup differences: Chi² = 2.03, df = 1 (P = 0.15), I² = 50.8%						



Analysis 6.11. Comparison 6: Cardiovascular (no bypass) (subgroup: timing), Outcome 11: Hospital LOS (days)

Study or Subgroup	Cell salvage Mean	Cell salvage SD	Cell salvage Total	No cell salvage Mean	No cell salvage SD	No cell salvage Total	Weight	Mean Difference IV, Random, 95% CI
6.11.1 Intraoperative								
Niranjan 2006	7.2	2.3	20	7.4	2.1	20	51.2%	-0.20 [-1.56 , 1.16]
Zhao 2017	10.23	3.82	60	12.76	4.71	60	48.8%	-2.53 [-4.06 , -1.00]
Subtotal (95% CI)			**80**			**80**	**100.0%**	**-1.34 [-3.62 , 0.95]**
Heterogeneity: Tau² = 2.17; Chi² = 4.94, df = 1 (P = 0.03); I² = 80%								
Test for overall effect: Z = 1.15 (P = 0.25)								
Total (95% CI)			**80**			**80**	**100.0%**	**-1.34 [-3.62 , 0.95]**
Heterogeneity: Tau² = 2.17; Chi² = 4.94, df = 1 (P = 0.03); I² = 80%								
Test for overall effect: Z = 1.15 (P = 0.25)								
Test for subgroup differences: Not applicable								



Comparison 7. Cardiovascular (no bypass) (subgroup: transfusion threshold)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
7.1 Transfusions	3	169	Risk Ratio (M-H, Random, 95% CI)	0.82 [0.69, 0.97]
7.1.1 Restrictive (Hb ≦ 80 g/L)	1	61	Risk Ratio (M-H, Random, 95% CI)	0.59 [0.19, 1.81]
7.1.2 Liberal (Hb > 80 g/L)	2	108	Risk Ratio (M-H, Random, 95% CI)	0.83 [0.70, 0.98]
7.2 Volume of transfusion (units) (PPR)	5	312	Mean Difference (IV, Random, 95% CI)	-0.90 [-1.78, -0.01]

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Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
7.2.1 Restrictive (Hb ≦ 80 g/L)	3	221	Mean Difference (IV, Random, 95% CI)	-0.68 [-1.67, 0.31]
7.2.2 Liberal (Hb > 80 g/L)	1	49	Mean Difference (IV, Random, 95% CI)	-0.86 [-4.31, 2.59]
7.2.3 No threshold/protocol reported	1	42	Mean Difference (IV, Random, 95% CI)	-2.30 [-4.13, -0.47]
7.3 Volume of transfusion (units) (PPT)	2	56	Mean Difference (IV, Random, 95% CI)	0.13 [-0.80, 1.07]
7.3.1 Restrictive (Hb ≦ 80 g/L)	1	11	Mean Difference (IV, Random, 95% CI)	0.18 [-0.79, 1.15]
7.3.2 Liberal (Hb > 80 g/L)	1	45	Mean Difference (IV, Random, 95% CI)	-0.55 [-4.33, 3.23]
7.4 Mortality	4	209	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.13 [0.01, 2.07]
7.4.1 Restrictive (Hb ≦ 80 g/L)	2	0	Peto Odds Ratio (Peto, Fixed, 95% CI)	Not estimable
7.4.2 Liberal (Hb > 80 g/L)	2	108	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.13 [0.01, 2.07]
7.5 Blood loss (mL)	3	131	Mean Difference (IV, Random, 95% CI)	-62.55 [-195.34, 70.24]
7.5.1 Restrictive (Hb ≦ 80 g/L)	1	40	Mean Difference (IV, Random, 95% CI)	-34.00 [-220.47, 152.47]
7.5.2 Liberal (Hb > 80 g/L)	1	49	Mean Difference (IV, Random, 95% CI)	39.00 [-411.23, 489.23]
7.5.3 No threshold/protocol reported	1	42	Mean Difference (IV, Random, 95% CI)	-120.00 [-328.45, 88.45]
7.6 Reoperation for bleeding	2	108	Risk Ratio (M-H, Random, 95% CI)	0.32 [0.04, 2.92]
7.6.1 Liberal (Hb > 80 g/L)	2	108	Risk Ratio (M-H, Random, 95% CI)	0.32 [0.04, 2.92]
7.7 Infection	2	110	Peto Odds Ratio (Peto, Fixed, 95% CI)	2.06 [0.21, 20.61]
7.7.1 Restrictive (Hb ≦ 80 g/L)	1	61	Peto Odds Ratio (Peto, Fixed, 95% CI)	2.06 [0.21, 20.61]
7.7.2 Liberal (Hb > 80 g/L)	1	0	Peto Odds Ratio (Peto, Fixed, 95% CI)	Not estimable
7.8 Wound complication	3	169	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.00 [0.06, 15.98]

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Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
7.8.1 Restrictive (Hb ≦ 80 g/L)	1	61	Peto Odds Ratio (Peto, Fixed, 95% CI)	7.64 [0.15, 385.21]
7.8.2 Liberal (Hb > 80 g/L)	2	108	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.13 [0.00, 6.59]
7.9 MI	2	120	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.98 [0.20, 19.32]
7.9.1 Restrictive (Hb ≦ 80 g/L)	1	61	Peto Odds Ratio (Peto, Fixed, 95% CI)	7.91 [0.48, 129.46]
7.9.2 Liberal (Hb > 80 g/L)	1	59	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.13 [0.00, 6.59]
7.10 CVA (stroke)	3	160	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.98 [0.06, 15.72]
7.10.1 Restrictive (Hb ≦ 80 g/L)	2	101	Peto Odds Ratio (Peto, Fixed, 95% CI)	7.39 [0.15, 372.38]
7.10.2 Liberal (Hb > 80 g/L)	1	59	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.13 [0.00, 6.59]
7.11 Hospital LOS (days)	2	160	Mean Difference (IV, Random, 95% CI)	-1.34 [-3.62, 0.95]
7.11.1 Restrictive (Hb ≦ 80 g/L)	2	160	Mean Difference (IV, Random, 95% CI)	-1.34 [-3.62, 0.95]

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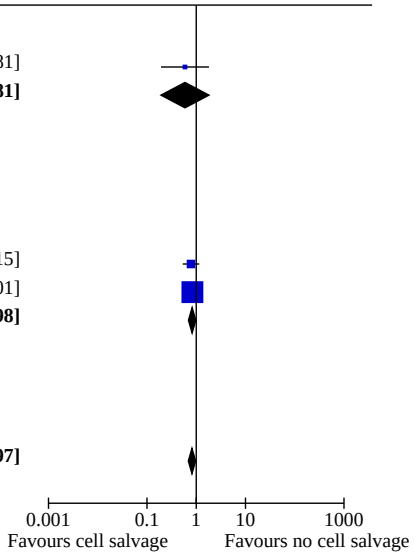
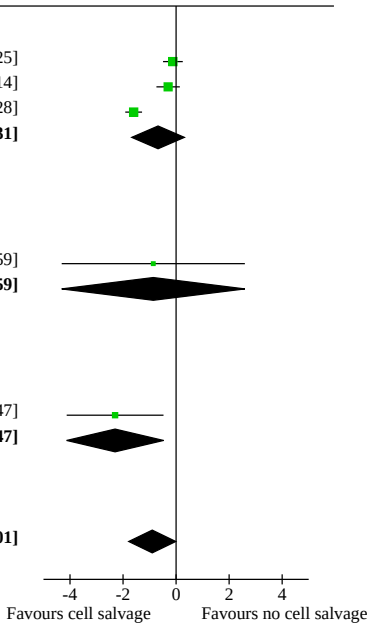
Analysis 7.1. Comparison 7: Cardiovascular (no bypass) (subgroup: transfusion threshold), Outcome 1: Transfusions

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Risk Ratio M-H, Random, 95% CI
7.1.1 Restrictive (Hb # 80 g/L)						
Murphy 2005	4	30	7	31	2.3%	0.59 [0.19 , 1.81]
Subtotal (95% CI)		**30**		**31**	**2.3%**	**0.59 [0.19 , 1.81]**
Total events:	4		7			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.92 (P = 0.36)						
7.1.2 Liberal (Hb > 80 g/L)						
Damgaard 2006	17	30	21	29	19.3%	0.78 [0.53 , 1.15]
Goel 2007	20	24	25	25	78.4%	0.84 [0.69 , 1.01]
Subtotal (95% CI)		**54**		**54**	**97.7%**	**0.83 [0.70 , 0.98]**
Total events:	37		46			
Heterogeneity: Tau² = 0.00; Chi² = 0.13, df = 1 (P = 0.72); I² = 0%						
Test for overall effect: Z = 2.20 (P = 0.03)						
Total (95% CI)		**84**		**85**	**100.0%**	**0.82 [0.69 , 0.97]**
Total events:	41		53			
Heterogeneity: Tau² = 0.00; Chi² = 0.70, df = 2 (P = 0.71); I² = 0%						
Test for overall effect: Z = 2.31 (P = 0.02)						
Test for subgroup differences: Chi² = 0.33, df = 1 (P = 0.56), I² = 0%						



Analysis 7.2. Comparison 7: Cardiovascular (no bypass) (subgroup: transfusion threshold), Outcome 2: Volume of transfusion (units) (PPR)

Study or Subgroup	Cell salvage Mean	Cell salvage SD	Cell salvage Total	No cell salvage Mean	No cell salvage SD	No cell salvage Total	Weight	Mean Difference IV, Random, 95% CI
7.2.1 Restrictive (Hb # 80 g/L)								
Murphy 2005	0.23	0.63	30	0.35	0.84	31	27.3%	-0.12 [-0.49 , 0.25]
Niranjan 2006	0.47	0.61	20	0.77	0.8	20	26.8%	-0.30 [-0.74 , 0.14]
Zhao 2017	2.47	0.79	60	4.07	0.97	60	27.7%	-1.60 [-1.92 , -1.28]
Subtotal (95% CI)			**110**			**111**	**81.7%**	**-0.68 [-1.67 , 0.31]**
Heterogeneity: Tau² = 0.73; Chi² = 42.28, df = 2 (P < 0.00001); I² = 95%								
Test for overall effect: Z = 1.34 (P = 0.18)								
7.2.2 Liberal (Hb > 80 g/L)								
Goel 2007	1.54	5.88	24	2.4	6.45	25	5.4%	-0.86 [-4.31 , 2.59]
Subtotal (95% CI)			**24**			**25**	**5.4%**	**-0.86 [-4.31 , 2.59]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.49 (P = 0.63)								
7.2.3 No threshold/protocol reported								
Zhao 1996	3.6	2.4	22	5.9	3.48	20	12.9%	-2.30 [-4.13 , -0.47]
Subtotal (95% CI)			**22**			**20**	**12.9%**	**-2.30 [-4.13 , -0.47]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 2.47 (P = 0.01)								
Total (95% CI)			**156**			**156**	**100.0%**	**-0.90 [-1.78 , -0.01]**
Heterogeneity: Tau² = 0.71; Chi² = 44.77, df = 4 (P < 0.00001); I² = 91%								
Test for overall effect: Z = 1.99 (P = 0.05)								
Test for subgroup differences: Chi² = 2.35, df = 2 (P = 0.31), I² = 14.8%								



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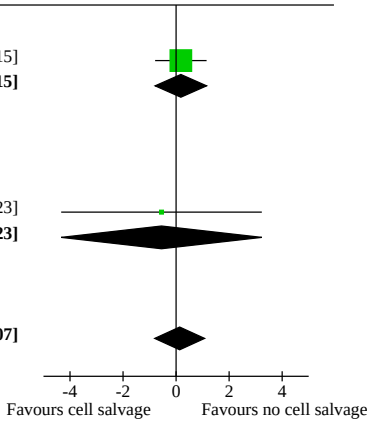
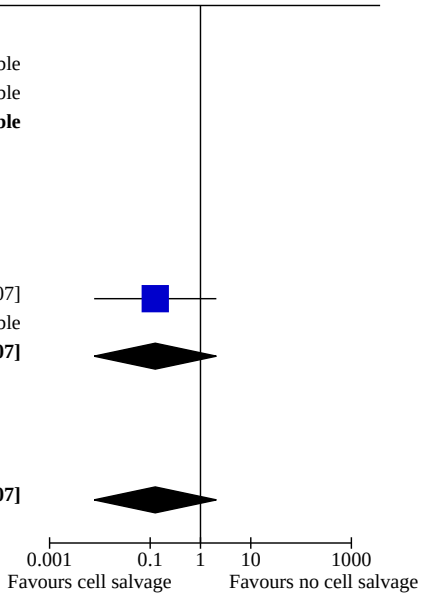
Analysis 7.3. Comparison 7: Cardiovascular (no bypass) (subgroup: transfusion threshold), Outcome 3: Volume of transfusion (units) (PPT)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
7.3.1 Restrictive (Hb # 80 g/L)								
Murphy 2005	1.75	0.5	4	1.57	1.13	7	93.8%	0.18 [-0.79 , 1.15]
Subtotal (95% CI)			**4**			**7**	**93.8%**	**0.18 [-0.79 , 1.15]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.36 (P = 0.72)								
7.3.2 Liberal (Hb > 80 g/L)								
Goel 2007	1.85	6.42	20	2.4	6.45	25	6.2%	-0.55 [-4.33 , 3.23]
Subtotal (95% CI)			**20**			**25**	**6.2%**	**-0.55 [-4.33 , 3.23]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.28 (P = 0.78)								
Total (95% CI)			**24**			**32**	**100.0%**	**0.13 [-0.80 , 1.07]**
Heterogeneity: Tau² = 0.00; Chi² = 0.13, df = 1 (P = 0.71); I² = 0%								
Test for overall effect: Z = 0.28 (P = 0.78)								
Test for subgroup differences: Chi² = 0.13, df = 1 (P = 0.71), I² = 0%								



Analysis 7.4. Comparison 7: Cardiovascular (no bypass) (subgroup: transfusion threshold), Outcome 4: Mortality

Study or Subgroup	Cell salvage Events	Total	No cell salvage Events	Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
7.4.1 Restrictive (Hb # 80 g/L)						
Murphy 2005	0	30	0	31		Not estimable
Niranjan 2006	0	20	0	20		Not estimable
Subtotal (95% CI)		**0**		**0**		**Not estimable**
Total events:	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Not applicable						
7.4.2 Liberal (Hb > 80 g/L)						
Damgaard 2006	0	30	2	29	100.0%	0.13 [0.01 , 2.07]
Goel 2007	0	24	0	25		Not estimable
Subtotal (95% CI)		**54**		**54**	**100.0%**	**0.13 [0.01 , 2.07]**
Total events:	0		2			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.45 (P = 0.15)						
Total (95% CI)		**104**		**105**	**100.0%**	**0.13 [0.01 , 2.07]**
Total events:	0		2			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.45 (P = 0.15)						
Test for subgroup differences: Not applicable						



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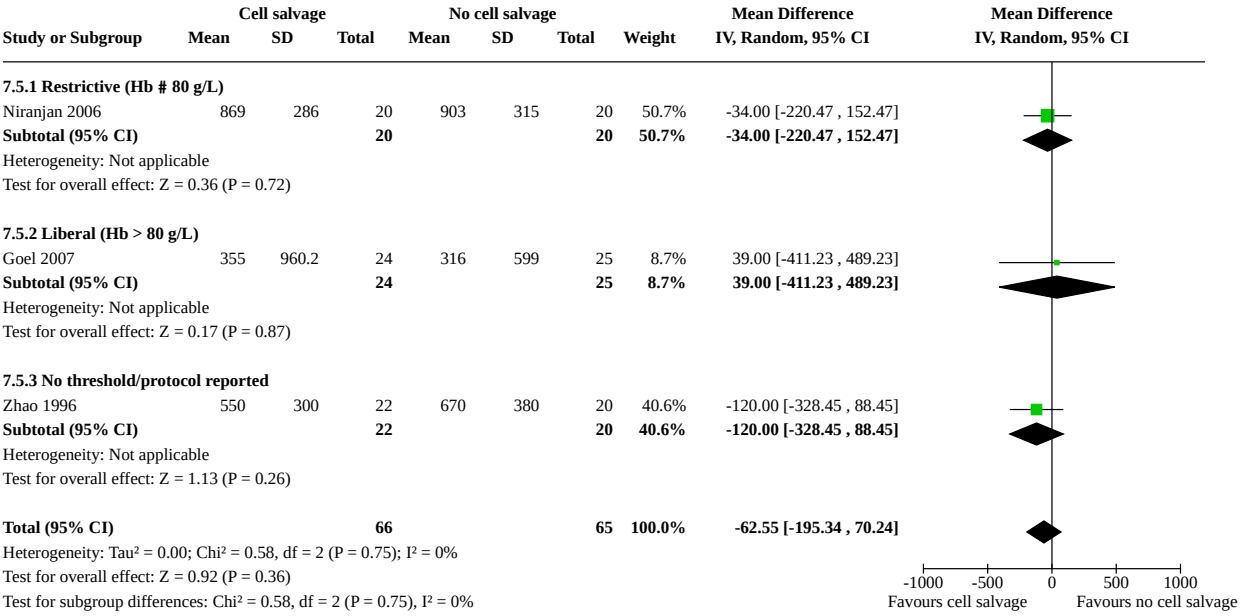
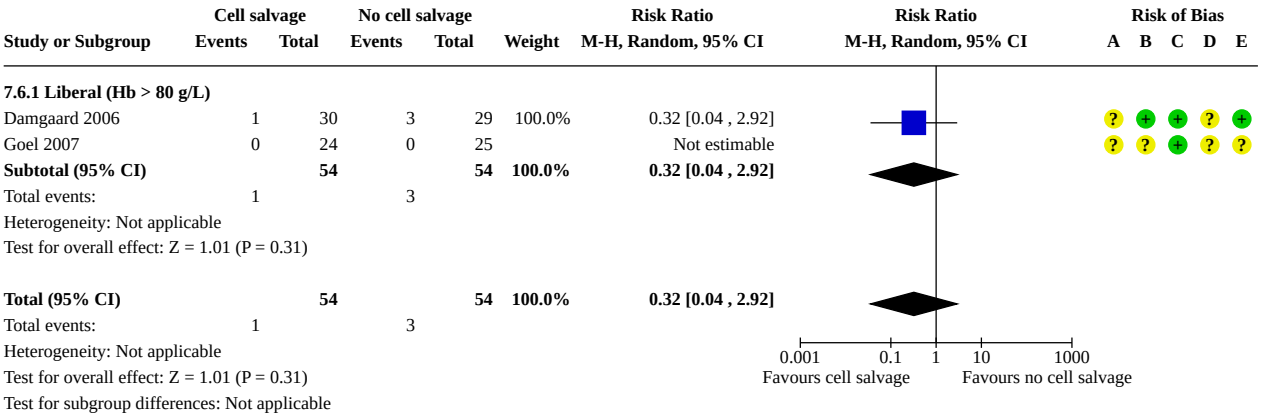
Analysis 7.5. Comparison 7: Cardiovascular (no bypass) (subgroup: transfusion threshold), Outcome 5: Blood loss (mL)



Analysis 7.6. Comparison 7: Cardiovascular (no bypass) (subgroup: transfusion threshold), Outcome 6: Reoperation for bleeding



Risk of bias legend

(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Incomplete outcome data (attrition bias)
(D) Selective reporting (reporting bias)
(E) Other bias

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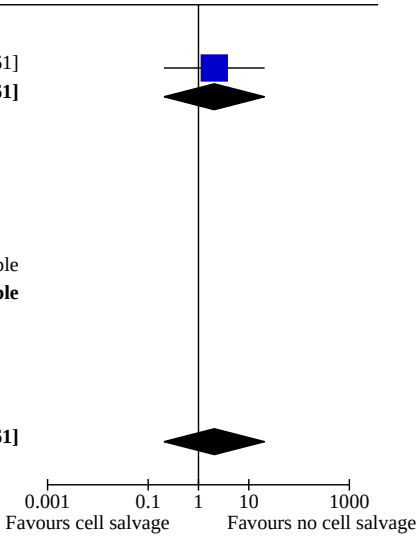
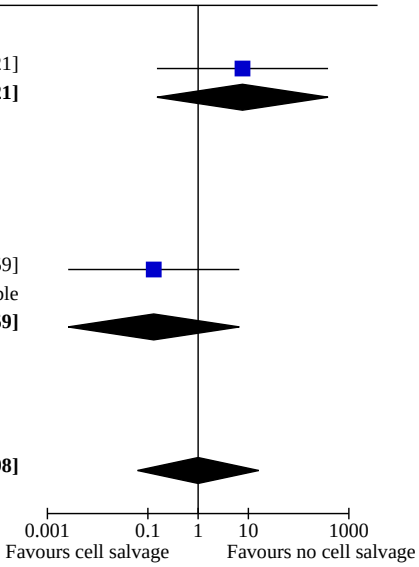
Analysis 7.7. Comparison 7: Cardiovascular (no bypass) (subgroup: transfusion threshold), Outcome 7: Infection

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
7.7.1 Restrictive (Hb # 80 g/L)						
Murphy 2005	2	30	1	31	100.0%	2.06 [0.21 , 20.61]
Subtotal (95% CI)		**30**		**31**	**100.0%**	**2.06 [0.21 , 20.61]**
Total events:	2		1			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.62 (P = 0.54)						
7.7.2 Liberal (Hb > 80 g/L)						
Goel 2007	0	24	0	25		Not estimable
Subtotal (95% CI)		**0**		**0**		**Not estimable**
Total events:	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Not applicable						
Total (95% CI)		**54**		**56**	**100.0%**	**2.06 [0.21 , 20.61]**
Total events:	2		1			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.62 (P = 0.54)						
Test for subgroup differences: Not applicable						



Analysis 7.8. Comparison 7: Cardiovascular (no bypass) (subgroup: transfusion threshold), Outcome 8: Wound complication

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
7.8.1 Restrictive (Hb # 80 g/L)						
Murphy 2005	1	30	0	31	50.0%	7.64 [0.15 , 385.21]
Subtotal (95% CI)		**30**		**31**	**50.0%**	**7.64 [0.15 , 385.21]**
Total events:	1		0			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.02 (P = 0.31)						
7.8.2 Liberal (Hb > 80 g/L)						
Damgaard 2006	0	30	1	29	50.0%	0.13 [0.00 , 6.59]
Goel 2007	0	24	0	25		Not estimable
Subtotal (95% CI)		**54**		**54**	**50.0%**	**0.13 [0.00 , 6.59]**
Total events:	0		1			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.02 (P = 0.31)						
Total (95% CI)		**84**		**85**	**100.0%**	**1.00 [0.06 , 15.98]**
Total events:	1		1			
Heterogeneity: Chi² = 2.07, df = 1 (P = 0.15); I² = 52%						
Test for overall effect: Z = 0.00 (P = 1.00)						
Test for subgroup differences: Chi² = 2.07, df = 1 (P = 0.15), I² = 51.6%						



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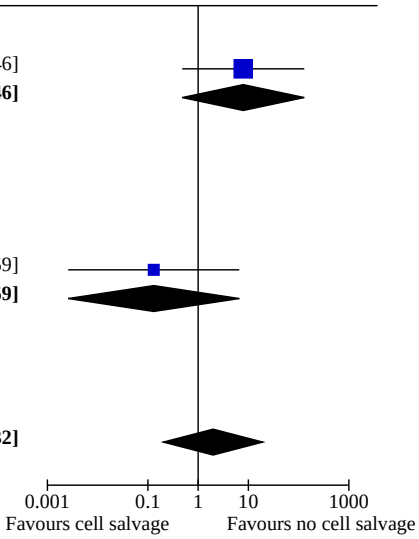
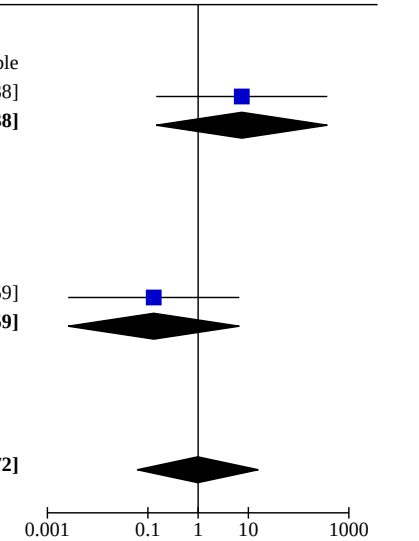
Analysis 7.9. Comparison 7: Cardiovascular (no bypass) (subgroup: transfusion threshold), Outcome 9: MI

Study or Subgroup	Cell salvage Events	Total	No cell salvage Events	Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
7.9.1 Restrictive (Hb # 80 g/L)						
Murphy 2005	2	30	0	31	66.3%	7.91 [0.48 , 129.46]
Subtotal (95% CI)		**30**		**31**	**66.3%**	**7.91 [0.48 , 129.46]**
Total events:	2		0			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.45 (P = 0.15)						
7.9.2 Liberal (Hb > 80 g/L)						
Damgaard 2006	0	30	1	29	33.7%	0.13 [0.00 , 6.59]
Subtotal (95% CI)		**30**		**29**	**33.7%**	**0.13 [0.00 , 6.59]**
Total events:	0		1			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.02 (P = 0.31)						
Total (95% CI)		**60**		**60**	**100.0%**	**1.98 [0.20 , 19.32]**
Total events:	2		1			
Heterogeneity: Chi² = 2.79, df = 1 (P = 0.09); I² = 64%						
Test for overall effect: Z = 0.59 (P = 0.56)						
Test for subgroup differences: Chi² = 2.79, df = 1 (P = 0.09), I² = 64.1%						



Analysis 7.10. Comparison 7: Cardiovascular (no bypass) (subgroup: transfusion threshold), Outcome 10: CVA (stroke)

Study or Subgroup	Cell salvage Events	Total	No cell salvage Events	Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
7.10.1 Restrictive (Hb # 80 g/L)						
Murphy 2005	0	30	0	31		Not estimable
Niranjan 2006	1	20	0	20	50.0%	7.39 [0.15 , 372.38]
Subtotal (95% CI)		**50**		**51**	**50.0%**	**7.39 [0.15 , 372.38]**
Total events:	1		0			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.00 (P = 0.32)						
7.10.2 Liberal (Hb > 80 g/L)						
Damgaard 2006	0	30	1	29	50.0%	0.13 [0.00 , 6.59]
Subtotal (95% CI)		**30**		**29**	**50.0%**	**0.13 [0.00 , 6.59]**
Total events:	0		1			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.02 (P = 0.31)						
Total (95% CI)		**80**		**80**	**100.0%**	**0.98 [0.06 , 15.72]**
Total events:	1		1			
Heterogeneity: Chi² = 2.03, df = 1 (P = 0.15); I² = 51%						
Test for overall effect: Z = 0.01 (P = 0.99)						
Test for subgroup differences: Chi² = 2.03, df = 1 (P = 0.15), I² = 50.8%						



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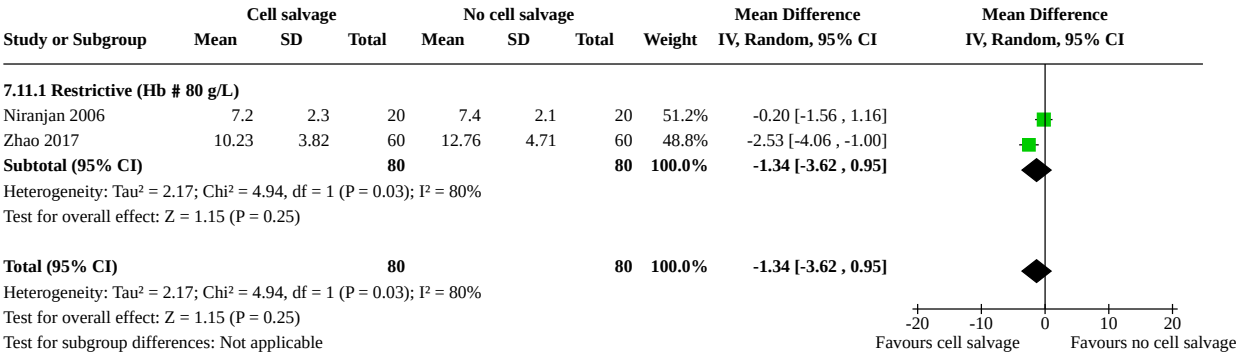
Analysis 7.11. Comparison 7: Cardiovascular (no bypass) (subgroup: transfusion threshold), Outcome 11: Hospital LOS (days)



Comparison 8. Cardiovascular (with bypass) (subgroup: timing)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
8.1 Transfusions	25	2676	Risk Ratio (M-H, Random, 95% CI)	0.81 [0.73, 0.89]
8.1.1 Intraoperative	8	1219	Risk Ratio (M-H, Random, 95% CI)	0.78 [0.63, 0.97]
8.1.2 Postoperative	14	1145	Risk Ratio (M-H, Random, 95% CI)	0.81 [0.72, 0.93]
8.1.3 Intra- and postoperative	4	312	Risk Ratio (M-H, Random, 95% CI)	0.82 [0.63, 1.08]
8.2 Volume of transfusion (units) (PPR)	18	2110	Mean Difference (IV, Random, 95% CI)	-1.23 [-1.71, -0.74]
8.2.1 Intraoperative	7	1162	Mean Difference (IV, Random, 95% CI)	-1.47 [-2.59, -0.36]
8.2.2 Postoperative	10	878	Mean Difference (IV, Random, 95% CI)	-0.78 [-1.16, -0.41]
8.2.3 Intra- and postoperative	2	70	Mean Difference (IV, Random, 95% CI)	-2.99 [-5.11, -0.87]
8.3 Volume of transfusion (units) (PPT)	16	1264	Mean Difference (IV, Random, 95% CI)	-0.80 [-1.21, -0.40]
8.3.1 Intraoperative	6	645	Mean Difference (IV, Random, 95% CI)	-0.86 [-1.89, 0.18]
8.3.2 Postoperative	9	560	Mean Difference (IV, Random, 95% CI)	-0.42 [-0.76, -0.09]
8.3.3 Intra- and postoperative	2	59	Mean Difference (IV, Random, 95% CI)	-2.35 [-4.59, -0.11]
8.4 Mortality	21	2491	Risk Ratio (M-H, Random, 95% CI)	0.86 [0.50, 1.48]
8.4.1 Intraoperative	8	1176	Risk Ratio (M-H, Random, 95% CI)	0.66 [0.32, 1.36]
8.4.2 Postoperative	12	1069	Risk Ratio (M-H, Random, 95% CI)	1.22 [0.46, 3.21]

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Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
8.4.3 Intra- and postoperative	2	246	Risk Ratio (M-H, Random, 95% CI)	1.20 [0.23, 6.26]
8.5 Blood loss (mL)	19	2117	Mean Difference (IV, Random, 95% CI)	4.72 [-49.88, 59.32]
8.5.1 Intraoperative	8	1229	Mean Difference (IV, Random, 95% CI)	41.01 [-16.90, 98.91]
8.5.2 Postoperative	9	790	Mean Difference (IV, Random, 95% CI)	-14.33 [-137.39, 108.73]
8.5.3 Intra- and postoperative	3	98	Mean Difference (IV, Random, 95% CI)	-45.79 [-119.78, 28.19]
8.6 Reoperation for bleeding	15	1274	Risk Ratio (M-H, Random, 95% CI)	1.37 [0.77, 2.43]
8.6.1 Intraoperative	5	329	Risk Ratio (M-H, Random, 95% CI)	2.05 [0.58, 7.22]
8.6.2 Postoperative	9	732	Risk Ratio (M-H, Random, 95% CI)	1.18 [0.59, 2.35]
8.6.3 Intra- and postoperative	1	213	Risk Ratio (M-H, Random, 95% CI)	1.63 [0.28, 9.57]
8.7 Infection	8	1231	Risk Ratio (M-H, Random, 95% CI)	1.16 [0.83, 1.61]
8.7.1 Intraoperative	5	941	Risk Ratio (M-H, Random, 95% CI)	1.22 [0.87, 1.72]
8.7.2 Postoperative	3	258	Risk Ratio (M-H, Random, 95% CI)	0.48 [0.12, 1.98]
8.7.3 Intra- and postoperative	1	0	Risk Ratio (M-H, Random, 95% CI)	Not estimable
8.8 Wound complication	6	618	Risk Ratio (M-H, Random, 95% CI)	0.96 [0.44, 2.08]
8.8.1 Intraoperative	1	103	Risk Ratio (M-H, Random, 95% CI)	1.42 [0.25, 8.12]
8.8.2 Postoperative	4	302	Risk Ratio (M-H, Random, 95% CI)	0.52 [0.14, 1.91]
8.8.3 Intra- and postoperative	1	213	Risk Ratio (M-H, Random, 95% CI)	1.31 [0.41, 4.15]
8.9 Thrombosis (VTE)	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
8.9.1 Intraoperative	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
8.10 DVT	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
8.10.1 Intraoperative	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
8.11 PE	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected

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Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
8.11.1 Intraoperative	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
8.12 MACE	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
8.12.1 Intraoperative	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
8.13 MI	9	1376	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.86 [0.47, 1.58]
8.13.1 Intraoperative	3	849	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.61 [0.27, 1.41]
8.13.2 Postoperative	6	527	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.27 [0.52, 3.13]
8.14 CVA (stroke)	5	1018	Risk Ratio (M-H, Random, 95% CI)	0.54 [0.23, 1.24]
8.14.1 Intraoperative	4	820	Risk Ratio (M-H, Random, 95% CI)	0.54 [0.22, 1.32]
8.14.2 Postoperative	1	198	Risk Ratio (M-H, Random, 95% CI)	0.51 [0.05, 5.54]
8.15 Hospital LOS (days)	8	1249	Mean Difference (IV, Random, 95% CI)	-0.78 [-1.81, 0.25]
8.15.1 Intraoperative	6	1097	Mean Difference (IV, Random, 95% CI)	-0.41 [-1.47, 0.66]
8.15.2 Postoperative	2	152	Mean Difference (IV, Random, 95% CI)	-2.32 [-3.83, -0.81]

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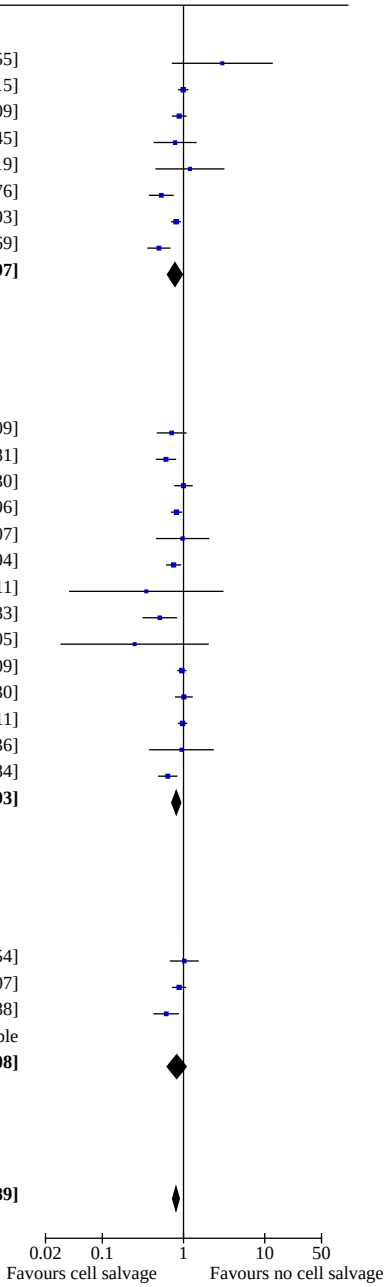
Analysis 8.1. Comparison 8: Cardiovascular (with bypass) (subgroup: timing), Outcome 1: Transfusions

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Risk Ratio M-H, Random, 95% CI
8.1.1 Intraoperative						
Gäbel 2013a	6	15	2	15	0.4%	3.00 [0.72 , 12.55]
Page 1989	42	48	45	51	7.0%	0.99 [0.86 , 1.15]
Parrot 1991	19	22	11	11	5.9%	0.88 [0.72 , 1.09]
Reyes 2011	12	34	13	29	1.9%	0.79 [0.43 , 1.45]
Scrascia 2012	6	17	5	17	0.9%	1.20 [0.45 , 3.19]
Shen 2016	22	53	39	50	3.9%	0.53 [0.37 , 0.76]
Vermeijden 2015	173	364	207	352	7.1%	0.81 [0.70 , 0.93]
Xie 2015	27	72	52	69	4.2%	0.50 [0.36 , 0.69]
Subtotal (95% CI)		**625**		**594**	**31.3%**	**0.78 [0.63 , 0.97]**
Total events:	307		374			
Heterogeneity: Tau² = 0.05; Chi² = 28.28, df = 7 (P = 0.0002); I² = 75%						
Test for overall effect: Z = 2.25 (P = 0.02)						
8.1.2 Postoperative						
Axford 1994	10	16	14	16	3.2%	0.71 [0.47 , 1.09]
Dalrymple-Hay 1999	28	56	46	56	4.7%	0.61 [0.46 , 0.81]
Eng 1990	17	20	17	20	5.1%	1.00 [0.77 , 1.30]
Lepore 1989	50	67	62	68	6.8%	0.82 [0.70 , 0.96]
Marberg 2010	10	39	10	38	1.3%	0.97 [0.46 , 2.07]
Martin 2000	54	98	73	100	5.9%	0.75 [0.61 , 0.94]
Pleym 2005	1	23	3	24	0.2%	0.35 [0.04 , 3.11]
Schmidt 1996	15	53	31	56	2.6%	0.51 [0.31 , 0.83]
Schönberger 1993	1	20	4	20	0.2%	0.25 [0.03 , 2.05]
Shirvani 1991	20	21	21	21	7.2%	0.95 [0.84 , 1.09]
Thurer 1979	37	54	40	59	5.3%	1.01 [0.79 , 1.30]
Unsworth 1996	63	71	31	34	7.2%	0.97 [0.85 , 1.11]
Ward 1993	6	18	6	17	1.0%	0.94 [0.38 , 2.36]
Zhao 2003	19	30	30	30	4.9%	0.64 [0.49 , 0.84]
Subtotal (95% CI)		**586**		**559**	**55.5%**	**0.81 [0.72 , 0.93]**
Total events:	331		388			
Heterogeneity: Tau² = 0.03; Chi² = 35.80, df = 13 (P = 0.0006); I² = 64%						
Test for overall effect: Z = 3.14 (P = 0.002)						
8.1.3 Intra- and postoperative						
Klein 2008	31	102	33	111	3.3%	1.02 [0.68 , 1.54]
Koopman-van Gemert 1993a	15	17	20	20	6.1%	0.88 [0.72 , 1.07]
Parrot 1991	13	22	11	11	3.8%	0.61 [0.43 , 0.88]
Westerberg 2004	0	12	0	17		Not estimable
Subtotal (95% CI)		**153**		**159**	**13.2%**	**0.82 [0.63 , 1.08]**
Total events:	59		64			
Heterogeneity: Tau² = 0.03; Chi² = 4.48, df = 2 (P = 0.11); I² = 55%						
Test for overall effect: Z = 1.40 (P = 0.16)						
Total (95% CI)		**1364**		**1312**	**100.0%**	**0.81 [0.73 , 0.89]**
Total events:	697		826			
Heterogeneity: Tau² = 0.03; Chi² = 66.93, df = 24 (P < 0.00001); I² = 64%						
Test for overall effect: Z = 4.41 (P < 0.0001)						
Test for subgroup differences: Chi² = 0.11, df = 2 (P = 0.95), I² = 0%						



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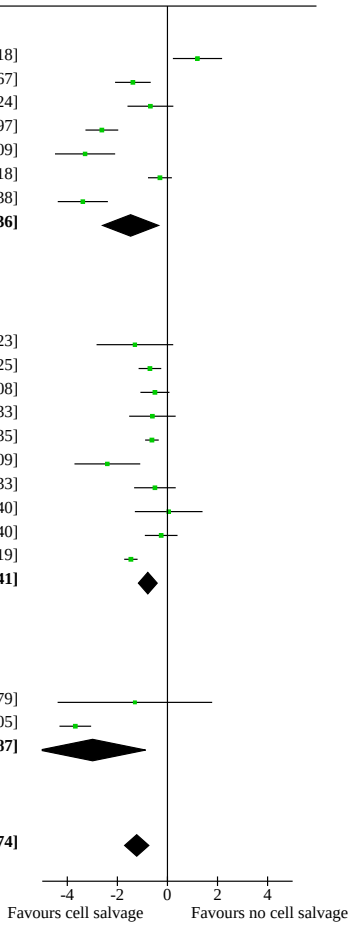
Analysis 8.2. Comparison 8: Cardiovascular (with bypass) (subgroup: timing), Outcome 2: Volume of transfusion (units) (PPR)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
8.2.1 Intraoperative								
Gäbel 2013a	1.3	1.9	15	0.1	0.4	15	5.2%	1.20 [0.22 , 2.18]
Niranjan 2006	0.6	0.71	20	1.98	1.46	20	5.7%	-1.38 [-2.09 , -0.67]
Page 1989	3.15	2.05	48	3.83	2.58	51	5.3%	-0.68 [-1.60 , 0.24]
Parrot 1991	1.88	0.97	22	4.5	0.87	11	5.8%	-2.62 [-3.27 , -1.97]
Shen 2016	2.11	2.66	53	5.4	3.48	50	4.7%	-3.29 [-4.49 , -2.09]
Vermeijden 2015	2	3.5	364	2.3	3	352	6.2%	-0.30 [-0.78 , 0.18]
Xie 2015	2.01	2.75	72	5.39	3.28	69	5.1%	-3.38 [-4.38 , -2.38]
Subtotal (95% CI)			**594**			**568**	**38.0%**	**-1.47 [-2.59 , -0.36]**
Heterogeneity: Tau² = 2.07; Chi² = 85.97, df = 6 (P < 0.00001); I² = 93%								
Test for overall effect: Z = 2.58 (P = 0.010)								
8.2.2 Postoperative								
Axford 1994	2	2	16	3.3	2.4	16	4.0%	-1.30 [-2.83 , 0.23]
Dalrymple-Hay 1999	0.99	1.22	56	1.69	1.22	56	6.2%	-0.70 [-1.15 , -0.25]
Eng 1990	1.2	0.83	20	1.7	1.03	20	6.0%	-0.50 [-1.08 , 0.08]
Lepore 1989	2.7	2.8	67	3.3	2.7	68	5.3%	-0.60 [-1.53 , 0.33]
Martin 2000	0.99	0.94	98	1.61	1.01	100	6.4%	-0.62 [-0.89 , -0.35]
Schaff 1978	2.4	2.38	63	4.8	4.28	51	4.4%	-2.40 [-3.71 , -1.09]
Schönberger 1993	0.1	1.34	20	0.6	1.34	20	5.5%	-0.50 [-1.33 , 0.33]
Shirvani 1991 (1)	4.11	2.77	21	4.06	1.52	21	4.3%	0.05 [-1.30 , 1.40]
Unsworth 1996	2.49	1.78	71	2.74	1.5	34	5.9%	-0.25 [-0.90 , 0.40]
Zhao 2003	0.76	0.63	30	2.22	0.4	30	6.4%	-1.46 [-1.73 , -1.19]
Subtotal (95% CI)			**462**			**416**	**54.3%**	**-0.78 [-1.16 , -0.41]**
Heterogeneity: Tau² = 0.22; Chi² = 35.83, df = 9 (P < 0.0001); I² = 75%								
Test for overall effect: Z = 4.10 (P < 0.0001)								
8.2.3 Intra- and postoperative								
Koopman-van Gemert 1993a	4.9	3.4	17	6.2	6	20	1.8%	-1.30 [-4.39 , 1.79]
Parrot 1991	0.82	0.88	22	4.5	0.87	11	5.9%	-3.68 [-4.31 , -3.05]
Subtotal (95% CI)			**39**			**31**	**7.7%**	**-2.99 [-5.11 , -0.87]**
Heterogeneity: Tau² = 1.54; Chi² = 2.19, df = 1 (P = 0.14); I² = 54%								
Test for overall effect: Z = 2.77 (P = 0.006)								
Total (95% CI)			**1095**			**1015**	**100.0%**	**-1.23 [-1.71 , -0.74]**
Heterogeneity: Tau² = 0.93; Chi² = 193.00, df = 18 (P < 0.00001); I² = 91%								
Test for overall effect: Z = 4.98 (P < 0.00001)								
Test for subgroup differences: Chi² = 5.11, df = 2 (P = 0.08), I² = 60.8%								



Footnotes

(1) reported as per square metre body surface: we have scaled up using 1.6 (for men body size)

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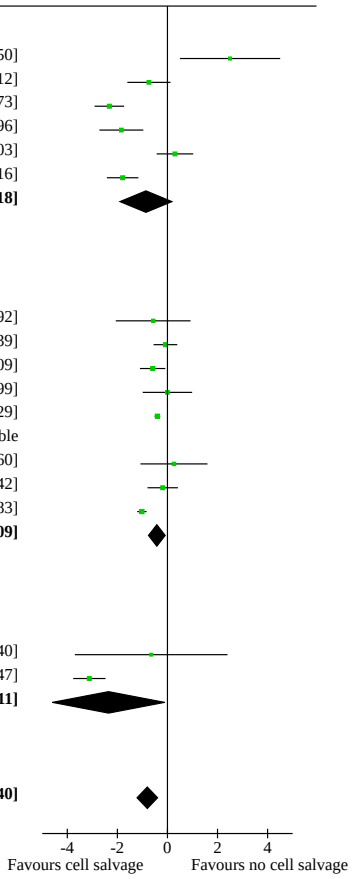
Analysis 8.3. Comparison 8: Cardiovascular (with bypass) (subgroup: timing), Outcome 3: Volume of transfusion (units) (PPT)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
8.3.1 Intraoperative								
Gäbel 2013a	3.25	1.58	6	0.75	1.12	2	2.8%	2.50 [0.50 , 4.50]
Page 1989	3.6	1.78	42	4.34	2.3	45	6.3%	-0.74 [-1.60 , 0.12]
Parrot 1991	2.18	0.65	19	4.5	0.87	11	7.4%	-2.32 [-2.91 , -1.73]
Shen 2016	5.08	1.3	22	6.92	2.19	39	6.2%	-1.84 [-2.72 , -0.96]
Vermeijden 2015	4.21	4.06	173	3.91	3	207	6.8%	0.30 [-0.43 , 1.03]
Xie 2015	5.36	1.42	27	7.15	1.22	52	7.2%	-1.79 [-2.42 , -1.16]
Subtotal (95% CI)			**289**			**356**	**36.8%**	**-0.86 [-1.89 , 0.18]**
Heterogeneity: Tau² = 1.43; Chi² = 49.12, df = 5 (P < 0.00001); I² = 90%								
Test for overall effect: Z = 1.62 (P = 0.10)								
8.3.2 Postoperative								
Axford 1994	3.2	1.55	10	3.77	2.18	14	4.0%	-0.57 [-2.06 , 0.92]
Dalrymple-Hay 1999	1.98	1	28	2.06	1.02	46	7.8%	-0.08 [-0.55 , 0.39]
Eng 1990	1.41	0.71	17	2	0.79	17	7.7%	-0.59 [-1.09 , -0.09]
Lepore 1989	3.62	2.68	50	3.62	2.61	62	5.8%	0.00 [-0.99 , 0.99]
Martin 2000	1.8	0.36	54	2.2	0.26	73	8.7%	-0.40 [-0.51 , -0.29]
Schönberger 1993	2	0	1	3	1.33	4		Not estimable
Shirvani 1991 (1)	4.32	2.67	20	4.06	1.52	21	4.5%	0.26 [-1.08 , 1.60]
Unsworth 1996	2.81	1.63	63	3	1.29	31	7.3%	-0.19 [-0.80 , 0.42]
Zhao 2003	1.2	0.27	19	2.22	0.4	30	8.6%	-1.02 [-1.21 , -0.83]
Subtotal (95% CI)			**262**			**298**	**54.5%**	**-0.42 [-0.76 , -0.09]**
Heterogeneity: Tau² = 0.13; Chi² = 38.44, df = 7 (P < 0.00001); I² = 82%								
Test for overall effect: Z = 2.49 (P = 0.01)								
8.3.3 Intra- and postoperative								
Koopman-van Gemert 1993a	5.55	3.05	15	6.2	6	20	1.5%	-0.65 [-3.70 , 2.40]
Parrot 1991	1.38	0.72	13	4.5	0.87	11	7.2%	-3.12 [-3.77 , -2.47]
Subtotal (95% CI)			**28**			**31**	**8.7%**	**-2.35 [-4.59 , -0.11]**
Heterogeneity: Tau² = 1.79; Chi² = 2.41, df = 1 (P = 0.12); I² = 59%								
Test for overall effect: Z = 2.06 (P = 0.04)								
Total (95% CI)			**579**			**685**	**100.0%**	**-0.80 [-1.21 , -0.40]**
Heterogeneity: Tau² = 0.50; Chi² = 167.42, df = 15 (P < 0.00001); I² = 91%								
Test for overall effect: Z = 3.85 (P = 0.0001)								
Test for subgroup differences: Chi² = 3.29, df = 2 (P = 0.19), I² = 39.2%								



Footnotes

(1) reported as per square metre body surface: we have scaled up using 1.6 (for men body size)

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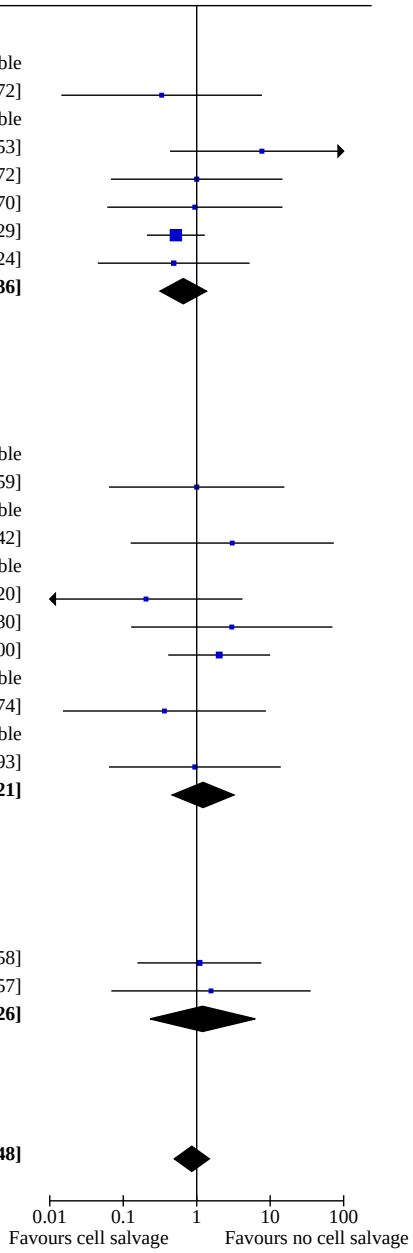
Analysis 8.4. Comparison 8: Cardiovascular (with bypass) (subgroup: timing), Outcome 4: Mortality

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Risk Ratio M-H, Random, 95% CI
8.4.1 Intraoperative						
McShane 1987	0	20	0	21		Not estimable
Niranjan 2006	0	20	1	20	3.0%	0.33 [0.01 , 7.72]
Parrot 1991	0	22	0	11		Not estimable
Reyes 2011	4	34	0	29	3.6%	7.71 [0.43 , 137.53]
Scrascia 2012	1	17	1	17	4.2%	1.00 [0.07 , 14.72]
Shen 2016	1	54	1	51	4.0%	0.94 [0.06 , 14.70]
Vermeijden 2015	7	364	13	352	36.6%	0.52 [0.21 , 1.29]
Xie 2015	1	73	2	71	5.3%	0.49 [0.05 , 5.24]
Subtotal (95% CI)		**604**		**572**	**56.7%**	**0.66 [0.32 , 1.36]**
Total events:	14		18			
Heterogeneity: Tau² = 0.00; Chi² = 3.59, df = 5 (P = 0.61); I² = 0%						
Test for overall effect: Z = 1.13 (P = 0.26)						
8.4.2 Postoperative						
Adan 1988	0	25	0	25		Not estimable
Dalrymple-Hay 1999	1	56	1	56	4.0%	1.00 [0.06 , 15.59]
Eng 1990	0	20	0	20		Not estimable
Lepore 1989	1	67	0	68	3.0%	3.04 [0.13 , 73.42]
Marberg 2010	0	39	0	38		Not estimable
Martin 2000	0	98	2	100	3.3%	0.20 [0.01 , 4.20]
Pleym 2005	1	25	0	25	3.0%	3.00 [0.13 , 70.30]
Schaff 1978	5	63	2	51	11.8%	2.02 [0.41 , 10.00]
Schönberger 1993	0	20	0	20		Not estimable
Thurer 1979	0	54	1	59	3.0%	0.36 [0.02 , 8.74]
Unsworth 1996	0	71	0	34		Not estimable
Ward 1993	1	18	1	17	4.2%	0.94 [0.06 , 13.93]
Subtotal (95% CI)		**556**		**513**	**32.2%**	**1.22 [0.46 , 3.21]**
Total events:	9		7			
Heterogeneity: Tau² = 0.00; Chi² = 2.99, df = 6 (P = 0.81); I² = 0%						
Test for overall effect: Z = 0.41 (P = 0.68)						
8.4.3 Intra- and postoperative						
Klein 2008	2	102	2	111	8.0%	1.09 [0.16 , 7.58]
Parrot 1991	1	22	0	11	3.1%	1.57 [0.07 , 35.57]
Subtotal (95% CI)		**124**		**122**	**11.1%**	**1.20 [0.23 , 6.26]**
Total events:	3		2			
Heterogeneity: Tau² = 0.00; Chi² = 0.04, df = 1 (P = 0.85); I² = 0%						
Test for overall effect: Z = 0.22 (P = 0.83)						
Total (95% CI)		**1284**		**1207**	**100.0%**	**0.86 [0.50 , 1.48]**
Total events:	26		27			
Heterogeneity: Tau² = 0.00; Chi² = 7.70, df = 14 (P = 0.90); I² = 0%						
Test for overall effect: Z = 0.55 (P = 0.58)						
Test for subgroup differences: Chi² = 1.20, df = 2 (P = 0.55), I² = 0%						



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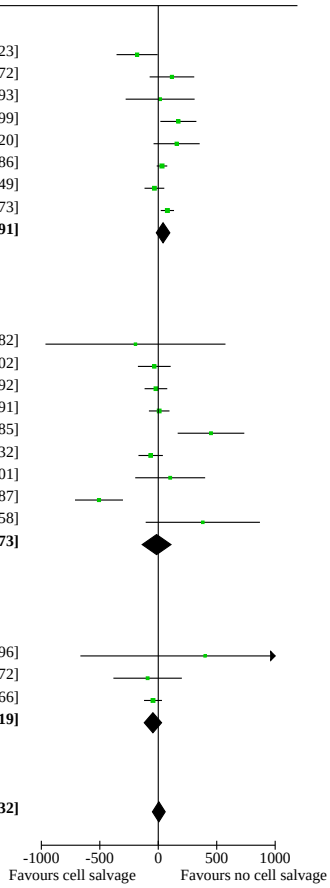
Analysis 8.5. Comparison 8: Cardiovascular (with bypass) (subgroup: timing), Outcome 5: Blood loss (mL)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
8.5.1 Intraoperative								
Niranjan 2006	842	276	20	1023	291	20	4.9%	-181.00 [-356.77 , -5.23]
Page 1989	822	445	48	705	522	51	4.5%	117.00 [-73.72 , 307.72]
Parrot 1991	967	350.58	22	951	433.15	11	2.6%	16.00 [-278.93 , 310.93]
Reyes 2011	538	430	34	366	146	29	5.6%	172.00 [18.01 , 325.99]
Scrascia 2012	749	320	17	592	264	17	4.4%	157.00 [-40.20 , 354.20]
Shen 2016	1640.96	87.73	53	1609.03	137.91	50	9.5%	31.93 [-13.00 , 76.86]
Vermeijden 2015	688	623	364	721	528	352	8.1%	-33.00 [-117.49 , 51.49]
Xie 2015	1425.6	162.4	72	1347.5	179.8	69	9.1%	78.10 [21.47 , 134.73]
Subtotal (95% CI)			**630**			**599**	**48.7%**	**41.01 [-16.90 , 98.91]**
Heterogeneity: Tau² = 2997.93; Chi² = 15.63, df = 7 (P = 0.03); I² = 55%								
Test for overall effect: Z = 1.39 (P = 0.17)								
8.5.2 Postoperative								
Axford 1994	2016	600	16	2211	1452	16	0.5%	-195.00 [-964.82 , 574.82]
Dalrymple-Hay 1999	652	382	56	686	374	56	6.1%	-34.00 [-174.02 , 106.02]
Lepore 1989	520	319	67	540	251	68	7.7%	-20.00 [-116.92 , 76.92]
Marberg 2010	394	181	39	386	211	38	8.0%	8.00 [-79.91 , 95.91]
Martin 2000	1684	1151	98	1233	872	100	2.7%	451.00 [166.15 , 735.85]
Pleym 2005	487	137	23	552	220	24	7.4%	-65.00 [-169.32 , 39.32]
Schaff 1978	813	960	63	711	664	51	2.5%	102.00 [-197.01 , 401.01]
Schönberger 1993	258	326.465925	20	765	335.4102	20	4.2%	-507.00 [-712.13 , -301.87]
Ward 1993	1495	679	18	1114	788	17	1.1%	381.00 [-107.58 , 869.58]
Subtotal (95% CI)			**400**			**390**	**40.1%**	**-14.33 [-137.39 , 108.73]**
Heterogeneity: Tau² = 21911.51; Chi² = 36.56, df = 8 (P < 0.0001); I² = 78%								
Test for overall effect: Z = 0.23 (P = 0.82)								
8.5.3 Intra- and postoperative								
Koopman-van Gemert 1993a	4100	1400	17	3700	1900	20	0.3%	400.00 [-665.96 , 1465.96]
Parrot 1991	860	332	21	951	433.15	11	2.6%	-91.00 [-383.72 , 201.72]
Westerberg 2004	315	114.3	12	360	86.6	17	8.4%	-45.00 [-121.66 , 31.66]
Subtotal (95% CI)			**50**			**48**	**11.3%**	**-45.79 [-119.78 , 28.19]**
Heterogeneity: Tau² = 0.00; Chi² = 0.76, df = 2 (P = 0.68); I² = 0%								
Test for overall effect: Z = 1.21 (P = 0.23)								
Total (95% CI)			**1080**			**1037**	**100.0%**	**4.72 [-49.88 , 59.32]**
Heterogeneity: Tau² = 7684.81; Chi² = 61.66, df = 19 (P < 0.00001); I² = 69%								
Test for overall effect: Z = 0.17 (P = 0.87)								
Test for subgroup differences: Chi² = 3.39, df = 2 (P = 0.18), I² = 41.0%								



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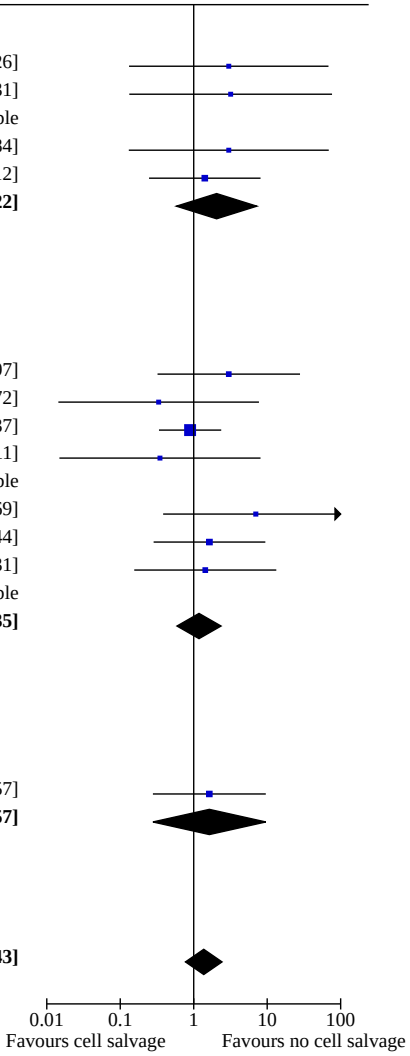
Analysis 8.6. Comparison 8: Cardiovascular (with bypass) (subgroup: timing), Outcome 6: Reoperation for bleeding

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Risk Ratio M-H, Random, 95% CI
8.6.1 Intraoperative						
Gäbel 2013a	1	15	0	15	3.4%	3.00 [0.13 , 68.26]
Page 1989	1	48	0	51	3.2%	3.18 [0.13 , 76.31]
Reyes 2011	0	34	0	29		Not estimable
Scrascia 2012	1	17	0	17	3.3%	3.00 [0.13 , 68.84]
Shen 2016	3	53	2	50	10.7%	1.42 [0.25 , 8.12]
Subtotal (95% CI)		**167**		**162**	**20.7%**	**2.05 [0.58 , 7.22]**
Total events:	6		2			
Heterogeneity: Tau² = 0.00; Chi² = 0.36, df = 3 (P = 0.95); I² = 0%						
Test for overall effect: Z = 1.12 (P = 0.26)						
8.6.2 Postoperative						
Dalrymple-Hay 1999	3	56	1	56	6.6%	3.00 [0.32 , 27.97]
Eng 1990	0	20	1	20	3.3%	0.33 [0.01 , 7.72]
Martin 2000	7	98	8	100	34.5%	0.89 [0.34 , 2.37]
Pleym 2005	0	23	1	24	3.3%	0.35 [0.01 , 8.11]
Schönberger 1993	0	20	0	20		Not estimable
Shirvani 1991	3	21	0	21	3.9%	7.00 [0.38 , 127.69]
Thurer 1979	3	54	2	59	10.7%	1.64 [0.28 , 9.44]
Unsworth 1996	3	71	1	34	6.6%	1.44 [0.16 , 13.31]
Ward 1993	0	18	0	17		Not estimable
Subtotal (95% CI)		**381**		**351**	**68.8%**	**1.18 [0.59 , 2.35]**
Total events:	19		14			
Heterogeneity: Tau² = 0.00; Chi² = 3.83, df = 6 (P = 0.70); I² = 0%						
Test for overall effect: Z = 0.47 (P = 0.64)						
8.6.3 Intra- and postoperative						
Klein 2008	3	102	2	111	10.5%	1.63 [0.28 , 9.57]
Subtotal (95% CI)		**102**		**111**	**10.5%**	**1.63 [0.28 , 9.57]**
Total events:	3		2			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.54 (P = 0.59)						
Total (95% CI)		**650**		**624**	**100.0%**	**1.37 [0.77 , 2.43]**
Total events:	28		18			
Heterogeneity: Tau² = 0.00; Chi² = 4.79, df = 11 (P = 0.94); I² = 0%						
Test for overall effect: Z = 1.08 (P = 0.28)						
Test for subgroup differences: Chi² = 0.61, df = 2 (P = 0.74), I² = 0%						



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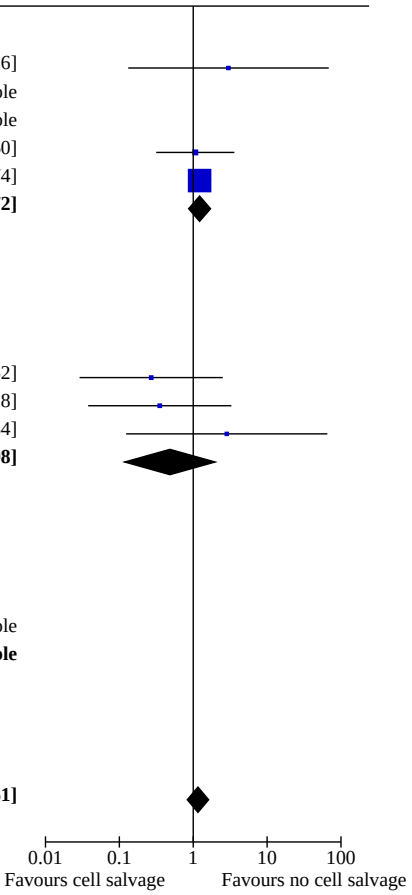
Analysis 8.7. Comparison 8: Cardiovascular (with bypass) (subgroup: timing), Outcome 7: Infection

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Risk Ratio M-H, Random, 95% CI
8.7.1 Intraoperative						
Gäbel 2013a	1	15	0	15	1.1%	3.00 [0.13 , 68.26]
Page 1989	0	48	0	51		Not estimable
Parrot 1991	0	22	0	11		Not estimable
Reyes 2011	5	34	4	29	7.4%	1.07 [0.32 , 3.60]
Vermeijden 2015	58	364	46	352	85.9%	1.22 [0.85 , 1.74]
Subtotal (95% CI)		**483**		**458**	**94.5%**	**1.22 [0.87 , 1.72]**
Total events:	64		50			
Heterogeneity: Tau² = 0.00; Chi² = 0.37, df = 2 (P = 0.83); I² = 0%						
Test for overall effect: Z = 1.14 (P = 0.25)						
8.7.2 Postoperative						
Schaff 1978	1	63	3	51	2.2%	0.27 [0.03 , 2.52]
Schmidt 1996	1	53	3	56	2.2%	0.35 [0.04 , 3.28]
Ward 1993	1	18	0	17	1.1%	2.84 [0.12 , 65.34]
Subtotal (95% CI)		**134**		**124**	**5.5%**	**0.48 [0.12 , 1.98]**
Total events:	3		6			
Heterogeneity: Tau² = 0.00; Chi² = 1.57, df = 2 (P = 0.46); I² = 0%						
Test for overall effect: Z = 1.01 (P = 0.31)						
8.7.3 Intra- and postoperative						
Parrot 1991	0	21	0	11		Not estimable
Subtotal (95% CI)		**0**		**0**		**Not estimable**
Total events:	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Not applicable						
Total (95% CI)		**638**		**593**	**100.0%**	**1.16 [0.83 , 1.61]**
Total events:	67		56			
Heterogeneity: Tau² = 0.00; Chi² = 3.51, df = 5 (P = 0.62); I² = 0%						
Test for overall effect: Z = 0.87 (P = 0.38)						
Test for subgroup differences: Chi² = 1.57, df = 1 (P = 0.21), I² = 36.1%						



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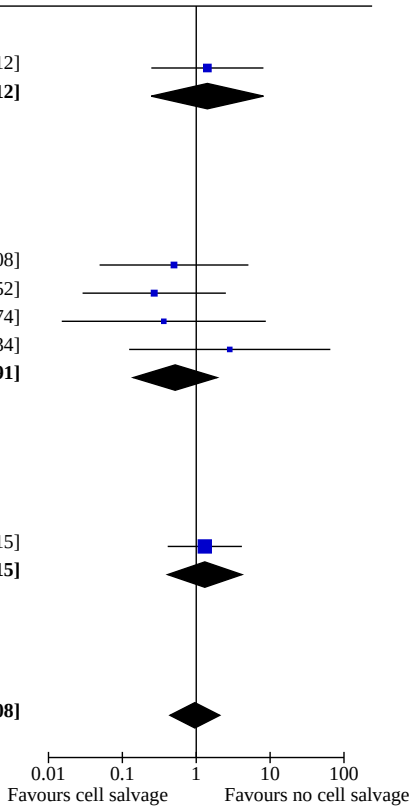
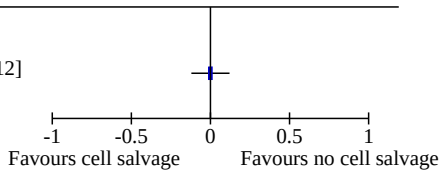
Analysis 8.8. Comparison 8: Cardiovascular (with bypass) (subgroup: timing), Outcome 8: Wound complication

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Risk Ratio M-H, Random, 95% CI
8.8.1 Intraoperative						
Shen 2016	3	53	2	50	19.7%	1.42 [0.25 , 8.12]
Subtotal (95% CI)		**53**		**50**	**19.7%**	**1.42 [0.25 , 8.12]**
Total events:	3		2			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.39 (P = 0.70)						
8.8.2 Postoperative						
Eng 1990	1	20	2	20	11.2%	0.50 [0.05 , 5.08]
Schaff 1978	1	63	3	51	12.1%	0.27 [0.03 , 2.52]
Thurer 1979	0	54	1	59	5.9%	0.36 [0.02 , 8.74]
Ward 1993	1	18	0	17	6.1%	2.84 [0.12 , 65.34]
Subtotal (95% CI)		**155**		**147**	**35.3%**	**0.52 [0.14 , 1.91]**
Total events:	3		6			
Heterogeneity: Tau² = 0.00; Chi² = 1.51, df = 3 (P = 0.68); I² = 0%						
Test for overall effect: Z = 0.99 (P = 0.32)						
8.8.3 Intra- and postoperative						
Klein 2008	6	102	5	111	45.0%	1.31 [0.41 , 4.15]
Subtotal (95% CI)		**102**		**111**	**45.0%**	**1.31 [0.41 , 4.15]**
Total events:	6		5			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.45 (P = 0.65)						
Total (95% CI)		**310**		**308**	**100.0%**	**0.96 [0.44 , 2.08]**
Total events:	12		13			
Heterogeneity: Tau² = 0.00; Chi² = 2.83, df = 5 (P = 0.73); I² = 0%						
Test for overall effect: Z = 0.11 (P = 0.91)						
Test for subgroup differences: Chi² = 1.32, df = 2 (P = 0.52), I² = 0%						



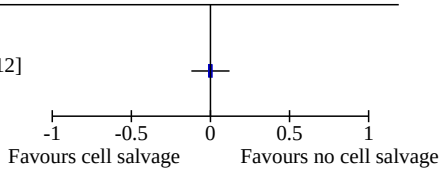
Analysis 8.9. Comparison 8: Cardiovascular (with bypass) (subgroup: timing), Outcome 9: Thrombosis (VTE)

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Risk Difference M-H, Random, 95% CI
8.9.1 Intraoperative					
Gäbel 2013a	0	15	0	15	0.00 [-0.12 , 0.12]



Analysis 8.10. Comparison 8: Cardiovascular (with bypass) (subgroup: timing), Outcome 10: DVT

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Risk Difference M-H, Random, 95% CI
8.10.1 Intraoperative					
Gäbel 2013a	0	15	0	15	0.00 [-0.12 , 0.12]



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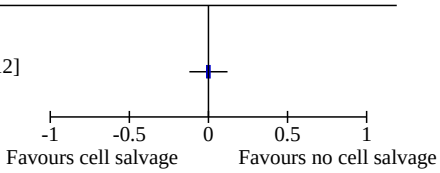
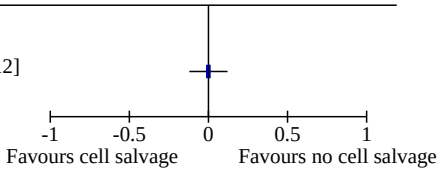
Analysis 8.11. Comparison 8: Cardiovascular (with bypass) (subgroup: timing), Outcome 11: PE

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Risk Difference M-H, Random, 95% CI
8.11.1 Intraoperative					
Gäbel 2013a	0	15	0	15	0.00 [-0.12 , 0.12]



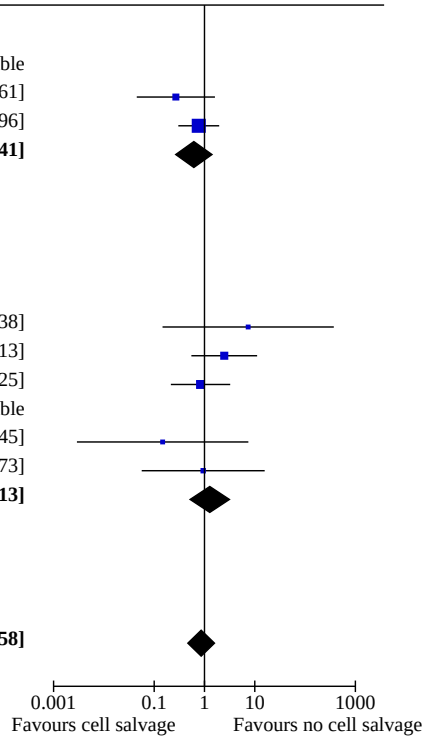
Analysis 8.12. Comparison 8: Cardiovascular (with bypass) (subgroup: timing), Outcome 12: MACE

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Risk Difference M-H, Random, 95% CI
8.12.1 Intraoperative					
Gäbel 2013a	0	15	0	15	0.00 [-0.12 , 0.12]



Analysis 8.13. Comparison 8: Cardiovascular (with bypass) (subgroup: timing), Outcome 13: MI

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
8.13.1 Intraoperative						
Gäbel 2013a	0	15	0	15		Not estimable
Shen 2016	1	53	4	50	11.6%	0.27 [0.05 , 1.61]
Vermeijden 2015	8	364	10	352	42.4%	0.77 [0.30 , 1.96]
Subtotal (95% CI)		**432**		**417**	**54.0%**	**0.61 [0.27 , 1.41]**
Total events:	9		14			
Heterogeneity: Chi² = 1.04, df = 1 (P = 0.31); I² = 4%						
Test for overall effect: Z = 1.15 (P = 0.25)						
8.13.2 Postoperative						
Axford 1994	1	16	0	16	2.4%	7.39 [0.15 , 372.38]
Martin 2000	5	98	2	100	16.4%	2.47 [0.55 , 11.13]
Schmidt 1996	4	53	5	56	20.1%	0.83 [0.21 , 3.25]
Schönberger 1993	0	20	0	20		Not estimable
Thurer 1979	0	54	1	59	2.4%	0.15 [0.00 , 7.45]
Ward 1993	1	18	1	17	4.7%	0.94 [0.06 , 15.73]
Subtotal (95% CI)		**259**		**268**	**46.0%**	**1.27 [0.52 , 3.13]**
Total events:	11		9			
Heterogeneity: Chi² = 3.10, df = 4 (P = 0.54); I² = 0%						
Test for overall effect: Z = 0.53 (P = 0.60)						
Total (95% CI)		**691**		**685**	**100.0%**	**0.86 [0.47 , 1.58]**
Total events:	20		23			
Heterogeneity: Chi² = 5.50, df = 6 (P = 0.48); I² = 0%						
Test for overall effect: Z = 0.49 (P = 0.63)						
Test for subgroup differences: Chi² = 1.37, df = 1 (P = 0.24), I² = 26.9%						



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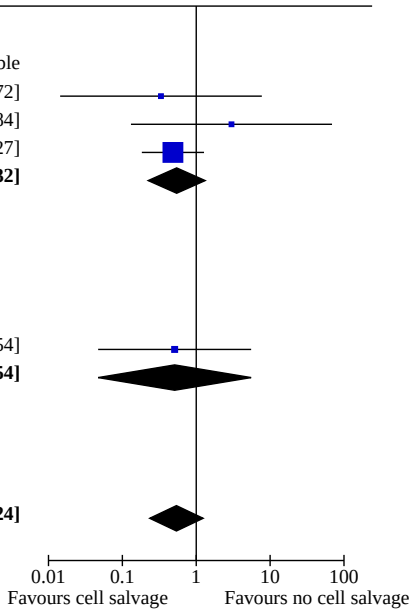
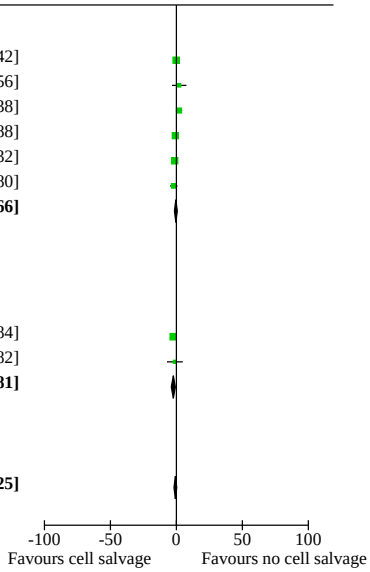
Analysis 8.14. Comparison 8: Cardiovascular (with bypass) (subgroup: timing), Outcome 14: CVA (stroke)

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Risk Ratio M-H, Random, 95% CI
8.14.1 Intraoperative						
Gäbel 2013a	0	15	0	15		Not estimable
Niranjan 2006	0	20	1	20	7.0%	0.33 [0.01 , 7.72]
Scrascia 2012	1	17	0	17	7.1%	3.00 [0.13 , 68.84]
Vermeijden 2015	6	364	12	352	73.8%	0.48 [0.18 , 1.27]
Subtotal (95% CI)		**416**		**404**	**87.8%**	**0.54 [0.22 , 1.32]**
Total events:	7		13			
Heterogeneity: Tau² = 0.00; Chi² = 1.29, df = 2 (P = 0.52); I² = 0%						
Test for overall effect: Z = 1.35 (P = 0.18)						
8.14.2 Postoperative						
Martin 2000	1	98	2	100	12.2%	0.51 [0.05 , 5.54]
Subtotal (95% CI)		**98**		**100**	**12.2%**	**0.51 [0.05 , 5.54]**
Total events:	1		2			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.55 (P = 0.58)						
Total (95% CI)		**514**		**504**	**100.0%**	**0.54 [0.23 , 1.24]**
Total events:	8		15			
Heterogeneity: Tau² = 0.00; Chi² = 1.30, df = 3 (P = 0.73); I² = 0%						
Test for overall effect: Z = 1.45 (P = 0.15)						
Test for subgroup differences: Chi² = 0.00, df = 1 (P = 0.96), I² = 0%						



Analysis 8.15. Comparison 8: Cardiovascular (with bypass) (subgroup: timing), Outcome 15: Hospital LOS (days)

Study or Subgroup	Cell salvage Mean	Cell salvage SD	Cell salvage Total	No cell salvage Mean	No cell salvage SD	No cell salvage Total	Weight	Mean Difference IV, Random, 95% CI
8.15.1 Intraoperative								
Niranjan 2006	8.1	2	20	8.3	3.1	20	18.2%	-0.20 [-1.82 , 1.42]
Reyes 2011	14.2	14.2	34	12.1	7.3	29	3.2%	2.10 [-3.36 , 7.56]
Scrascia 2012	13	3	17	11	4	17	12.0%	2.00 [-0.38 , 4.38]
Shen 2016	22.56	4.23	53	23.38	4.54	50	17.4%	-0.82 [-2.52 , 0.88]
Vermeijden 2015	10.9	9.3	364	12.2	12.5	352	18.2%	-1.30 [-2.92 , 0.32]
Xie 2015	23.1	7.8	72	25.1	9.1	69	9.6%	-2.00 [-4.80 , 0.80]
Subtotal (95% CI)			**560**			**537**	**78.5%**	**-0.41 [-1.47 , 0.66]**
Heterogeneity: Tau² = 0.56; Chi² = 7.42, df = 5 (P = 0.19); I² = 33%								
Test for overall effect: Z = 0.74 (P = 0.46)								
8.15.2 Postoperative								
Dalrymple-Hay 1999	7.3	2.92	56	9.7	5.2	56	18.8%	-2.40 [-3.96 , -0.84]
Eng 1990	10.8	6.93	20	11.95	11.72	20	2.7%	-1.15 [-7.12 , 4.82]
Subtotal (95% CI)			**76**			**76**	**21.5%**	**-2.32 [-3.83 , -0.81]**
Heterogeneity: Tau² = 0.00; Chi² = 0.16, df = 1 (P = 0.69); I² = 0%								
Test for overall effect: Z = 3.01 (P = 0.003)								
Total (95% CI)			**636**			**613**	**100.0%**	**-0.78 [-1.81 , 0.25]**
Heterogeneity: Tau² = 0.83; Chi² = 11.98, df = 7 (P = 0.10); I² = 42%								
Test for overall effect: Z = 1.49 (P = 0.14)								
Test for subgroup differences: Chi² = 4.12, df = 1 (P = 0.04), I² = 75.7%								



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Comparison 9. Cardiovascular (with bypass) (subgroup: transfusion threshold)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
9.1 Transfusions	25	2676	Risk Ratio (M-H, Random, 95% CI)	0.81 [0.73, 0.89]
9.1.1 Restrictive (Hb ≦ 80 g/L)	7	797	Risk Ratio (M-H, Random, 95% CI)	0.74 [0.56, 0.98]
9.1.2 Liberal (Hb > 80 g/L)	11	1398	Risk Ratio (M-H, Random, 95% CI)	0.84 [0.74, 0.94]
9.1.3 No threshold/protocol reported	7	481	Risk Ratio (M-H, Random, 95% CI)	0.82 [0.69, 0.97]
9.2 Volume of transfusion (units) (PPR)	18	2110	Mean Difference (IV, Random, 95% CI)	-1.23 [-1.71, -0.74]
9.2.1 Restrictive (Hb ≦ 80 g/L)	5	512	Mean Difference (IV, Random, 95% CI)	-1.45 [-2.73, -0.17]
9.2.2 Liberal (Hb > 80 g/L)	11	1403	Mean Difference (IV, Random, 95% CI)	-1.17 [-1.90, -0.45]
9.2.3 No threshold/protocol reported	2	195	Mean Difference (IV, Random, 95% CI)	-1.15 [-1.96, -0.34]
9.3 Volume of transfusion (units) (PPT)	16	1264	Mean Difference (IV, Random, 95% CI)	-0.80 [-1.21, -0.40]
9.3.1 Restrictive (Hb ≦ 80 g/L)	4	275	Mean Difference (IV, Random, 95% CI)	-0.71 [-1.84, 0.43]
9.3.2 Liberal (Hb > 80 g/L)	10	828	Mean Difference (IV, Random, 95% CI)	-0.81 [-1.59, -0.02]
9.3.3 No threshold/protocol reported	2	161	Mean Difference (IV, Random, 95% CI)	-0.63 [-1.60, 0.34]
9.4 Mortality	21	2491	Risk Ratio (M-H, Random, 95% CI)	0.86 [0.50, 1.48]
9.4.1 Restrictive (Hb ≦ 80 g/L)	8	853	Risk Ratio (M-H, Random, 95% CI)	0.64 [0.23, 1.82]
9.4.2 Liberal (Hb > 80 g/L)	8	1243	Risk Ratio (M-H, Random, 95% CI)	0.77 [0.37, 1.62]
9.4.3 No threshold/protocol reported	5	395	Risk Ratio (M-H, Random, 95% CI)	1.93 [0.51, 7.37]
9.5 Blood loss (mL)	19	2117	Mean Difference (IV, Random, 95% CI)	4.72 [-49.88, 59.32]
9.5.1 Restrictive (Hb ≦ 80 g/L)	6	594	Mean Difference (IV, Random, 95% CI)	47.98 [-33.60, 129.56]
9.5.2 Liberal (Hb > 80 g/L)	8	1215	Mean Difference (IV, Random, 95% CI)	-62.72 [-195.64, 70.20]
9.5.3 No threshold/protocol reported	5	308	Mean Difference (IV, Random, 95% CI)	13.64 [-67.99, 95.27]

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Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
9.6 Reoperation for bleeding	15	1274	Risk Ratio (M-H, Random, 95% CI)	1.37 [0.77, 2.43]
9.6.1 Restrictive (Hb ≦ 80 g/L)	5	579	Risk Ratio (M-H, Random, 95% CI)	1.16 [0.55, 2.44]
9.6.2 Liberal (Hb > 80 g/L)	6	438	Risk Ratio (M-H, Random, 95% CI)	2.08 [0.64, 6.75]
9.6.3 No threshold/protocol reported	4	257	Risk Ratio (M-H, Random, 95% CI)	1.37 [0.35, 5.42]
9.7 Infection	8	1231	Risk Ratio (M-H, Random, 95% CI)	1.16 [0.83, 1.61]
9.7.1 Restrictive (Hb ≦ 80 g/L)	2	65	Risk Ratio (M-H, Random, 95% CI)	2.92 [0.32, 26.70]
9.7.2 Liberal (Hb > 80 g/L)	5	1103	Risk Ratio (M-H, Random, 95% CI)	0.83 [0.33, 2.08]
9.7.3 No threshold/protocol reported	1	63	Risk Ratio (M-H, Random, 95% CI)	1.07 [0.32, 3.60]
9.8 Wound complication	6	618	Risk Ratio (M-H, Random, 95% CI)	0.96 [0.44, 2.08]
9.8.1 Restrictive (Hb ≦ 80 g/L)	3	351	Risk Ratio (M-H, Random, 95% CI)	1.43 [0.57, 3.59]
9.8.2 Liberal (Hb > 80 g/L)	2	154	Risk Ratio (M-H, Random, 95% CI)	0.36 [0.07, 1.81]
9.8.3 No threshold/protocol reported	1	113	Risk Ratio (M-H, Random, 95% CI)	0.36 [0.02, 8.74]
9.9 Thrombosis (VTE)	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
9.9.1 Restrictive (Hb ≦ 80 g/L)	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
9.10 DVT	1	30	Risk Difference (M-H, Random, 95% CI)	0.00 [-0.12, 0.12]
9.10.1 Restrictive (Hb ≦ 80 g/L)	1	30	Risk Difference (M-H, Random, 95% CI)	0.00 [-0.12, 0.12]
9.11 PE	1	30	Risk Difference (M-H, Random, 95% CI)	0.00 [-0.12, 0.12]
9.11.1 Restrictive (Hb ≦ 80 g/L)	1	30	Risk Difference (M-H, Random, 95% CI)	0.00 [-0.12, 0.12]
9.12 MACE	1	30	Risk Difference (M-H, Random, 95% CI)	0.00 [-0.12, 0.12]
9.12.1 Restrictive (Hb ≦ 80 g/L)	1	30	Risk Difference (M-H, Random, 95% CI)	0.00 [-0.12, 0.12]
9.13 MI	9	1376	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.86 [0.47, 1.58]

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Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
9.13.1 Restrictive (Hb ≦ 80 g/L)	4	366	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.98 [0.34, 2.85]
9.13.2 Liberal (Hb > 80 g/L)	4	897	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.86 [0.40, 1.83]
9.13.3 No threshold/protocol reported	1	113	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.15 [0.00, 7.45]
9.14 CVA (stroke)	5	1018	Risk Ratio (M-H, Random, 95% CI)	0.54 [0.23, 1.24]
9.14.1 Restrictive (Hb ≦ 80 g/L)	3	268	Risk Ratio (M-H, Random, 95% CI)	0.44 [0.07, 2.92]
9.14.2 Liberal (Hb > 80 g/L)	1	716	Risk Ratio (M-H, Random, 95% CI)	0.48 [0.18, 1.27]
9.14.3 No threshold/protocol reported	1	34	Risk Ratio (M-H, Random, 95% CI)	3.00 [0.13, 68.84]
9.15 Hospital LOS (days)	8	1249	Mean Difference (IV, Random, 95% CI)	-0.78 [-1.81, 0.25]
9.15.1 Restrictive (Hb ≦ 80 g/L)	3	284	Mean Difference (IV, Random, 95% CI)	-0.72 [-1.80, 0.36]
9.15.2 Liberal (Hb > 80 g/L)	3	868	Mean Difference (IV, Random, 95% CI)	-1.84 [-2.95, -0.74]
9.15.3 No threshold/protocol reported	2	97	Mean Difference (IV, Random, 95% CI)	2.02 [-0.16, 4.20]

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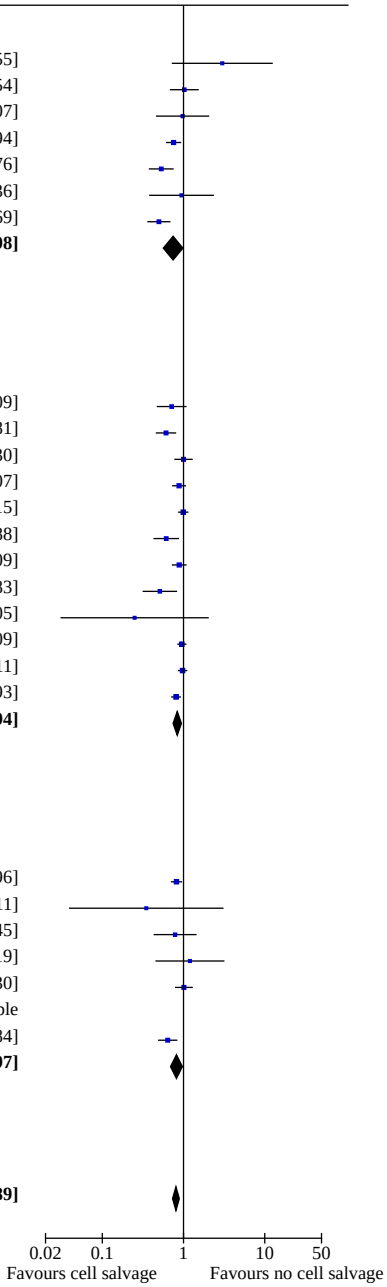
Analysis 9.1. Comparison 9: Cardiovascular (with bypass) (subgroup: transfusion threshold), Outcome 1: Transfusions

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Risk Ratio M-H, Random, 95% CI
9.1.1 Restrictive (Hb # 80 g/L)						
Gäbel 2013a	6	15	2	15	0.4%	3.00 [0.72 , 12.55]
Klein 2008	31	102	33	111	3.3%	1.02 [0.68 , 1.54]
Marberg 2010	10	39	10	38	1.3%	0.97 [0.46 , 2.07]
Martin 2000	54	98	73	100	5.9%	0.75 [0.61 , 0.94]
Shen 2016	22	53	39	50	3.9%	0.53 [0.37 , 0.76]
Ward 1993	6	18	6	17	1.0%	0.94 [0.38 , 2.36]
Xie 2015	27	72	52	69	4.2%	0.50 [0.36 , 0.69]
Subtotal (95% CI)		**397**		**400**	**20.0%**	**0.74 [0.56 , 0.98]**
Total events:	156		215			
Heterogeneity: Tau² = 0.07; Chi² = 15.59, df = 6 (P = 0.02); I² = 62%						
Test for overall effect: Z = 2.09 (P = 0.04)						
9.1.2 Liberal (Hb > 80 g/L)						
Axford 1994	10	16	14	16	3.2%	0.71 [0.47 , 1.09]
Dalrymple-Hay 1999	28	56	46	56	4.7%	0.61 [0.46 , 0.81]
Eng 1990	17	20	17	20	5.1%	1.00 [0.77 , 1.30]
Koopman-van Gemert 1993a	15	17	20	20	6.1%	0.88 [0.72 , 1.07]
Page 1989	42	48	45	51	7.0%	0.99 [0.86 , 1.15]
Parrot 1991 (1)	13	22	11	11	3.8%	0.61 [0.43 , 0.88]
Parrot 1991 (2)	19	22	11	11	5.9%	0.88 [0.72 , 1.09]
Schmidt 1996	15	53	31	56	2.6%	0.51 [0.31 , 0.83]
Schönberger 1993	1	20	4	20	0.2%	0.25 [0.03 , 2.05]
Shirvani 1991	20	21	21	21	7.2%	0.95 [0.84 , 1.09]
Unsworth 1996	63	71	31	34	7.2%	0.97 [0.85 , 1.11]
Vermeijden 2015	173	364	207	352	7.1%	0.81 [0.70 , 0.93]
Subtotal (95% CI)		**730**		**668**	**60.1%**	**0.84 [0.74 , 0.94]**
Total events:	416		458			
Heterogeneity: Tau² = 0.03; Chi² = 36.50, df = 11 (P = 0.0001); I² = 70%						
Test for overall effect: Z = 2.96 (P = 0.003)						
9.1.3 No threshold/protocol reported						
Lepore 1989	50	67	62	68	6.8%	0.82 [0.70 , 0.96]
Pleym 2005	1	23	3	24	0.2%	0.35 [0.04 , 3.11]
Reyes 2011	12	34	13	29	1.9%	0.79 [0.43 , 1.45]
Scrascia 2012	6	17	5	17	0.9%	1.20 [0.45 , 3.19]
Thurer 1979	37	54	40	59	5.3%	1.01 [0.79 , 1.30]
Westerberg 2004	0	12	0	17		Not estimable
Zhao 2003	19	30	30	30	4.9%	0.64 [0.49 , 0.84]
Subtotal (95% CI)		**237**		**244**	**19.9%**	**0.82 [0.69 , 0.97]**
Total events:	125		153			
Heterogeneity: Tau² = 0.01; Chi² = 7.05, df = 5 (P = 0.22); I² = 29%						
Test for overall effect: Z = 2.33 (P = 0.02)						
Total (95% CI)		**1364**		**1312**	**100.0%**	**0.81 [0.73 , 0.89]**
Total events:	697		826			
Heterogeneity: Tau² = 0.03; Chi² = 66.93, df = 24 (P < 0.00001); I² = 64%						
Test for overall effect: Z = 4.41 (P < 0.0001)						
Test for subgroup differences: Chi² = 0.59, df = 2 (P = 0.75), I² = 0%						



Footnotes

(1) both intra & post-op collection

(2) intra-op collection only

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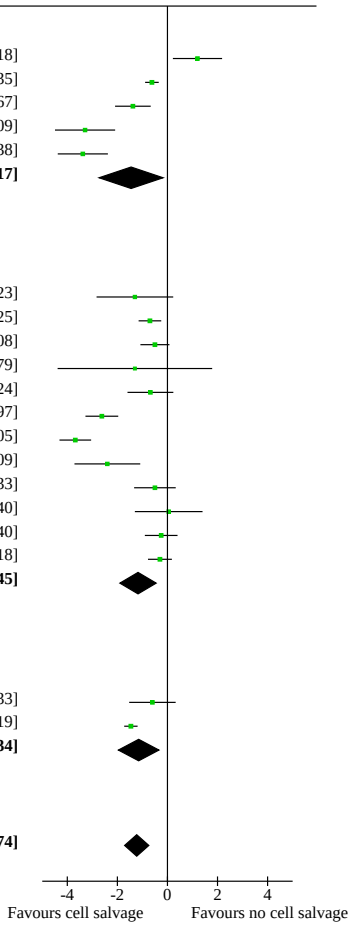
Analysis 9.2. Comparison 9: Cardiovascular (with bypass) (subgroup: transfusion threshold), Outcome 2: Volume of transfusion (units) (PPR)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
9.2.1 Restrictive (Hb # 80 g/L)								
Gäbel 2013a	1.3	1.9	15	0.1	0.4	15	5.2%	1.20 [0.22 , 2.18]
Martin 2000	0.99	0.94	98	1.61	1.01	100	6.4%	-0.62 [-0.89 , -0.35]
Niranjan 2006	0.6	0.71	20	1.98	1.46	20	5.7%	-1.38 [-2.09 , -0.67]
Shen 2016	2.11	2.66	53	5.4	3.48	50	4.7%	-3.29 [-4.49 , -2.09]
Xie 2015	2.01	2.75	72	5.39	3.28	69	5.1%	-3.38 [-4.38 , -2.38]
Subtotal (95% CI)			**258**			**254**	**27.1%**	**-1.45 [-2.73 , -0.17]**
Heterogeneity: Tau² = 1.93; Chi² = 61.98, df = 4 (P < 0.00001); I² = 94%								
Test for overall effect: Z = 2.23 (P = 0.03)								
9.2.2 Liberal (Hb > 80 g/L)								
Axford 1994	2	2	16	3.3	2.4	16	4.0%	-1.30 [-2.83 , 0.23]
Dalrymple-Hay 1999	0.99	1.22	56	1.69	1.22	56	6.2%	-0.70 [-1.15 , -0.25]
Eng 1990	1.2	0.83	20	1.7	1.03	20	6.0%	-0.50 [-1.08 , 0.08]
Koopman-van Gemert 1993a	4.9	3.4	17	6.2	6	20	1.8%	-1.30 [-4.39 , 1.79]
Page 1989	3.15	2.05	48	3.83	2.58	51	5.3%	-0.68 [-1.60 , 0.24]
Parrot 1991 (1)	1.88	0.97	22	4.5	0.87	11	5.8%	-2.62 [-3.27 , -1.97]
Parrot 1991 (2)	0.82	0.88	22	4.5	0.87	11	5.9%	-3.68 [-4.31 , -3.05]
Schaff 1978	2.4	2.38	63	4.8	4.28	51	4.4%	-2.40 [-3.71 , -1.09]
Schönberger 1993	0.1	1.34	20	0.6	1.34	20	5.5%	-0.50 [-1.33 , 0.33]
Shirvani 1991 (3)	4.11	2.77	21	4.06	1.52	21	4.3%	0.05 [-1.30 , 1.40]
Unsworth 1996	2.49	1.78	71	2.74	1.5	34	5.9%	-0.25 [-0.90 , 0.40]
Vermeijden 2015	2	3.5	364	2.3	3	352	6.2%	-0.30 [-0.78 , 0.18]
Subtotal (95% CI)			**740**			**663**	**61.2%**	**-1.17 [-1.90 , -0.45]**
Heterogeneity: Tau² = 1.36; Chi² = 118.57, df = 11 (P < 0.00001); I² = 91%								
Test for overall effect: Z = 3.18 (P = 0.001)								
9.2.3 No threshold/protocol reported								
Lepore 1989	2.7	2.8	67	3.3	2.7	68	5.3%	-0.60 [-1.53 , 0.33]
Zhao 2003	0.76	0.63	30	2.22	0.4	30	6.4%	-1.46 [-1.73 , -1.19]
Subtotal (95% CI)			**97**			**98**	**11.7%**	**-1.15 [-1.96 , -0.34]**
Heterogeneity: Tau² = 0.25; Chi² = 3.05, df = 1 (P = 0.08); I² = 67%								
Test for overall effect: Z = 2.78 (P = 0.005)								
Total (95% CI)			**1095**			**1015**	**100.0%**	**-1.23 [-1.71 , -0.74]**
Heterogeneity: Tau² = 0.93; Chi² = 193.00, df = 18 (P < 0.00001); I² = 91%								
Test for overall effect: Z = 4.98 (P < 0.00001)								
Test for subgroup differences: Chi² = 0.17, df = 2 (P = 0.92), I² = 0%								



Footnotes

(1) intra-op collection only
(2) both intra & post-op collection
(3) reported as per square metre body surface: we have scaled up using 1.6 (for men body size)

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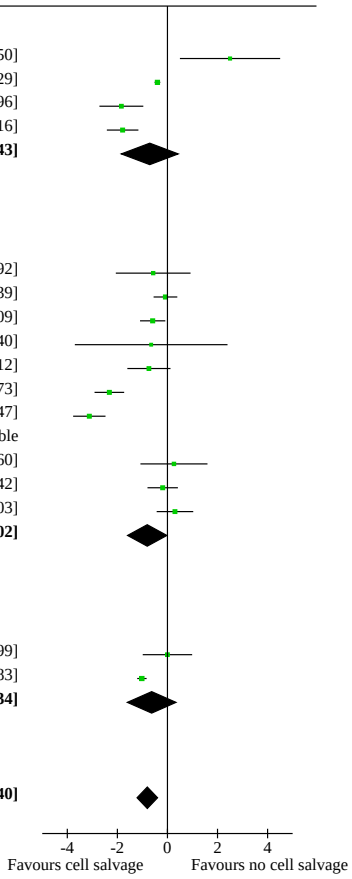
Analysis 9.3. Comparison 9: Cardiovascular (with bypass) (subgroup: transfusion threshold), Outcome 3: Volume of transfusion (units) (PPT)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
9.3.1 Restrictive (Hb # 80 g/L)								
Gäbel 2013a	3.25	1.58	6	0.75	1.12	2	2.8%	2.50 [0.50 , 4.50]
Martin 2000	1.8	0.36	54	2.2	0.26	73	8.7%	-0.40 [-0.51 , -0.29]
Shen 2016	5.08	1.3	22	6.92	2.19	39	6.2%	-1.84 [-2.72 , -0.96]
Xie 2015	5.36	1.42	27	7.15	1.22	52	7.2%	-1.79 [-2.42 , -1.16]
Subtotal (95% CI)			**109**			**166**	**25.0%**	**-0.71 [-1.84 , 0.43]**
Heterogeneity: Tau² = 1.10; Chi² = 36.13, df = 3 (P < 0.00001); I² = 92%								
Test for overall effect: Z = 1.22 (P = 0.22)								
9.3.2 Liberal (Hb > 80 g/L)								
Axford 1994	3.2	1.55	10	3.77	2.18	14	4.0%	-0.57 [-2.06 , 0.92]
Dalrymple-Hay 1999	1.98	1	28	2.06	1.02	46	7.8%	-0.08 [-0.55 , 0.39]
Eng 1990	1.41	0.71	17	2	0.79	17	7.7%	-0.59 [-1.09 , -0.09]
Koopman-van Gemert 1993a	5.55	3.05	15	6.2	6	20	1.5%	-0.65 [-3.70 , 2.40]
Page 1989	3.6	1.78	42	4.34	2.3	45	6.3%	-0.74 [-1.60 , 0.12]
Parrot 1991 (1)	2.18	0.65	19	4.5	0.87	11	7.4%	-2.32 [-2.91 , -1.73]
Parrot 1991 (2)	1.38	0.72	13	4.5	0.87	11	7.2%	-3.12 [-3.77 , -2.47]
Schönberger 1993	2	0	1	3	1.33	4		Not estimable
Shirvani 1991 (3)	4.32	2.67	20	4.06	1.52	21	4.5%	0.26 [-1.08 , 1.60]
Unsworth 1996	2.81	1.63	63	3	1.29	31	7.3%	-0.19 [-0.80 , 0.42]
Vermeijden 2015	4.21	4.06	173	3.91	3	207	6.8%	0.30 [-0.43 , 1.03]
Subtotal (95% CI)			**401**			**427**	**60.6%**	**-0.81 [-1.59 , -0.02]**
Heterogeneity: Tau² = 1.33; Chi² = 99.24, df = 9 (P < 0.00001); I² = 91%								
Test for overall effect: Z = 2.01 (P = 0.04)								
9.3.3 No threshold/protocol reported								
Lepore 1989	3.62	2.68	50	3.62	2.61	62	5.8%	0.00 [-0.99 , 0.99]
Zhao 2003	1.2	0.27	19	2.22	0.4	30	8.6%	-1.02 [-1.21 , -0.83]
Subtotal (95% CI)			**69**			**92**	**14.4%**	**-0.63 [-1.60 , 0.34]**
Heterogeneity: Tau² = 0.39; Chi² = 3.96, df = 1 (P = 0.05); I² = 75%								
Test for overall effect: Z = 1.27 (P = 0.20)								
Total (95% CI)			**579**			**685**	**100.0%**	**-0.80 [-1.21 , -0.40]**
Heterogeneity: Tau² = 0.50; Chi² = 167.42, df = 15 (P < 0.00001); I² = 91%								
Test for overall effect: Z = 3.85 (P = 0.0001)								
Test for subgroup differences: Chi² = 0.08, df = 2 (P = 0.96), I² = 0%								



Footnotes

(1) intra-op collection only

(2) both intra & post-op collection

(3) reported as per square metre body surface: we have scaled up using 1.6 (for men body size)

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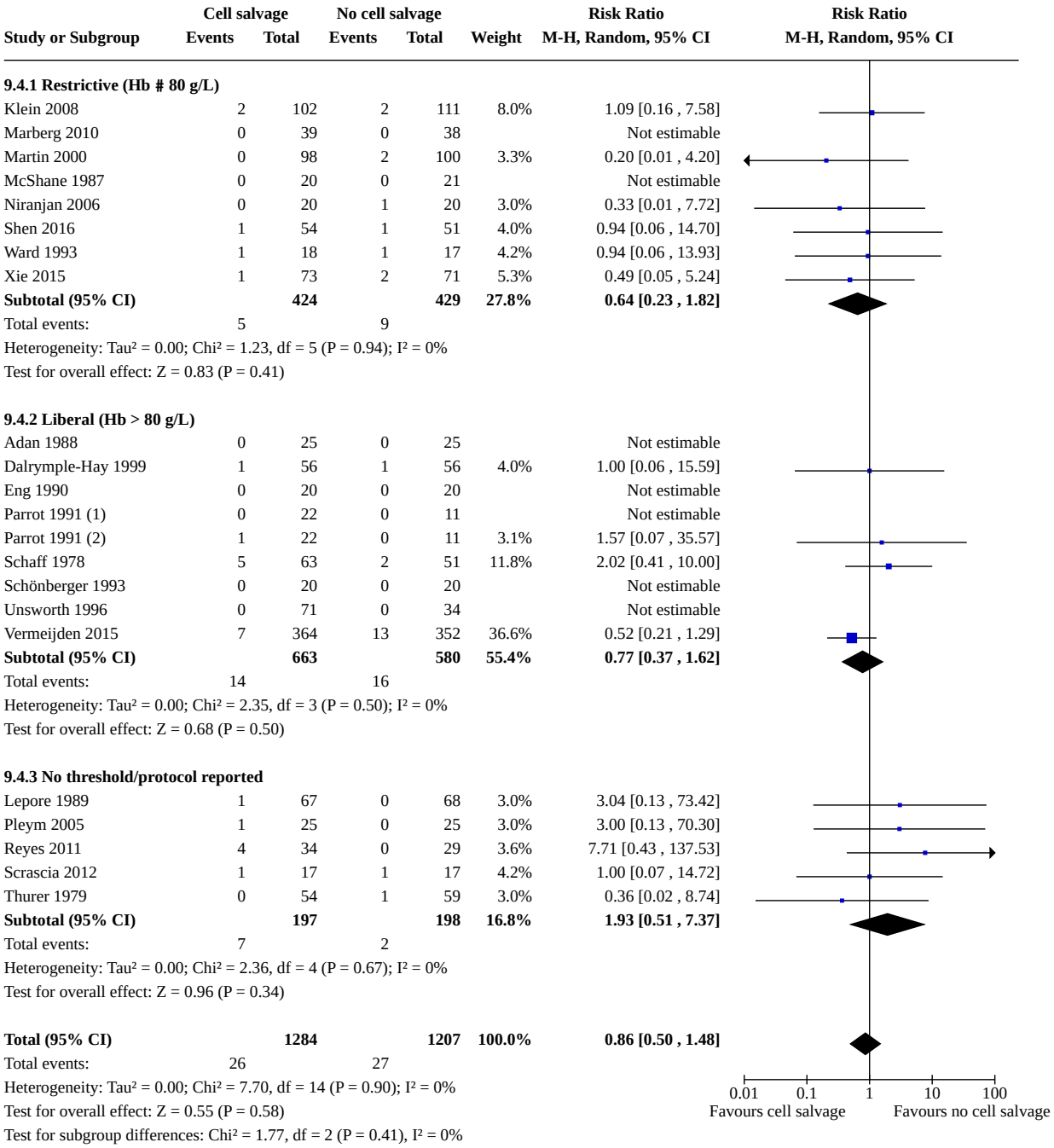
Analysis 9.4. Comparison 9: Cardiovascular (with bypass) (subgroup: transfusion threshold), Outcome 4: Mortality



Footnotes

(1) intra-op collection only

(2) both intra & post-op collection

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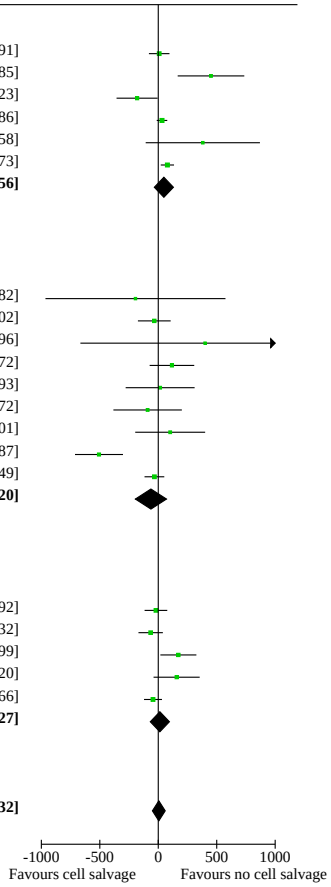
Analysis 9.5. Comparison 9: Cardiovascular (with bypass) (subgroup: transfusion threshold), Outcome 5: Blood loss (mL)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
9.5.1 Restrictive (Hb # 80 g/L)								
Marberg 2010	394	181	39	386	211	38	8.0%	8.00 [-79.91 , 95.91]
Martin 2000	1684	1151	98	1233	872	100	2.7%	451.00 [166.15 , 735.85]
Niranjan 2006	842	276	20	1023	291	20	4.9%	-181.00 [-356.77 , -5.23]
Shen 2016	1640.96	87.73	53	1609.03	137.91	50	9.5%	31.93 [-13.00 , 76.86]
Ward 1993	1495	679	18	1114	788	17	1.1%	381.00 [-107.58 , 869.58]
Xie 2015	1425.6	162.4	72	1347.5	179.8	69	9.1%	78.10 [21.47 , 134.73]
Subtotal (95% CI)			**300**			**294**	**35.3%**	**47.98 [-33.60 , 129.56]**
Heterogeneity: Tau² = 5578.22; Chi² = 18.28, df = 5 (P = 0.003); I² = 73%								
Test for overall effect: Z = 1.15 (P = 0.25)								
9.5.2 Liberal (Hb > 80 g/L)								
Axford 1994	2016	600	16	2211	1452	16	0.5%	-195.00 [-964.82 , 574.82]
Dalrymple-Hay 1999	652	382	56	686	374	56	6.1%	-34.00 [-174.02 , 106.02]
Koopman-van Gemert 1993a	4100	1400	17	3700	1900	20	0.3%	400.00 [-665.96 , 1465.96]
Page 1989	822	445	48	705	522	51	4.5%	117.00 [-73.72 , 307.72]
Parrot 1991 (1)	967	350.58	22	951	433.15	11	2.6%	16.00 [-278.93 , 310.93]
Parrot 1991 (2)	860	332	21	951	433.15	11	2.6%	-91.00 [-383.72 , 201.72]
Schaff 1978	813	960	63	711	664	51	2.5%	102.00 [-197.01 , 401.01]
Schönberger 1993	258	326.465925	20	765	335.4102	20	4.2%	-507.00 [-712.13 , -301.87]
Vermeijden 2015	688	623	364	721	528	352	8.1%	-33.00 [-117.49 , 51.49]
Subtotal (95% CI)			**627**			**588**	**31.3%**	**-62.72 [-195.64 , 70.20]**
Heterogeneity: Tau² = 21906.30; Chi² = 24.29, df = 8 (P = 0.002); I² = 67%								
Test for overall effect: Z = 0.92 (P = 0.36)								
9.5.3 No threshold/protocol reported								
Lepore 1989	520	319	67	540	251	68	7.7%	-20.00 [-116.92 , 76.92]
Pleym 2005	487	137	23	552	220	24	7.4%	-65.00 [-169.32 , 39.32]
Reyes 2011	538	430	34	366	146	29	5.6%	172.00 [18.01 , 325.99]
Scrascia 2012	749	320	17	592	264	17	4.4%	157.00 [-40.20 , 354.20]
Westerberg 2004	315	114.3	12	360	86.6	17	8.4%	-45.00 [-121.66 , 31.66]
Subtotal (95% CI)			**153**			**155**	**33.4%**	**13.64 [-67.99 , 95.27]**
Heterogeneity: Tau² = 4918.69; Chi² = 10.03, df = 4 (P = 0.04); I² = 60%								
Test for overall effect: Z = 0.33 (P = 0.74)								
Total (95% CI)			**1080**			**1037**	**100.0%**	**4.72 [-49.88 , 59.32]**
Heterogeneity: Tau² = 7684.81; Chi² = 61.66, df = 19 (P < 0.00001); I² = 69%								
Test for overall effect: Z = 0.17 (P = 0.87)								
Test for subgroup differences: Chi² = 1.94, df = 2 (P = 0.38), I² = 0%								



Footnotes

(1) intra-op collection only

(2) both intra & post-op collection

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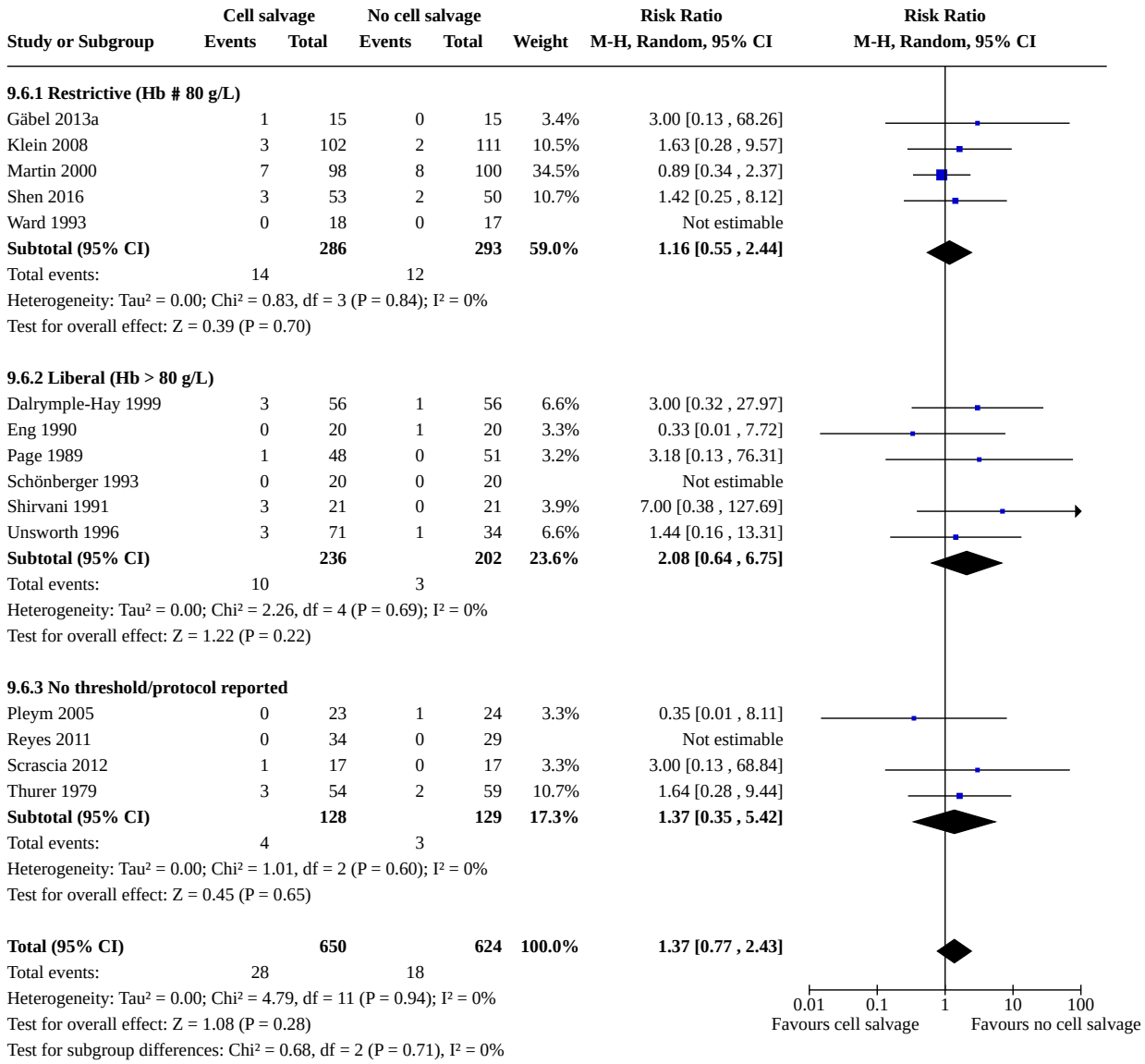
Analysis 9.6. Comparison 9: Cardiovascular (with bypass) (subgroup: transfusion threshold), Outcome 6: Reoperation for bleeding



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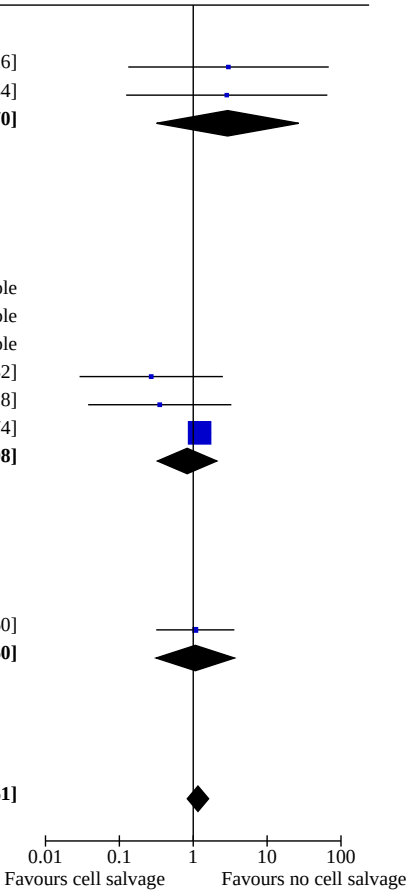
Analysis 9.7. Comparison 9: Cardiovascular (with bypass) (subgroup: transfusion threshold), Outcome 7: Infection

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Risk Ratio M-H, Random, 95% CI
9.7.1 Restrictive (Hb # 80 g/L)						
Gäbel 2013a	1	15	0	15	1.1%	3.00 [0.13 , 68.26]
Ward 1993	1	18	0	17	1.1%	2.84 [0.12 , 65.34]
Subtotal (95% CI)		**33**		**32**	**2.2%**	**2.92 [0.32 , 26.70]**
Total events:	2		0			
Heterogeneity: Tau² = 0.00; Chi² = 0.00, df = 1 (P = 0.98); I² = 0%						
Test for overall effect: Z = 0.95 (P = 0.34)						
9.7.2 Liberal (Hb > 80 g/L)						
Page 1989	0	48	0	51		Not estimable
Parrot 1991 (1)	0	22	0	11		Not estimable
Parrot 1991 (2)	0	21	0	11		Not estimable
Schaff 1978	1	63	3	51	2.2%	0.27 [0.03 , 2.52]
Schmidt 1996	1	53	3	56	2.2%	0.35 [0.04 , 3.28]
Vermeijden 2015	58	364	46	352	85.9%	1.22 [0.85 , 1.74]
Subtotal (95% CI)		**571**		**532**	**90.3%**	**0.83 [0.33 , 2.08]**
Total events:	60		52			
Heterogeneity: Tau² = 0.28; Chi² = 2.82, df = 2 (P = 0.24); I² = 29%						
Test for overall effect: Z = 0.40 (P = 0.69)						
9.7.3 No threshold/protocol reported						
Reyes 2011	5	34	4	29	7.4%	1.07 [0.32 , 3.60]
Subtotal (95% CI)		**34**		**29**	**7.4%**	**1.07 [0.32 , 3.60]**
Total events:	5		4			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.10 (P = 0.92)						
Total (95% CI)		**638**		**593**	**100.0%**	**1.16 [0.83 , 1.61]**
Total events:	67		56			
Heterogeneity: Tau² = 0.00; Chi² = 3.51, df = 5 (P = 0.62); I² = 0%						
Test for overall effect: Z = 0.87 (P = 0.38)						
Test for subgroup differences: Chi² = 1.07, df = 2 (P = 0.59), I² = 0%						



Footnotes

(1) intra-op collection only

(2) both intra & post-op collection

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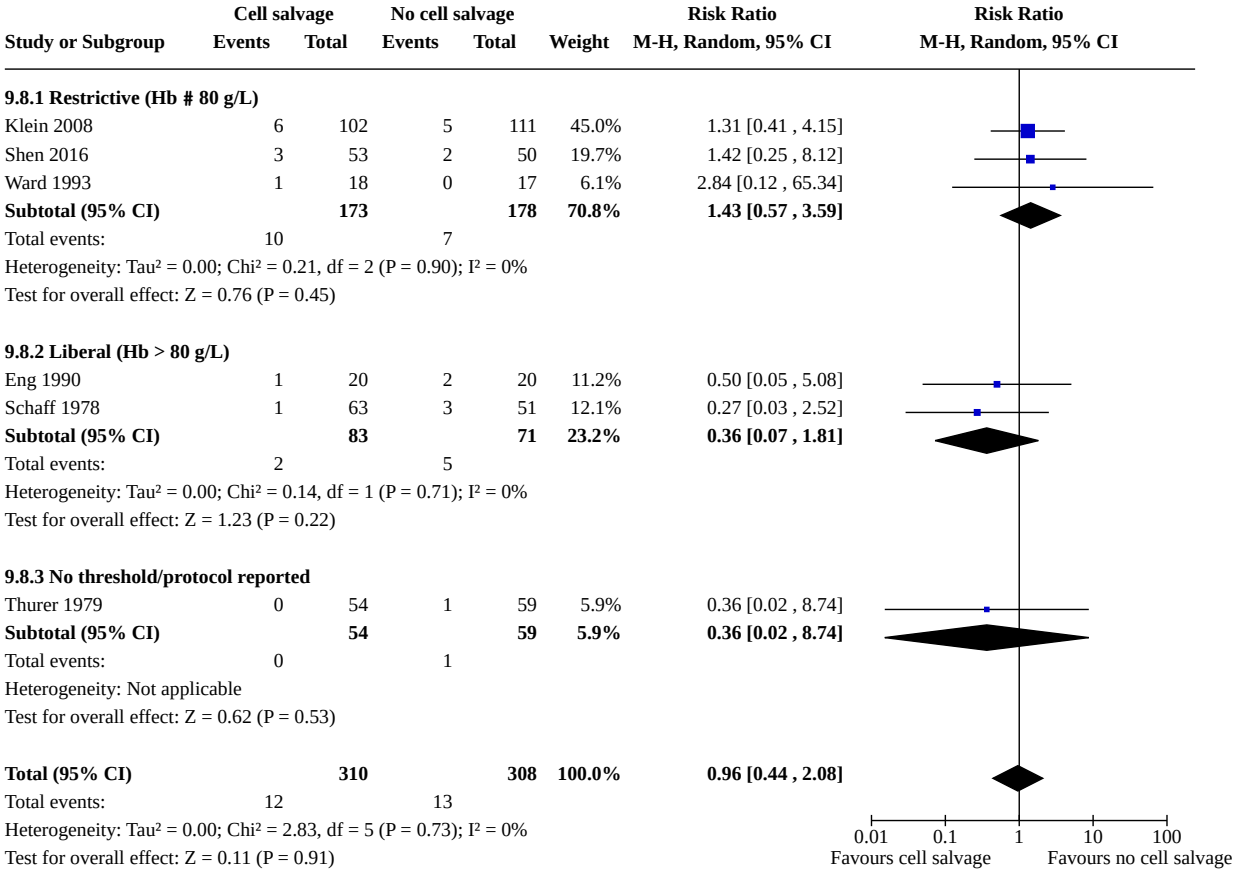
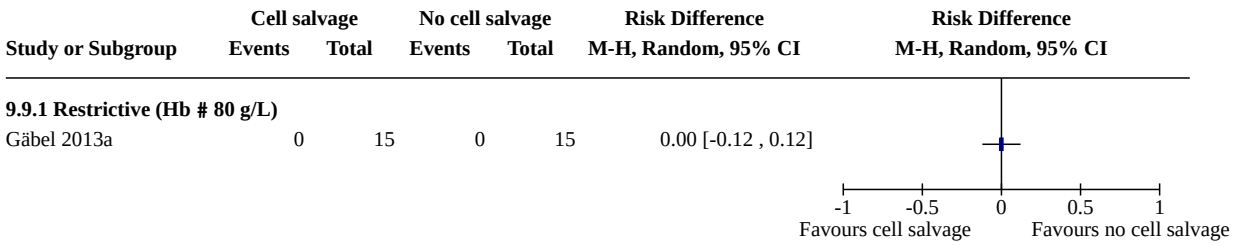
Analysis 9.8. Comparison 9: Cardiovascular (with bypass) (subgroup: transfusion threshold), Outcome 8: Wound complication



Analysis 9.9. Comparison 9: Cardiovascular (with bypass) (subgroup: transfusion threshold), Outcome 9: Thrombosis (VTE)



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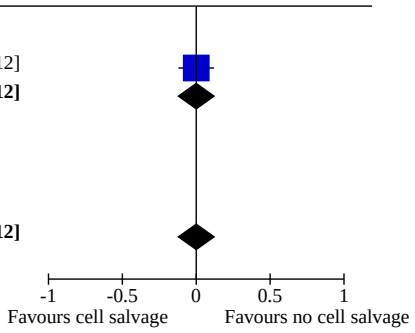
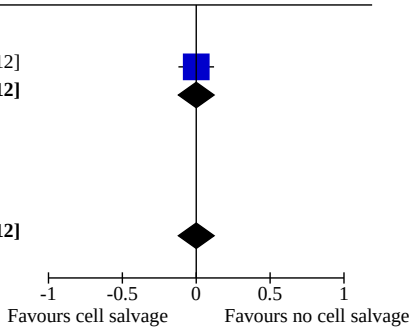
Analysis 9.10. Comparison 9: Cardiovascular (with bypass) (subgroup: transfusion threshold), Outcome 10: DVT

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Risk Difference M-H, Random, 95% CI
9.10.1 Restrictive (Hb # 80 g/L)						
Gäbel 2013a	0	15	0	15	100.0%	0.00 [-0.12 , 0.12]
Subtotal (95% CI)		**15**		**15**	**100.0%**	**0.00 [-0.12 , 0.12]**
Total events:	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.00 (P = 1.00)						
Total (95% CI)		**15**		**15**	**100.0%**	**0.00 [-0.12 , 0.12]**
Total events:	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.00 (P = 1.00)						
Test for subgroup differences: Not applicable						



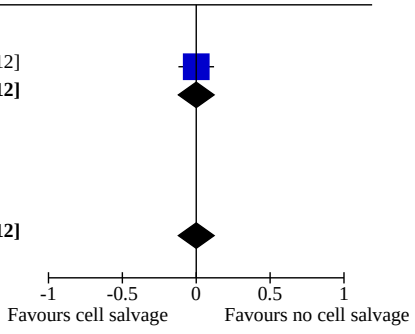
Analysis 9.11. Comparison 9: Cardiovascular (with bypass) (subgroup: transfusion threshold), Outcome 11: PE

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Risk Difference M-H, Random, 95% CI
9.11.1 Restrictive (Hb # 80 g/L)						
Gäbel 2013a	0	15	0	15	100.0%	0.00 [-0.12 , 0.12]
Subtotal (95% CI)		**15**		**15**	**100.0%**	**0.00 [-0.12 , 0.12]**
Total events:	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.00 (P = 1.00)						
Total (95% CI)		**15**		**15**	**100.0%**	**0.00 [-0.12 , 0.12]**
Total events:	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.00 (P = 1.00)						
Test for subgroup differences: Not applicable						



Analysis 9.12. Comparison 9: Cardiovascular (with bypass) (subgroup: transfusion threshold), Outcome 12: MACE

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Risk Difference M-H, Random, 95% CI
9.12.1 Restrictive (Hb # 80 g/L)						
Gäbel 2013a	0	15	0	15	100.0%	0.00 [-0.12 , 0.12]
Subtotal (95% CI)		**15**		**15**	**100.0%**	**0.00 [-0.12 , 0.12]**
Total events:	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.00 (P = 1.00)						
Total (95% CI)		**15**		**15**	**100.0%**	**0.00 [-0.12 , 0.12]**
Total events:	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.00 (P = 1.00)						
Test for subgroup differences: Not applicable						



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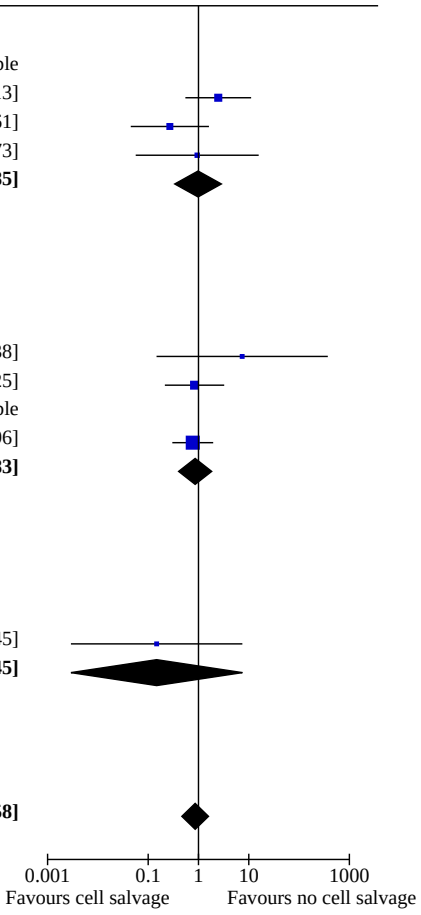
Analysis 9.13. Comparison 9: Cardiovascular (with bypass) (subgroup: transfusion threshold), Outcome 13: MI

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
9.13.1 Restrictive (Hb # 80 g/L)						
Gäbel 2013a	0	15	0	15		Not estimable
Martin 2000	5	98	2	100	16.4%	2.47 [0.55 , 11.13]
Shen 2016	1	53	4	50	11.6%	0.27 [0.05 , 1.61]
Ward 1993	1	18	1	17	4.7%	0.94 [0.06 , 15.73]
Subtotal (95% CI)		**184**		**182**	**32.7%**	**0.98 [0.34 , 2.85]**
Total events:	7		7			
Heterogeneity: Chi² = 3.45, df = 2 (P = 0.18); I² = 42%						
Test for overall effect: Z = 0.04 (P = 0.97)						
9.13.2 Liberal (Hb > 80 g/L)						
Axford 1994	1	16	0	16	2.4%	7.39 [0.15 , 372.38]
Schmidt 1996	4	53	5	56	20.1%	0.83 [0.21 , 3.25]
Schönberger 1993	0	20	0	20		Not estimable
Vermeijden 2015	8	364	10	352	42.4%	0.77 [0.30 , 1.96]
Subtotal (95% CI)		**453**		**444**	**64.9%**	**0.86 [0.40 , 1.83]**
Total events:	13		15			
Heterogeneity: Chi² = 1.21, df = 2 (P = 0.55); I² = 0%						
Test for overall effect: Z = 0.40 (P = 0.69)						
9.13.3 No threshold/protocol reported						
Thurer 1979	0	54	1	59	2.4%	0.15 [0.00 , 7.45]
Subtotal (95% CI)		**54**		**59**	**2.4%**	**0.15 [0.00 , 7.45]**
Total events:	0		1			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.96 (P = 0.34)						
Total (95% CI)		**691**		**685**	**100.0%**	**0.86 [0.47 , 1.58]**
Total events:	20		23			
Heterogeneity: Chi² = 5.50, df = 6 (P = 0.48); I² = 0%						
Test for overall effect: Z = 0.49 (P = 0.63)						
Test for subgroup differences: Chi² = 0.84, df = 2 (P = 0.66), I² = 0%						



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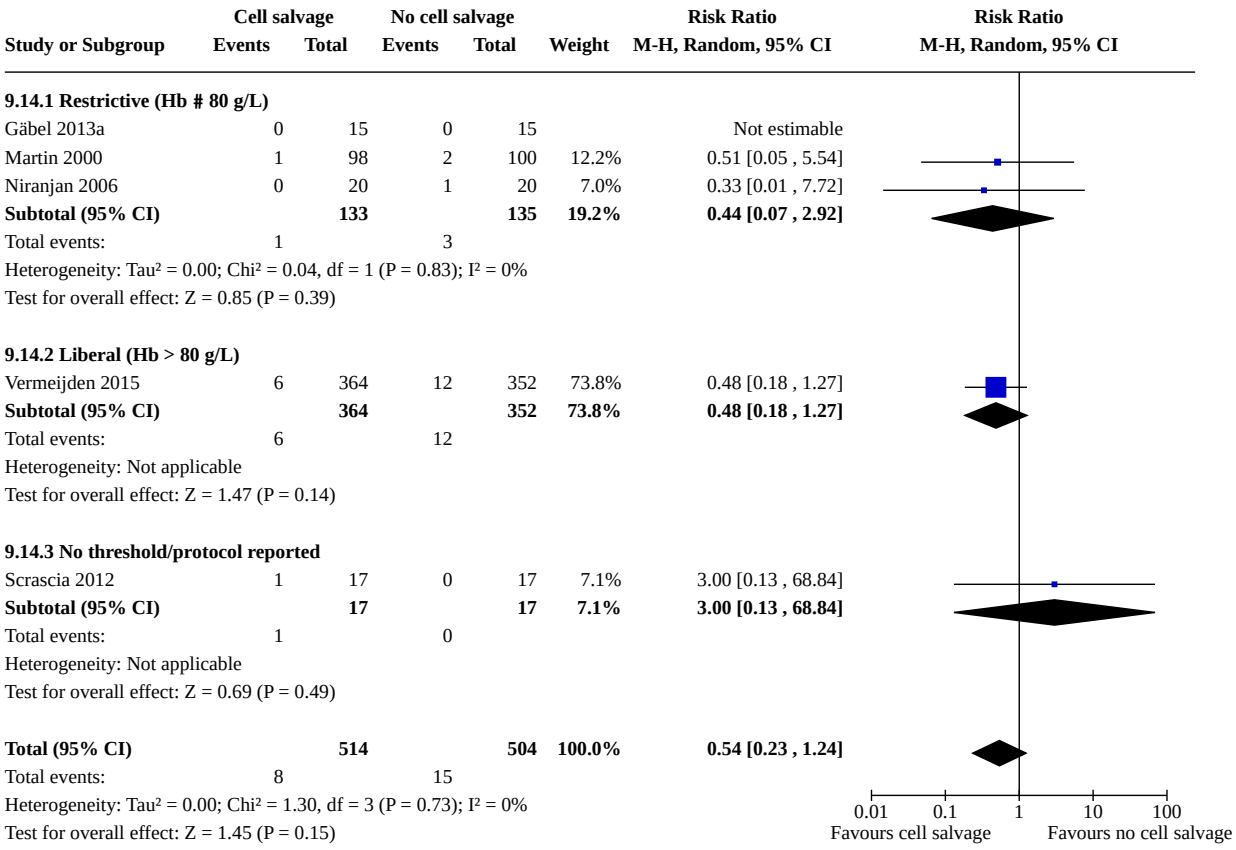
Analysis 9.14. Comparison 9: Cardiovascular (with bypass) (subgroup: transfusion threshold), Outcome 14: CVA (stroke)



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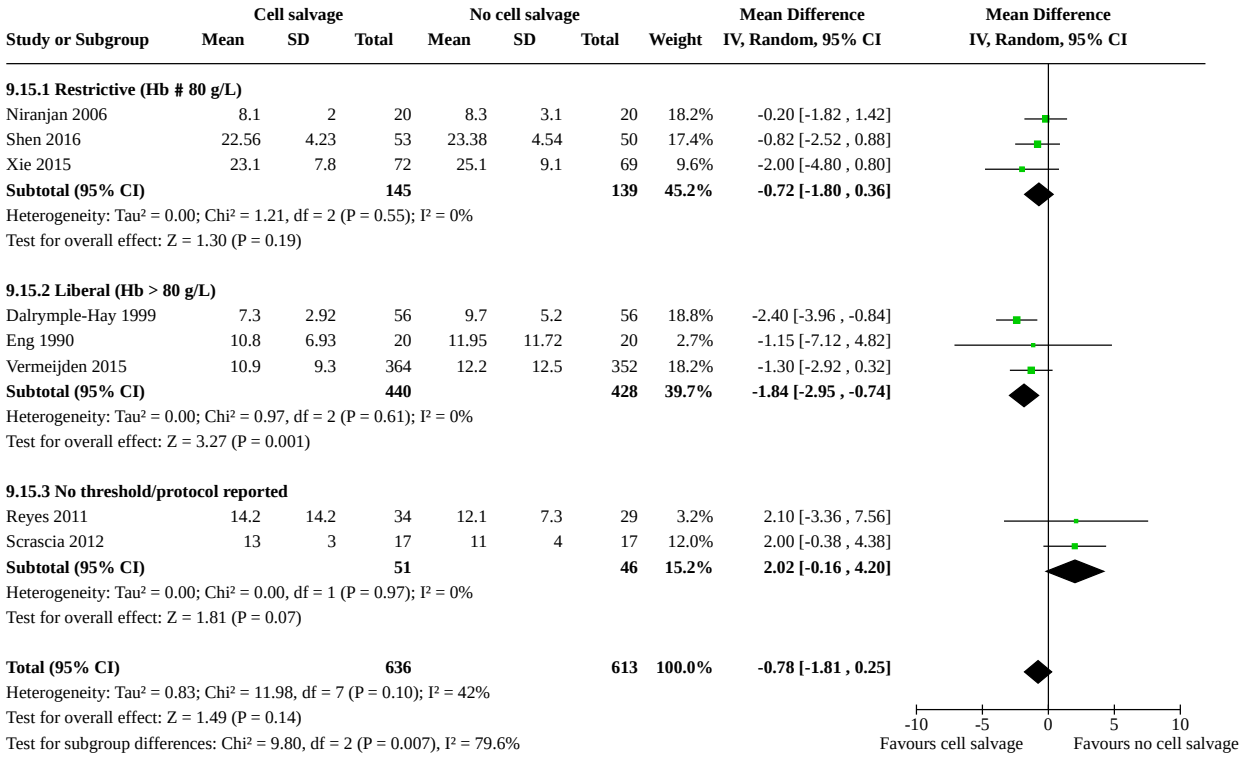
Analysis 9.15. Comparison 9: Cardiovascular (with bypass) (subgroup: transfusion threshold), Outcome 15: Hospital LOS (days)



Comparison 10. Obstetrics (subgroup: timing)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
10.1 Transfusions	1		Peto Odds Ratio (Peto, Fixed, 95% CI)	Totals not selected
10.1.1 Intraoperative	1		Peto Odds Ratio (Peto, Fixed, 95% CI)	Totals not selected
10.2 Volume of transfusion (units) (PPR)	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
10.2.1 Intraoperative	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
10.3 Volume of transfusion (units) (PPT)	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
10.3.1 Intraoperative	1		Mean Difference (IV, Random, 95% CI)	Totals not selected

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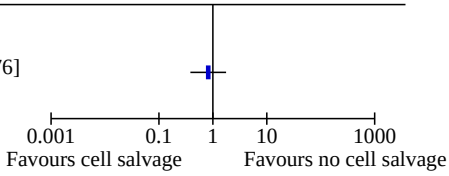
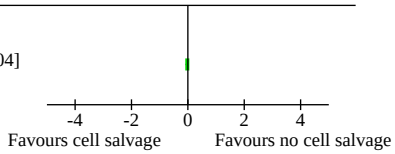
Analysis 10.1. Comparison 10: Obstetrics (subgroup: timing), Outcome 1: Transfusions

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Peto Odds Ratio Peto, Fixed, 95% CI
10.1.1 Intraoperative					
Khan 2017 (SALVO)	12	665	15	684	0.82 [0.38 , 1.76]



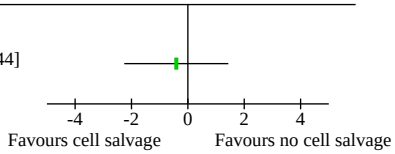
Analysis 10.2. Comparison 10: Obstetrics (subgroup: timing), Outcome 2: Volume of transfusion (units) (PPR)

Study or Subgroup	Cell salvage Mean	Cell salvage SD	Cell salvage Total	No cell salvage Mean	No cell salvage SD	No cell salvage Total	Mean Difference IV, Random, 95% CI
10.2.1 Intraoperative							
Khan 2017 (SALVO)	0.05	0.49	665	0.07	0.61	684	-0.02 [-0.08 , 0.04]



Analysis 10.3. Comparison 10: Obstetrics (subgroup: timing), Outcome 3: Volume of transfusion (units) (PPT)

Study or Subgroup	Cell salvage Mean	Cell salvage SD	Cell salvage Total	No cell salvage Mean	No cell salvage SD	No cell salvage Total	Mean Difference IV, Random, 95% CI
10.3.1 Intraoperative							
Khan 2017 (SALVO)	2.92	2.35	12	3.33	2.53	15	-0.41 [-2.26 , 1.44]



Comparison 11. Obstetrics (subgroup: transfusion threshold)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
11.1 Transfusions	1		Peto Odds Ratio (Peto, Fixed, 95% CI)	Totals not selected
11.1.1 No threshold/protocol reported	1		Peto Odds Ratio (Peto, Fixed, 95% CI)	Totals not selected
11.2 Volume of transfusion (units) (PPR)	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
11.2.1 No threshold/protocol reported	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
11.3 Volume of transfusion (units) (PPT)	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
11.3.1 No threshold/protocol reported	1		Mean Difference (IV, Random, 95% CI)	Totals not selected

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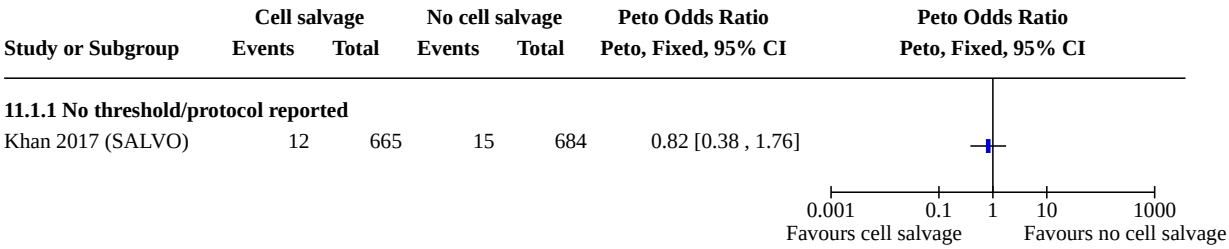
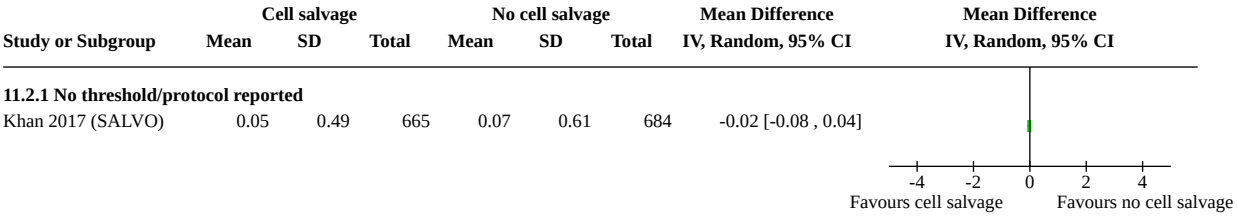
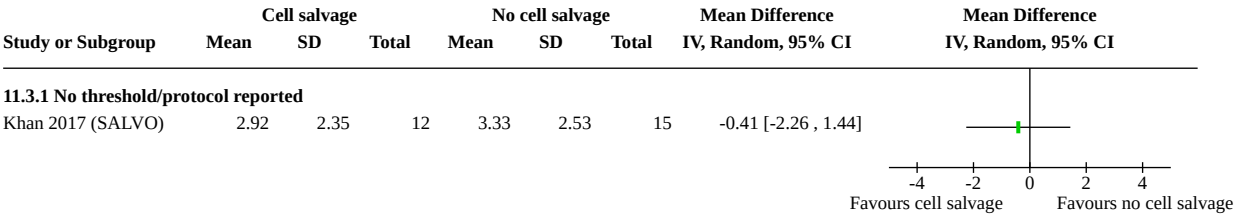
Analysis 11.1. Comparison 11: Obstetrics (subgroup: transfusion threshold), Outcome 1: Transfusions



Analysis 11.2. Comparison 11: Obstetrics (subgroup: transfusion threshold), Outcome 2: Volume of transfusion (units) (PPR)



Analysis 11.3. Comparison 11: Obstetrics (subgroup: transfusion threshold), Outcome 3: Volume of transfusion (units) (PPT)



Comparison 12. Orthopaedic (hip) (subgroup: timing)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
12.1 Transfusions	14	1641	Risk Ratio (M-H, Random, 95% CI)	0.52 [0.38, 0.72]
12.1.1 Intraoperative	2	65	Risk Ratio (M-H, Random, 95% CI)	0.60 [0.40, 0.89]
12.1.2 Postoperative	9	1168	Risk Ratio (M-H, Random, 95% CI)	0.44 [0.26, 0.76]
12.1.3 Intra- and postoperative	4	408	Risk Ratio (M-H, Random, 95% CI)	0.67 [0.41, 1.11]
12.2 Volume of transfusion (units) (PPR)	5	433	Mean Difference (IV, Random, 95% CI)	-0.61 [-1.04, -0.19]

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Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
12.2.1 Intraoperative	2	69	Mean Difference (IV, Random, 95% CI)	-1.03 [-1.61, -0.45]
12.2.2 Postoperative	2	160	Mean Difference (IV, Random, 95% CI)	-0.78 [-2.19, 0.63]
12.2.3 Intra- and postoperative	1	204	Mean Difference (IV, Random, 95% CI)	-0.10 [-0.23, 0.03]
12.3 Volume of transfusion (units) (PPT)	4	63	Mean Difference (IV, Random, 95% CI)	-1.74 [-2.92, -0.55]
12.3.1 Intraoperative	1	16	Mean Difference (IV, Random, 95% CI)	-2.04 [-2.92, -1.16]
12.3.2 Postoperative	2	34	Mean Difference (IV, Random, 95% CI)	-0.53 [-2.98, 1.92]
12.3.3 Intra- and postoperative	1	0	Mean Difference (IV, Random, 95% CI)	Not estimable
12.4 Mortality	4	651	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.46 [0.06, 3.33]
12.4.1 Postoperative	2	317	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.19 [0.01, 3.20]
12.4.2 Intra- and postoperative	2	334	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.07 [0.07, 17.17]
12.5 Blood loss (mL)	10	1085	Mean Difference (IV, Random, 95% CI)	-78.13 [-162.74, 6.48]
12.5.1 Intraoperative	2	65	Mean Difference (IV, Random, 95% CI)	-260.64 [-1209.11, 687.83]
12.5.2 Postoperative	4	451	Mean Difference (IV, Random, 95% CI)	-12.52 [-27.17, 2.13]
12.5.3 Intra- and postoperative	4	569	Mean Difference (IV, Random, 95% CI)	-111.32 [-238.53, 15.89]
12.6 Reoperation for bleeding	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
12.6.1 Postoperative	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
12.7 Infection	4	549	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.72 [0.17, 2.98]
12.7.1 Postoperative	4	494	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.55 [0.12, 2.52]
12.7.2 Intra- and postoperative	1	55	Peto Odds Ratio (Peto, Fixed, 95% CI)	4.81 [0.08, 283.10]
12.8 Wound complication	4	609	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.94 [0.36, 2.45]
12.8.1 Postoperative	3	338	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.18 [0.38, 3.65]
12.8.2 Intra- and postoperative	2	271	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.54 [0.09, 3.22]

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Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
12.9 Prosthetic joint infection (PJI)	5	806	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.31 [0.05, 1.78]
12.9.1 Postoperative	2	0	Peto Odds Ratio (Peto, Fixed, 95% CI)	Not estimable
12.9.2 Intra- and postoperative	4	593	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.31 [0.05, 1.78]
12.10 Thrombosis (VTE)	2	196	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.45 [0.24, 8.72]
12.10.1 Postoperative	2	196	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.45 [0.24, 8.72]
12.11 DVT	3	343	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.05 [0.20, 5.60]
12.11.1 Intraoperative	1	39	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.66 [0.26, 10.58]
12.11.2 Postoperative	1	0	Peto Odds Ratio (Peto, Fixed, 95% CI)	Not estimable
12.11.3 Intra- and postoperative	1	204	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.14 [0.00, 6.82]
12.12 PE	2	316	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.14 [0.00, 7.08]
12.12.1 Postoperative	1	0	Peto Odds Ratio (Peto, Fixed, 95% CI)	Not estimable
12.12.2 Intra- and postoperative	1	216	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.14 [0.00, 7.08]
12.13 CVA (stroke)	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
12.13.1 Intraoperative	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
12.14 Hospital LOS (days)	4	542	Mean Difference (IV, Random, 95% CI)	0.07 [-0.37, 0.52]
12.14.1 Postoperative	2	220	Mean Difference (IV, Random, 95% CI)	0.19 [-0.79, 1.17]
12.14.2 Intra- and postoperative	2	322	Mean Difference (IV, Random, 95% CI)	-0.01 [-0.50, 0.47]

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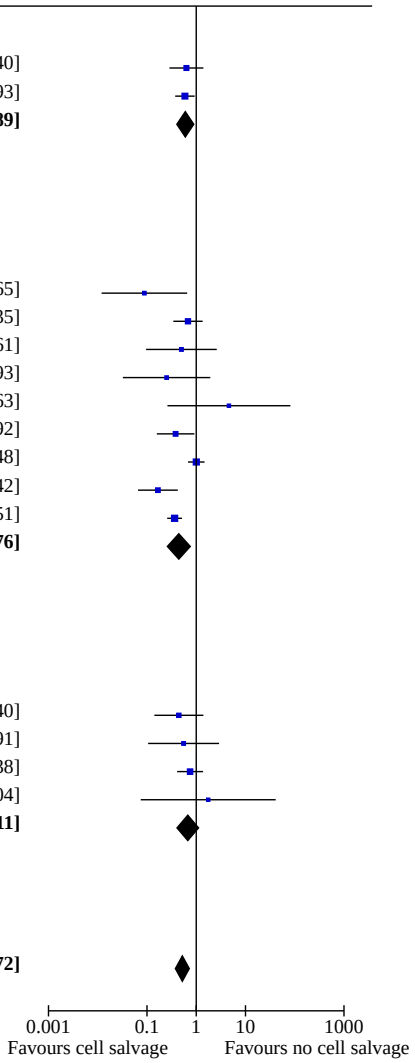
Analysis 12.1. Comparison 12: Orthopaedic (hip) (subgroup: timing), Outcome 1: Transfusions

Study or Subgroup	Cell salvage Events	Total	No cell salvage Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
12.1.1 Intraoperative						
Elawad 1991	6	19	10	20	8.2%	0.63 [0.29 , 1.40]
Menges 1992	8	14	12	12	12.3%	0.59 [0.37 , 0.93]
Subtotal (95% CI)		**33**		**32**	**20.6%**	**0.60 [0.40 , 0.89]**
Total events:	14		22			
Heterogeneity: Tau² = 0.00; Chi² = 0.03, df = 1 (P = 0.87); I² = 0%						
Test for overall effect: Z = 2.54 (P = 0.01)						
12.1.2 Postoperative						
Ayers 1995	1	67	15	89	2.3%	0.09 [0.01 , 0.65]
Cheung 2010	9	53	25	100	9.4%	0.68 [0.34 , 1.35]
Horstmann 2012	2	50	4	50	3.1%	0.50 [0.10 , 2.61]
Kleinert 2012	1	40	8	80	2.2%	0.25 [0.03 , 1.93]
Rollo 1995	4	40	0	20	1.2%	4.61 [0.26 , 81.63]
Smith 2007	6	76	17	82	7.4%	0.38 [0.16 , 0.92]
Teetzman 2014	29	74	34	87	13.2%	1.00 [0.68 , 1.48]
Tripkovic 2008	4	30	24	30	7.0%	0.17 [0.07 , 0.42]
Zhao 2016	31	127	49	73	13.8%	0.36 [0.26 , 0.51]
Subtotal (95% CI)		**557**		**611**	**59.6%**	**0.44 [0.26 , 0.76]**
Total events:	87		176			
Heterogeneity: Tau² = 0.36; Chi² = 28.19, df = 8 (P = 0.0004); I² = 72%						
Test for overall effect: Z = 2.98 (P = 0.003)						
12.1.3 Intra- and postoperative						
Horstmann 2013	4	102	9	102	5.4%	0.44 [0.14 , 1.40]
Horstmann 2014a	2	56	4	62	3.1%	0.55 [0.11 , 2.91]
Lorentz 1991	8	16	10	15	10.4%	0.75 [0.41 , 1.38]
Rollo 1995	1	35	0	20	1.0%	1.75 [0.07 , 41.04]
Subtotal (95% CI)		**209**		**199**	**19.8%**	**0.67 [0.41 , 1.11]**
Total events:	15		23			
Heterogeneity: Tau² = 0.00; Chi² = 1.10, df = 3 (P = 0.78); I² = 0%						
Test for overall effect: Z = 1.54 (P = 0.12)						
Total (95% CI)		**799**		**842**	**100.0%**	**0.52 [0.38 , 0.72]**
Total events:	116		221			
Heterogeneity: Tau² = 0.17; Chi² = 30.66, df = 14 (P = 0.006); I² = 54%						
Test for overall effect: Z = 3.93 (P < 0.0001)						
Test for subgroup differences: Chi² = 1.34, df = 2 (P = 0.51), I² = 0%						



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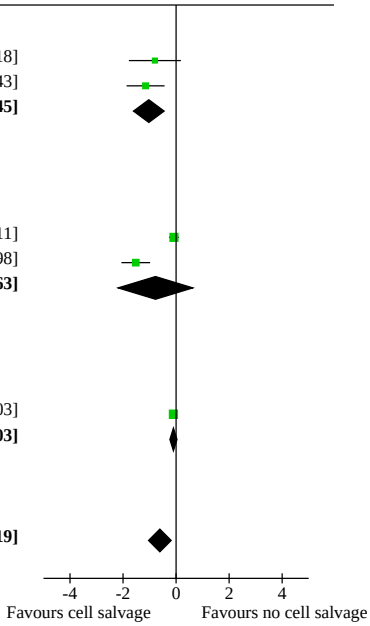
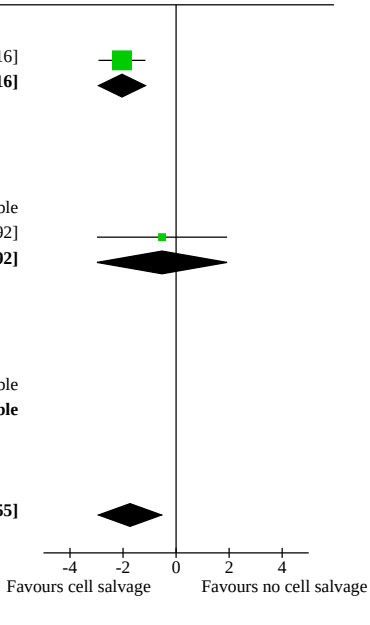
Analysis 12.2. Comparison 12: Orthopaedic (hip) (subgroup: timing), Outcome 2: Volume of transfusion (units) (PPR)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
12.2.1 Intraoperative								
Ekback 1995	1.9	1.55	15	2.7	1.16	15	11.3%	-0.80 [-1.78 , 0.18]
Elawad 1991	0.22	0.56	19	1.37	1.53	20	15.7%	-1.15 [-1.87 , -0.43]
Subtotal (95% CI)			**34**			**35**	**27.0%**	**-1.03 [-1.61 , -0.45]**
Heterogeneity: Tau² = 0.00; Chi² = 0.32, df = 1 (P = 0.57); I² = 0%								
Test for overall effect: Z = 3.48 (P = 0.0005)								
12.2.2 Postoperative								
Horstmann 2012	0.08	0.4	50	0.16	0.55	50	26.5%	-0.08 [-0.27 , 0.11]
Tripkovic 2008	0.22	0.98	30	1.74	1.15	30	19.3%	-1.52 [-2.06 , -0.98]
Subtotal (95% CI)			**80**			**80**	**45.8%**	**-0.78 [-2.19 , 0.63]**
Heterogeneity: Tau² = 0.99; Chi² = 24.30, df = 1 (P < 0.00001); I² = 96%								
Test for overall effect: Z = 1.08 (P = 0.28)								
12.2.3 Intra- and postoperative								
Horstmann 2013	0.08	0.39	102	0.18	0.57	102	27.2%	-0.10 [-0.23 , 0.03]
Subtotal (95% CI)			**102**			**102**	**27.2%**	**-0.10 [-0.23 , 0.03]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 1.46 (P = 0.14)								
Total (95% CI)			**216**			**217**	**100.0%**	**-0.61 [-1.04 , -0.19]**
Heterogeneity: Tau² = 0.17; Chi² = 34.63, df = 4 (P < 0.00001); I² = 88%								
Test for overall effect: Z = 2.81 (P = 0.005)								
Test for subgroup differences: Chi² = 10.15, df = 2 (P = 0.006), I² = 80.3%								



Analysis 12.3. Comparison 12: Orthopaedic (hip) (subgroup: timing), Outcome 3: Volume of transfusion (units) (PPT)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
12.3.1 Intraoperative								
Elawad 1991	0.69	0.87	6	2.73	0.88	10	79.9%	-2.04 [-2.92 , -1.16]
Subtotal (95% CI)			**6**			**10**	**79.9%**	**-2.04 [-2.92 , -1.16]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 4.52 (P < 0.00001)								
12.3.2 Postoperative								
Horstmann 2012	2	0	2	2	0	4		Not estimable
Tripkovic 2008	1.65	2.48	4	2.18	0.82	24	20.1%	-0.53 [-2.98 , 1.92]
Subtotal (95% CI)			**6**			**28**	**20.1%**	**-0.53 [-2.98 , 1.92]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.42 (P = 0.67)								
12.3.3 Intra- and postoperative								
Horstmann 2013	2	0	4	2	0	9		Not estimable
Subtotal (95% CI)			**0**			**0**		**Not estimable**
Heterogeneity: Not applicable								
Test for overall effect: Not applicable								
Total (95% CI)			**16**			**47**	**100.0%**	**-1.74 [-2.92 , -0.55]**
Heterogeneity: Tau² = 0.26; Chi² = 1.29, df = 1 (P = 0.26); I² = 22%								
Test for overall effect: Z = 2.87 (P = 0.004)								
Test for subgroup differences: Chi² = 1.29, df = 1 (P = 0.26), I² = 22.4%								



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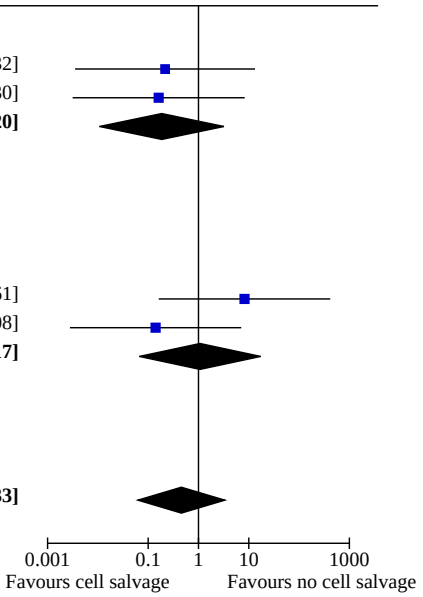
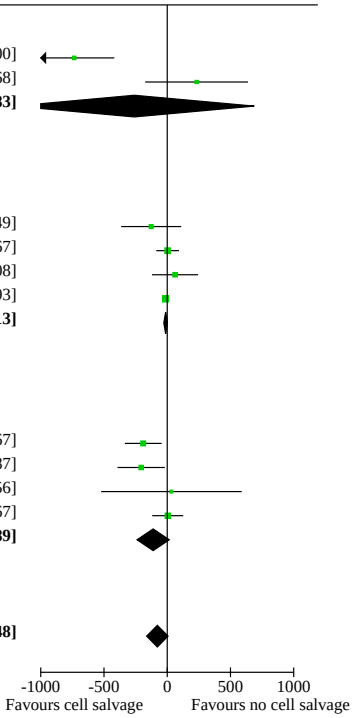
Analysis 12.4. Comparison 12: Orthopaedic (hip) (subgroup: timing), Outcome 4: Mortality

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
12.4.1 Postoperative						
Cheung 2010	0	53	1	100	23.3%	0.22 [0.00 , 13.32]
Teetzman 2014	0	74	1	90	25.4%	0.16 [0.00 , 8.30]
Subtotal (95% CI)		**127**		**190**	**48.7%**	**0.19 [0.01 , 3.20]**
Total events:	0		2			
Heterogeneity: Chi² = 0.01, df = 1 (P = 0.92); I² = 0%						
Test for overall effect: Z = 1.16 (P = 0.25)						
12.4.2 Intra- and postoperative						
Horstmann 2014a	1	56	0	62	25.6%	8.22 [0.16 , 416.61]
Thomassen 2011	0	106	1	110	25.7%	0.14 [0.00 , 7.08]
Subtotal (95% CI)		**162**		**172**	**51.3%**	**1.07 [0.07 , 17.17]**
Total events:	1		1			
Heterogeneity: Chi² = 2.07, df = 1 (P = 0.15); I² = 52%						
Test for overall effect: Z = 0.05 (P = 0.96)						
Total (95% CI)		**289**		**362**	**100.0%**	**0.46 [0.06 , 3.33]**
Total events:	1		3			
Heterogeneity: Chi² = 2.82, df = 3 (P = 0.42); I² = 0%						
Test for overall effect: Z = 0.77 (P = 0.44)						
Test for subgroup differences: Chi² = 0.75, df = 1 (P = 0.39), I² = 0%						



Analysis 12.5. Comparison 12: Orthopaedic (hip) (subgroup: timing), Outcome 5: Blood loss (mL)

Study or Subgroup	Cell salvage Mean	Cell salvage SD	Cell salvage Total	No cell salvage Mean	No cell salvage SD	No cell salvage Total	Weight	Mean Difference IV, Random, 95% CI
12.5.1 Intraoperative								
Elawad 1991	1464	386	19	2200	608	20	5.2%	-736.00 [-1054.00 , -418.00]
Menges 1992	2104	567	14	1872	491	12	3.5%	232.00 [-174.68 , 638.68]
Subtotal (95% CI)			**33**			**32**	**8.7%**	**-260.64 [-1209.11 , 687.83]**
Heterogeneity: Tau² = 433822.66; Chi² = 13.51, df = 1 (P = 0.0002); I² = 93%								
Test for overall effect: Z = 0.54 (P = 0.59)								
12.5.2 Postoperative								
Horstmann 2012	1506	564	50	1633	645	50	7.7%	-127.00 [-364.49 , 110.49]
Luo 2016	691	225.22	49	688	210.79	42	15.9%	3.00 [-86.67 , 92.67]
Tripkovic 2008	1434	374	30	1372	345	30	10.2%	62.00 [-120.08 , 244.08]
Zhao 2016	312	48.53	127	325	53.67	73	19.3%	-13.00 [-27.93 , 1.93]
Subtotal (95% CI)			**256**			**195**	**53.1%**	**-12.52 [-27.17 , 2.13]**
Heterogeneity: Tau² = 0.00; Chi² = 1.66, df = 3 (P = 0.65); I² = 0%								
Test for overall effect: Z = 1.68 (P = 0.09)								
12.5.3 Intra- and postoperative								
Horstmann 2013	1464	505	102	1654	553	102	12.3%	-190.00 [-335.33 , -44.67]
Horstmann 2014a	1472	531	56	1678	503	62	10.0%	-206.00 [-393.13 , -18.87]
Lorentz 1991	1753	783	16	1720	794	15	2.1%	33.00 [-522.56 , 588.56]
Thomassen 2011	931	486	106	927	431	110	13.8%	4.00 [-118.67 , 126.67]
Subtotal (95% CI)			**280**			**289**	**38.2%**	**-111.32 [-238.53 , 15.89]**
Heterogeneity: Tau² = 7425.99; Chi² = 5.69, df = 3 (P = 0.13); I² = 47%								
Test for overall effect: Z = 1.72 (P = 0.09)								
Total (95% CI)			**569**			**516**	**100.0%**	**-78.13 [-162.74 , 6.48]**
Heterogeneity: Tau² = 9603.08; Chi² = 32.59, df = 9 (P = 0.0002); I² = 72%								
Test for overall effect: Z = 1.81 (P = 0.07)								
Test for subgroup differences: Chi² = 2.55, df = 2 (P = 0.28), I² = 21.5%								



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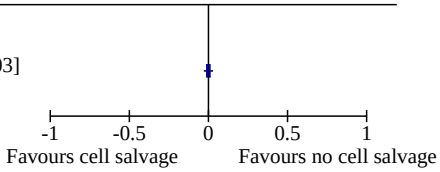
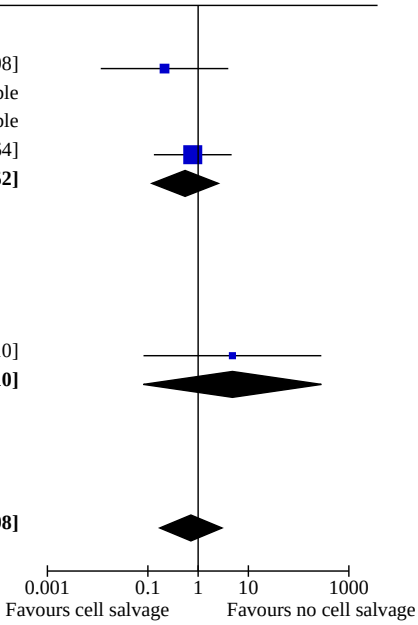
Analysis 12.6. Comparison 12: Orthopaedic (hip) (subgroup: timing), Outcome 6: Reoperation for bleeding

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Risk Difference M-H, Random, 95% CI
12.6.1 Postoperative					
Cheung 2010	0	53	0	100	0.00 [-0.03 , 0.03]



Analysis 12.7. Comparison 12: Orthopaedic (hip) (subgroup: timing), Outcome 7: Infection

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
12.7.1 Postoperative						
Cheung 2010	0	53	2	100	23.8%	0.21 [0.01 , 3.98]
Kleinert 2012	0	40	0	80		Not estimable
Rollo 1995	0	40	0	20		Not estimable
Teetzman 2014	2	74	3	87	64.0%	0.78 [0.13 , 4.64]
Subtotal (95% CI)		**207**		**287**	**87.8%**	**0.55 [0.12 , 2.52]**
Total events:	2		5			
Heterogeneity: Chi² = 0.55, df = 1 (P = 0.46); I² = 0%						
Test for overall effect: Z = 0.77 (P = 0.44)						
12.7.2 Intra- and postoperative						
Rollo 1995	1	35	0	20	12.2%	4.81 [0.08 , 283.10]
Subtotal (95% CI)		**35**		**20**	**12.2%**	**4.81 [0.08 , 283.10]**
Total events:	1		0			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.76 (P = 0.45)						
Total (95% CI)		**242**		**307**	**100.0%**	**0.72 [0.17 , 2.98]**
Total events:	3		5			
Heterogeneity: Chi² = 1.50, df = 2 (P = 0.47); I² = 0%						
Test for overall effect: Z = 0.46 (P = 0.65)						
Test for subgroup differences: Chi² = 0.95, df = 1 (P = 0.33), I² = 0%						



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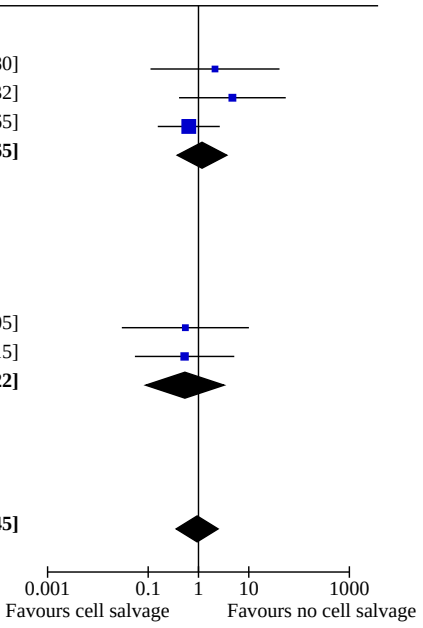
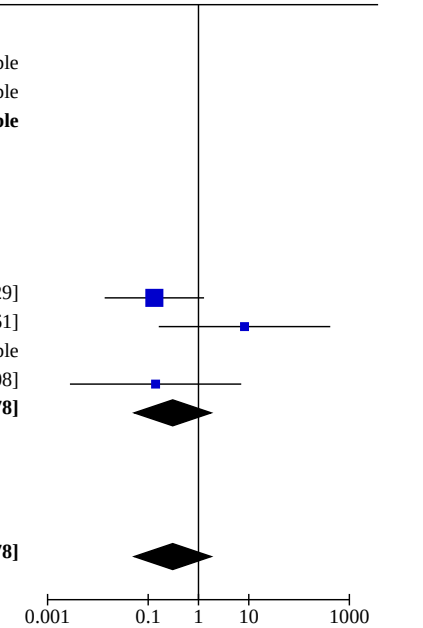
Analysis 12.8. Comparison 12: Orthopaedic (hip) (subgroup: timing), Outcome 8: Wound complication

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
12.8.1 Postoperative						
Kleinert 2012	1	40	1	80	10.5%	2.13 [0.11 , 40.80]
Rollo 1995	3	40	0	20	15.4%	4.72 [0.41 , 54.32]
Smith 2007	3	76	5	82	45.5%	0.64 [0.16 , 2.65]
Subtotal (95% CI)		**156**		**182**	**71.4%**	**1.18 [0.38 , 3.65]**
Total events:	7		6			
Heterogeneity: Chi² = 2.10, df = 2 (P = 0.35); I² = 5%						
Test for overall effect: Z = 0.28 (P = 0.78)						
12.8.2 Intra- and postoperative						
Rollo 1995	1	35	1	20	10.8%	0.55 [0.03 , 10.05]
Thomassen 2011	1	106	2	110	17.7%	0.53 [0.05 , 5.15]
Subtotal (95% CI)		**141**		**130**	**28.6%**	**0.54 [0.09 , 3.22]**
Total events:	2		3			
Heterogeneity: Chi² = 0.00, df = 1 (P = 0.99); I² = 0%						
Test for overall effect: Z = 0.68 (P = 0.50)						
Total (95% CI)		**297**		**312**	**100.0%**	**0.94 [0.36 , 2.45]**
Total events:	9		9			
Heterogeneity: Chi² = 2.63, df = 4 (P = 0.62); I² = 0%						
Test for overall effect: Z = 0.13 (P = 0.90)						
Test for subgroup differences: Chi² = 0.53, df = 1 (P = 0.47), I² = 0%						



Analysis 12.9. Comparison 12: Orthopaedic (hip) (subgroup: timing), Outcome 9: Prosthetic joint infection (PJI)

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
12.9.1 Postoperative						
Cheung 2010	0	53	0	100		Not estimable
Rollo 1995	0	40	0	20		Not estimable
Subtotal (95% CI)		**0**		**0**		**Not estimable**
Total events:	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Not applicable						
12.9.2 Intra- and postoperative						
Horstmann 2013	0	102	3	102	59.8%	0.13 [0.01 , 1.29]
Horstmann 2014a	1	56	0	62	20.1%	8.22 [0.16 , 416.61]
Rollo 1995	0	35	0	20		Not estimable
Thomassen 2011	0	106	1	110	20.1%	0.14 [0.00 , 7.08]
Subtotal (95% CI)		**299**		**294**	**100.0%**	**0.31 [0.05 , 1.78]**
Total events:	1		4			
Heterogeneity: Chi² = 3.37, df = 2 (P = 0.19); I² = 41%						
Test for overall effect: Z = 1.31 (P = 0.19)						
Total (95% CI)		**392**		**414**	**100.0%**	**0.31 [0.05 , 1.78]**
Total events:	1		4			
Heterogeneity: Chi² = 3.37, df = 2 (P = 0.19); I² = 41%						
Test for overall effect: Z = 1.31 (P = 0.19)						
Test for subgroup differences: Not applicable						



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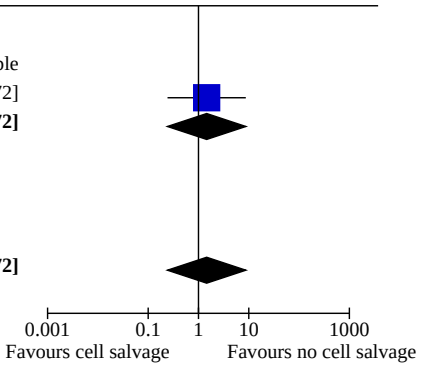
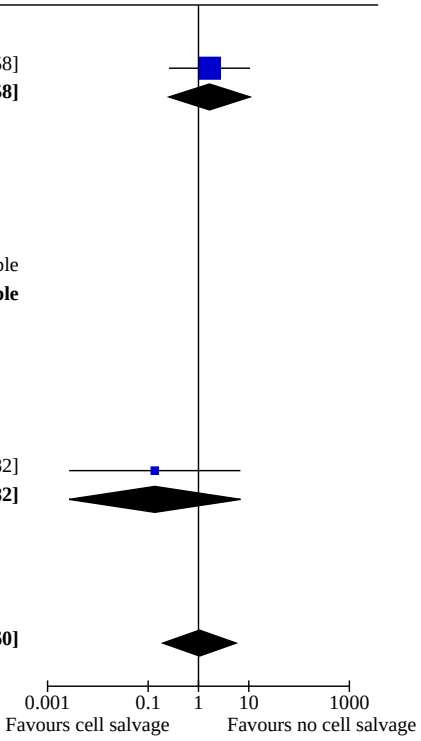
Analysis 12.10. Comparison 12: Orthopaedic (hip) (subgroup: timing), Outcome 10: Thrombosis (VTE)

Study or Subgroup	Cell salvage Events	Total	No cell salvage Events	Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
12.10.1 Postoperative						
Horstmann 2012	0	50	0	50		Not estimable
Luo 2016	3	49	2	47	100.0%	1.45 [0.24 , 8.72]
Subtotal (95% CI)		**99**		**97**	**100.0%**	**1.45 [0.24 , 8.72]**
Total events:	3		2			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.41 (P = 0.68)						
Total (95% CI)		**99**		**97**	**100.0%**	**1.45 [0.24 , 8.72]**
Total events:	3		2			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.41 (P = 0.68)						
Test for subgroup differences: Not applicable						



Analysis 12.11. Comparison 12: Orthopaedic (hip) (subgroup: timing), Outcome 11: DVT

Study or Subgroup	Cell salvage Events	Total	No cell salvage Events	Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
12.11.1 Intraoperative						
Elawad 1991	3	19	2	20	81.7%	1.66 [0.26 , 10.58]
Subtotal (95% CI)		**19**		**20**	**81.7%**	**1.66 [0.26 , 10.58]**
Total events:	3		2			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.53 (P = 0.59)						
12.11.2 Postoperative						
Horstmann 2012	0	50	0	50		Not estimable
Subtotal (95% CI)		**0**		**0**		**Not estimable**
Total events:	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Not applicable						
12.11.3 Intra- and postoperative						
Horstmann 2013	0	102	1	102	18.3%	0.14 [0.00 , 6.82]
Subtotal (95% CI)		**102**		**102**	**18.3%**	**0.14 [0.00 , 6.82]**
Total events:	0		1			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.00 (P = 0.32)						
Total (95% CI)		**171**		**172**	**100.0%**	**1.05 [0.20 , 5.60]**
Total events:	3		3			
Heterogeneity: Chi² = 1.28, df = 1 (P = 0.26); I² = 22%						
Test for overall effect: Z = 0.05 (P = 0.96)						
Test for subgroup differences: Chi² = 1.28, df = 1 (P = 0.26), I² = 22.0%						



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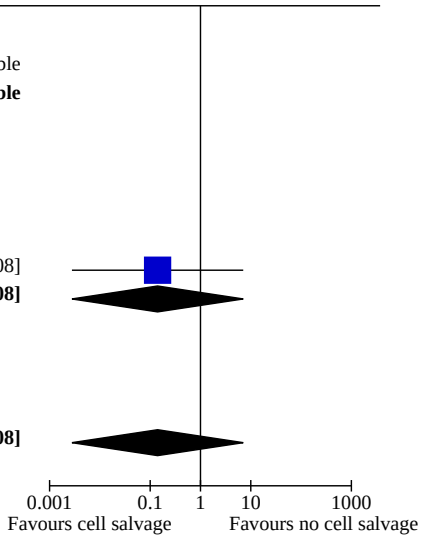
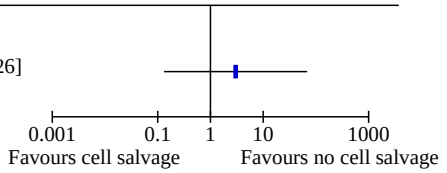
Analysis 12.12. Comparison 12: Orthopaedic (hip) (subgroup: timing), Outcome 12: PE

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
12.12.1 Postoperative						
Horstmann 2012	0	50	0	50		Not estimable
Subtotal (95% CI)		**0**		**0**		**Not estimable**
Total events:	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Not applicable						
12.12.2 Intra- and postoperative						
Thomassen 2011	0	106	1	110	100.0%	0.14 [0.00 , 7.08]
Subtotal (95% CI)		**106**		**110**	**100.0%**	**0.14 [0.00 , 7.08]**
Total events:	0		1			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.98 (P = 0.33)						
Total (95% CI)		**156**		**160**	**100.0%**	**0.14 [0.00 , 7.08]**
Total events:	0		1			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.98 (P = 0.33)						
Test for subgroup differences: Not applicable						



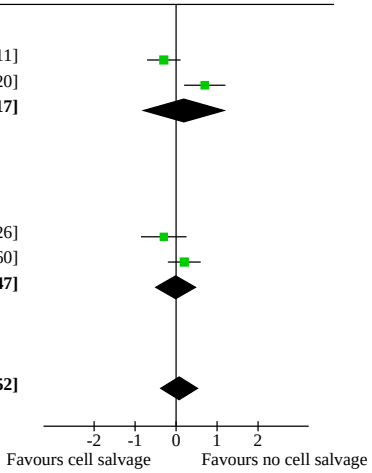
Analysis 12.13. Comparison 12: Orthopaedic (hip) (subgroup: timing), Outcome 13: CVA (stroke)

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Risk Ratio M-H, Random, 95% CI
12.13.1 Intraoperative					
Ekback 1995	1	15	0	15	3.00 [0.13 , 68.26]



Analysis 12.14. Comparison 12: Orthopaedic (hip) (subgroup: timing), Outcome 14: Hospital LOS (days)

Study or Subgroup	Cell salvage Mean	Cell salvage SD	Cell salvage Total	No cell salvage Mean	No cell salvage SD	No cell salvage Total	Weight	Mean Difference IV, Random, 95% CI
12.14.1 Postoperative								
Horstmann 2012	4.3	0.7	50	4.6	1.3	50	26.7%	-0.30 [-0.71 , 0.11]
Kleinert 2012	6.7	1.4	40	6	1.1627	80	23.9%	0.70 [0.20 , 1.20]
Subtotal (95% CI)			**90**			**130**	**50.6%**	**0.19 [-0.79 , 1.17]**
Heterogeneity: Tau² = 0.45; Chi² = 9.13, df = 1 (P = 0.003); I² = 89%								
Test for overall effect: Z = 0.38 (P = 0.71)								
12.14.2 Intra- and postoperative								
Horstmann 2013	4.8	1.7	102	5.1	2.3	102	22.5%	-0.30 [-0.86 , 0.26]
Horstmann 2014a	4.5	1.2	56	4.3	1	62	26.9%	0.20 [-0.20 , 0.60]
Subtotal (95% CI)			**158**			**164**	**49.4%**	**-0.01 [-0.50 , 0.47]**
Heterogeneity: Tau² = 0.06; Chi² = 2.05, df = 1 (P = 0.15); I² = 51%								
Test for overall effect: Z = 0.05 (P = 0.96)								
Total (95% CI)			**248**			**294**	**100.0%**	**0.07 [-0.37 , 0.52]**
Heterogeneity: Tau² = 0.15; Chi² = 11.27, df = 3 (P = 0.01); I² = 73%								
Test for overall effect: Z = 0.32 (P = 0.75)								
Test for subgroup differences: Chi² = 0.13, df = 1 (P = 0.72), I² = 0%								



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Comparison 13. Orthopaedic (hip) (subgroup: transfusion threshold)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
13.1 Transfusions	14	1641	Risk Ratio (M-H, Random, 95% CI)	0.52 [0.38, 0.72]
13.1.1 Restrictive (Hb ≦ 80 g/L)	6	900	Risk Ratio (M-H, Random, 95% CI)	0.38 [0.28, 0.51]
13.1.2 Liberal (Hb > 80 g/L)	4	156	Risk Ratio (M-H, Random, 95% CI)	0.50 [0.28, 0.90]
13.1.3 No threshold/protocol reported	4	585	Risk Ratio (M-H, Random, 95% CI)	0.76 [0.37, 1.57]
13.2 Volume of transfusion (units) (PPR)	5	433	Mean Difference (IV, Random, 95% CI)	-0.61 [-1.04, -0.19]
13.2.1 Restrictive (Hb ≦ 80 g/L)	2	304	Mean Difference (IV, Random, 95% CI)	-0.09 [-0.20, 0.02]
13.2.2 Liberal (Hb > 80 g/L)	3	129	Mean Difference (IV, Random, 95% CI)	-1.29 [-1.69, -0.90]
13.3 Volume of transfusion (units) (PPT)	4	63	Mean Difference (IV, Random, 95% CI)	-1.74 [-2.92, -0.55]
13.3.1 Restrictive (Hb ≦ 80 g/L)	2	0	Mean Difference (IV, Random, 95% CI)	Not estimable
13.3.2 Liberal (Hb > 80 g/L)	2	44	Mean Difference (IV, Random, 95% CI)	-1.74 [-2.92, -0.55]
13.4 Mortality	4	651	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.46 [0.06, 3.33]
13.4.1 Restrictive (Hb ≦ 80 g/L)	1	118	Peto Odds Ratio (Peto, Fixed, 95% CI)	8.22 [0.16, 416.61]
13.4.2 Liberal (Hb > 80 g/L)	1	216	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.14 [0.00, 7.08]
13.4.3 No threshold/protocol reported	2	317	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.19 [0.01, 3.20]
13.5 Blood loss (mL)	10	1085	Mean Difference (IV, Random, 95% CI)	-78.13 [-162.74, 6.48]
13.5.1 Restrictive (Hb ≦ 80 g/L)	4	622	Mean Difference (IV, Random, 95% CI)	-115.60 [-240.14, 8.95]
13.5.2 Liberal (Hb > 80 g/L)	5	372	Mean Difference (IV, Random, 95% CI)	-86.79 [-354.95, 181.36]
13.5.3 No threshold/protocol reported	1	91	Mean Difference (IV, Random, 95% CI)	3.00 [-86.67, 92.67]

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Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
13.6 Reoperation for bleeding	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
13.6.1 No threshold/protocol reported	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
13.7 Infection	4	549	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.72 [0.17, 2.98]
13.7.1 Restrictive (Hb ≦ 80 g/L)	1	0	Peto Odds Ratio (Peto, Fixed, 95% CI)	Not estimable
13.7.2 No threshold/protocol reported	3	429	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.72 [0.17, 2.98]
13.8 Wound complication	4	609	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.94 [0.36, 2.45]
13.8.1 Restrictive (Hb ≦ 80 g/L)	2	278	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.80 [0.22, 2.89]
13.8.2 Liberal (Hb > 80 g/L)	1	216	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.53 [0.05, 5.15]
13.8.3 No threshold/protocol reported	1	115	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.94 [0.30, 12.58]
13.9 Prosthetic joint infection (PJI)	5	806	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.31 [0.05, 1.78]
13.9.1 Restrictive (Hb ≦ 80 g/L)	2	322	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.37 [0.05, 2.68]
13.9.2 Liberal (Hb > 80 g/L)	1	216	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.14 [0.00, 7.08]
13.9.3 No threshold/protocol reported	2	0	Peto Odds Ratio (Peto, Fixed, 95% CI)	Not estimable
13.10 Thrombosis (VTE)	2	196	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.45 [0.24, 8.72]
13.10.1 Restrictive (Hb ≦ 80 g/L)	1	0	Peto Odds Ratio (Peto, Fixed, 95% CI)	Not estimable
13.10.2 No threshold/protocol reported	1	96	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.45 [0.24, 8.72]
13.11 DVT	3	343	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.05 [0.20, 5.60]
13.11.1 Restrictive (Hb ≦ 80 g/L)	2	304	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.14 [0.00, 6.82]

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Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
13.11.2 Liberal (Hb > 80 g/L)	1	39	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.66 [0.26, 10.58]
13.12 PE	2	316	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.14 [0.00, 7.08]
13.12.1 Restrictive (Hb ≦ 80 g/L)	1	0	Peto Odds Ratio (Peto, Fixed, 95% CI)	Not estimable
13.12.2 Liberal (Hb > 80 g/L)	1	216	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.14 [0.00, 7.08]
13.13 CVA (stroke)	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
13.13.1 Liberal (Hb > 80 g/L)	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
13.14 Hospital LOS (days)	4	542	Mean Difference (IV, Random, 95% CI)	0.07 [-0.37, 0.52]
13.14.1 Restrictive (Hb ≦ 80 g/L)	4	542	Mean Difference (IV, Random, 95% CI)	0.07 [-0.37, 0.52]

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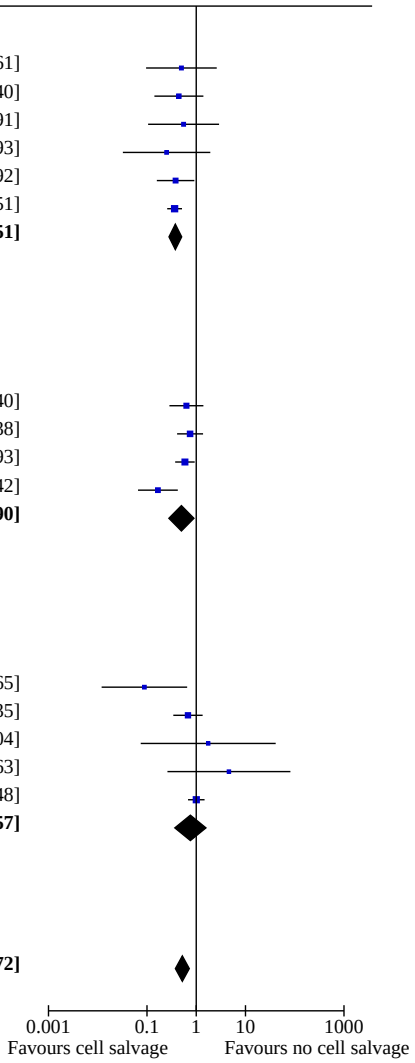
Analysis 13.1. Comparison 13: Orthopaedic (hip) (subgroup: transfusion threshold), Outcome 1: Transfusions

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Risk Ratio M-H, Random, 95% CI
13.1.1 Restrictive (Hb # 80 g/L)						
Horstmann 2012	2	50	4	50	3.1%	0.50 [0.10 , 2.61]
Horstmann 2013	4	102	9	102	5.4%	0.44 [0.14 , 1.40]
Horstmann 2014a	2	56	4	62	3.1%	0.55 [0.11 , 2.91]
Kleinert 2012	1	40	8	80	2.2%	0.25 [0.03 , 1.93]
Smith 2007	6	76	17	82	7.4%	0.38 [0.16 , 0.92]
Zhao 2016	31	127	49	73	13.8%	0.36 [0.26 , 0.51]
Subtotal (95% CI)		**451**		**449**	**35.0%**	**0.38 [0.28 , 0.51]**
Total events:	46		91			
Heterogeneity: Tau² = 0.00; Chi² = 0.60, df = 5 (P = 0.99); I² = 0%						
Test for overall effect: Z = 6.47 (P < 0.00001)						
13.1.2 Liberal (Hb > 80 g/L)						
Elawad 1991	6	19	10	20	8.2%	0.63 [0.29 , 1.40]
Lorentz 1991	8	16	10	15	10.4%	0.75 [0.41 , 1.38]
Menges 1992	8	14	12	12	12.3%	0.59 [0.37 , 0.93]
Tripkovic 2008	4	30	24	30	7.0%	0.17 [0.07 , 0.42]
Subtotal (95% CI)		**79**		**77**	**37.9%**	**0.50 [0.28 , 0.90]**
Total events:	26		56			
Heterogeneity: Tau² = 0.23; Chi² = 9.20, df = 3 (P = 0.03); I² = 67%						
Test for overall effect: Z = 2.32 (P = 0.02)						
13.1.3 No threshold/protocol reported						
Ayers 1995	1	67	15	89	2.3%	0.09 [0.01 , 0.65]
Cheung 2010	9	53	25	100	9.4%	0.68 [0.34 , 1.35]
Rollo 1995 (1)	1	35	0	20	1.0%	1.75 [0.07 , 41.04]
Rollo 1995 (2)	4	40	0	20	1.2%	4.61 [0.26 , 81.63]
Teetzman 2014	29	74	34	87	13.2%	1.00 [0.68 , 1.48]
Subtotal (95% CI)		**269**		**316**	**27.1%**	**0.76 [0.37 , 1.57]**
Total events:	44		74			
Heterogeneity: Tau² = 0.27; Chi² = 8.15, df = 4 (P = 0.09); I² = 51%						
Test for overall effect: Z = 0.74 (P = 0.46)						
Total (95% CI)		**799**		**842**	**100.0%**	**0.52 [0.38 , 0.72]**
Total events:	116		221			
Heterogeneity: Tau² = 0.17; Chi² = 30.66, df = 14 (P = 0.006); I² = 54%						
Test for overall effect: Z = 3.93 (P < 0.0001)						
Test for subgroup differences: Chi² = 3.40, df = 2 (P = 0.18), I² = 41.1%						



Footnotes

(1) both intra & post-op collection

(2) post-op collection only

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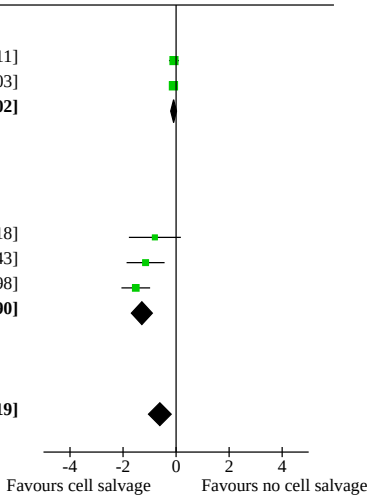
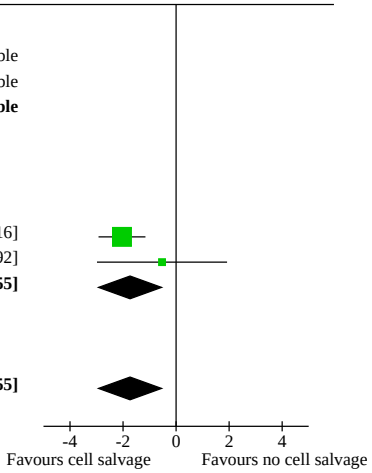
Analysis 13.2. Comparison 13: Orthopaedic (hip) (subgroup: transfusion threshold), Outcome 2: Volume of transfusion (units) (PPR)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
13.2.1 Restrictive (Hb # 80 g/L)								
Horstmann 2012	0.08	0.4	50	0.16	0.55	50	26.5%	-0.08 [-0.27 , 0.11]
Horstmann 2013	0.08	0.39	102	0.18	0.57	102	27.2%	-0.10 [-0.23 , 0.03]
Subtotal (95% CI)			**152**			**152**	**53.7%**	**-0.09 [-0.20 , 0.02]**
Heterogeneity: Tau² = 0.00; Chi² = 0.03, df = 1 (P = 0.87); I² = 0%								
Test for overall effect: Z = 1.67 (P = 0.09)								
13.2.2 Liberal (Hb > 80 g/L)								
Ekback 1995	1.9	1.55	15	2.7	1.16	15	11.3%	-0.80 [-1.78 , 0.18]
Elawad 1991	0.22	0.56	19	1.37	1.53	20	15.7%	-1.15 [-1.87 , -0.43]
Tripkovic 2008	0.22	0.98	30	1.74	1.15	30	19.3%	-1.52 [-2.06 , -0.98]
Subtotal (95% CI)			**64**			**65**	**46.3%**	**-1.29 [-1.69 , -0.90]**
Heterogeneity: Tau² = 0.00; Chi² = 1.80, df = 2 (P = 0.41); I² = 0%								
Test for overall effect: Z = 6.40 (P < 0.00001)								
Total (95% CI)			**216**			**217**	**100.0%**	**-0.61 [-1.04 , -0.19]**
Heterogeneity: Tau² = 0.17; Chi² = 34.63, df = 4 (P < 0.00001); I² = 88%								
Test for overall effect: Z = 2.81 (P = 0.005)								
Test for subgroup differences: Chi² = 32.80, df = 1 (P < 0.00001), I² = 97.0%								



Analysis 13.3. Comparison 13: Orthopaedic (hip) (subgroup: transfusion threshold), Outcome 3: Volume of transfusion (units) (PPT)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
13.3.1 Restrictive (Hb # 80 g/L)								
Horstmann 2012	2	0	2	2	0	4		Not estimable
Horstmann 2013	2	0	4	2	0	9		Not estimable
Subtotal (95% CI)			**0**			**0**		**Not estimable**
Heterogeneity: Not applicable								
Test for overall effect: Not applicable								
13.3.2 Liberal (Hb > 80 g/L)								
Elawad 1991	0.69	0.87	6	2.73	0.88	10	79.9%	-2.04 [-2.92 , -1.16]
Tripkovic 2008	1.65	2.48	4	2.18	0.82	24	20.1%	-0.53 [-2.98 , 1.92]
Subtotal (95% CI)			**10**			**34**	**100.0%**	**-1.74 [-2.92 , -0.55]**
Heterogeneity: Tau² = 0.26; Chi² = 1.29, df = 1 (P = 0.26); I² = 22%								
Test for overall effect: Z = 2.87 (P = 0.004)								
Total (95% CI)			**16**			**47**	**100.0%**	**-1.74 [-2.92 , -0.55]**
Heterogeneity: Tau² = 0.26; Chi² = 1.29, df = 1 (P = 0.26); I² = 22%								
Test for overall effect: Z = 2.87 (P = 0.004)								
Test for subgroup differences: Not applicable								



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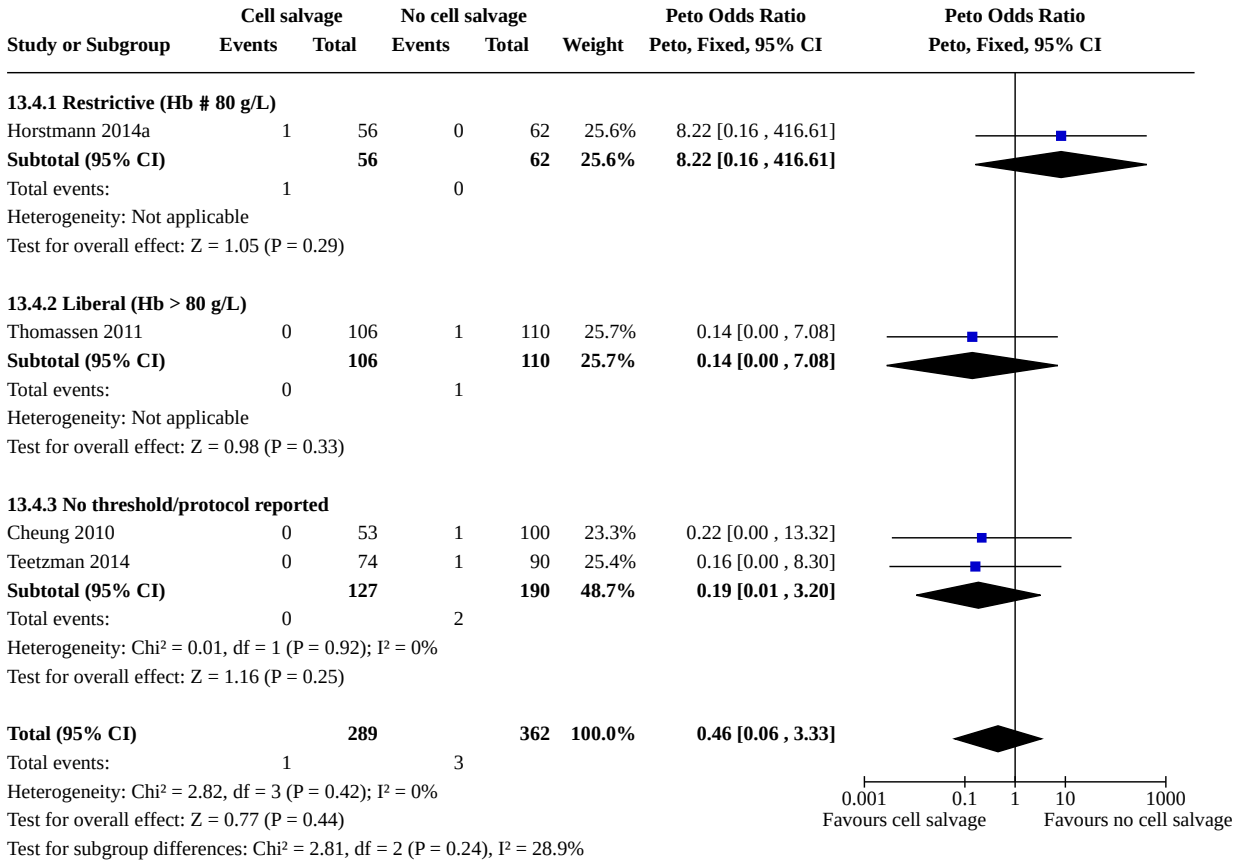
Analysis 13.4. Comparison 13: Orthopaedic (hip) (subgroup: transfusion threshold), Outcome 4: Mortality



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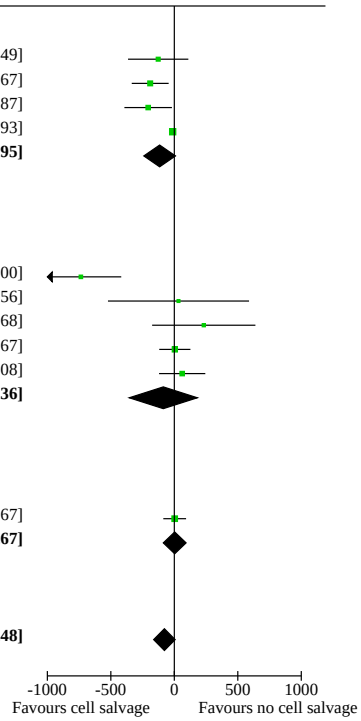
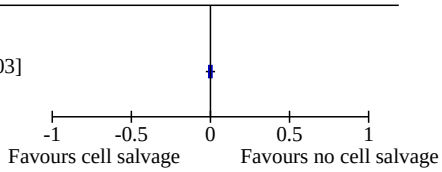
Analysis 13.5. Comparison 13: Orthopaedic (hip) (subgroup: transfusion threshold), Outcome 5: Blood loss (mL)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
13.5.1 Restrictive (Hb # 80 g/L)								
Horstmann 2012	1506	564	50	1633	645	50	7.7%	-127.00 [-364.49 , 110.49]
Horstmann 2013	1464	505	102	1654	553	102	12.3%	-190.00 [-335.33 , -44.67]
Horstmann 2014a	1472	531	56	1678	503	62	10.0%	-206.00 [-393.13 , -18.87]
Zhao 2016	312	48.53	127	325	53.67	73	19.3%	-13.00 [-27.93 , 1.93]
Subtotal (95% CI)			**335**			**287**	**49.3%**	**-115.60 [-240.14 , 8.95]**
Heterogeneity: Tau² = 10514.77; Chi² = 10.46, df = 3 (P = 0.02); I² = 71%								
Test for overall effect: Z = 1.82 (P = 0.07)								
13.5.2 Liberal (Hb > 80 g/L)								
Elawad 1991	1464	386	19	2200	608	20	5.2%	-736.00 [-1054.00 , -418.00]
Lorentz 1991	1753	783	16	1720	794	15	2.1%	33.00 [-522.56 , 588.56]
Menges 1992	2104	567	14	1872	491	12	3.5%	232.00 [-174.68 , 638.68]
Thomassen 2011	931	486	106	927	431	110	13.8%	4.00 [-118.67 , 126.67]
Tripkovic 2008	1434	374	30	1372	345	30	10.2%	62.00 [-120.08 , 244.08]
Subtotal (95% CI)			**185**			**187**	**34.8%**	**-86.79 [-354.95 , 181.36]**
Heterogeneity: Tau² = 67798.03; Chi² = 21.85, df = 4 (P = 0.0002); I² = 82%								
Test for overall effect: Z = 0.63 (P = 0.53)								
13.5.3 No threshold/protocol reported								
Luo 2016	691	225.22	49	688	210.79	42	15.9%	3.00 [-86.67 , 92.67]
Subtotal (95% CI)			**49**			**42**	**15.9%**	**3.00 [-86.67 , 92.67]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.07 (P = 0.95)								
Total (95% CI)			**569**			**516**	**100.0%**	**-78.13 [-162.74 , 6.48]**
Heterogeneity: Tau² = 9603.08; Chi² = 32.59, df = 9 (P = 0.0002); I² = 72%								
Test for overall effect: Z = 1.81 (P = 0.07)								
Test for subgroup differences: Chi² = 2.42, df = 2 (P = 0.30), I² = 17.2%								



Analysis 13.6. Comparison 13: Orthopaedic (hip) (subgroup: transfusion threshold), Outcome 6: Reoperation for bleeding

Study or Subgroup	Cell salvage Events	Total	No cell salvage Events	Total	Risk Difference M-H, Random, 95% CI
13.6.1 No threshold/protocol reported					
Cheung 2010	0	53	0	100	0.00 [-0.03 , 0.03]



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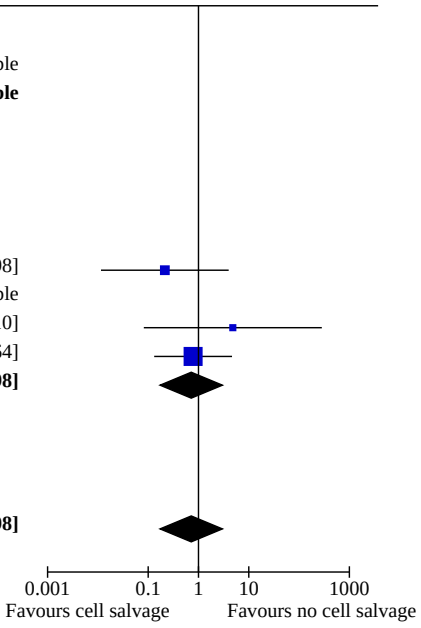
Analysis 13.7. Comparison 13: Orthopaedic (hip) (subgroup: transfusion threshold), Outcome 7: Infection

Study or Subgroup	Cell salvage Events	Total	No cell salvage Events	Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
13.7.1 Restrictive (Hb # 80 g/L)						
Kleinert 2012	0	40	0	80		Not estimable
Subtotal (95% CI)		**0**		**0**		**Not estimable**
Total events:	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Not applicable						
13.7.2 No threshold/protocol reported						
Cheung 2010	0	53	2	100	23.8%	0.21 [0.01 , 3.98]
Rollo 1995 (1)	0	40	0	20		Not estimable
Rollo 1995 (2)	1	35	0	20	12.2%	4.81 [0.08 , 283.10]
Teetzman 2014	2	74	3	87	64.0%	0.78 [0.13 , 4.64]
Subtotal (95% CI)		**202**		**227**	**100.0%**	**0.72 [0.17 , 2.98]**
Total events:	3		5			
Heterogeneity: Chi² = 1.50, df = 2 (P = 0.47); I² = 0%						
Test for overall effect: Z = 0.46 (P = 0.65)						
Total (95% CI)		**242**		**307**	**100.0%**	**0.72 [0.17 , 2.98]**
Total events:	3		5			
Heterogeneity: Chi² = 1.50, df = 2 (P = 0.47); I² = 0%						
Test for overall effect: Z = 0.46 (P = 0.65)						
Test for subgroup differences: Not applicable						



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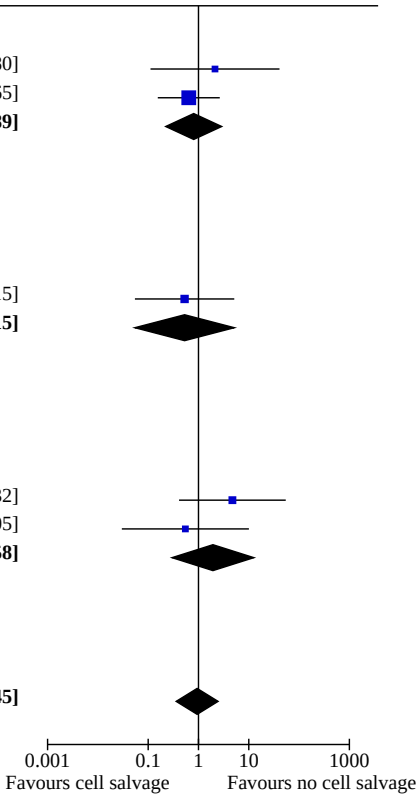
Analysis 13.8. Comparison 13: Orthopaedic (hip) (subgroup: transfusion threshold), Outcome 8: Wound complication

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
13.8.1 Restrictive (Hb # 80 g/L)						
Kleinert 2012	1	40	1	80	10.5%	2.13 [0.11 , 40.80]
Smith 2007	3	76	5	82	45.5%	0.64 [0.16 , 2.65]
Subtotal (95% CI)		**116**		**162**	**56.1%**	**0.80 [0.22 , 2.89]**
Total events:	4		6			
Heterogeneity: Chi² = 0.52, df = 1 (P = 0.47); I² = 0%						
Test for overall effect: Z = 0.34 (P = 0.74)						
13.8.2 Liberal (Hb > 80 g/L)						
Thomassen 2011	1	106	2	110	17.7%	0.53 [0.05 , 5.15]
Subtotal (95% CI)		**106**		**110**	**17.7%**	**0.53 [0.05 , 5.15]**
Total events:	1		2			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.55 (P = 0.58)						
13.8.3 No threshold/protocol reported						
Rollo 1995 (1)	3	40	0	20	15.4%	4.72 [0.41 , 54.32]
Rollo 1995 (2)	1	35	1	20	10.8%	0.55 [0.03 , 10.05]
Subtotal (95% CI)		**75**		**40**	**26.2%**	**1.94 [0.30 , 12.58]**
Total events:	4		1			
Heterogeneity: Chi² = 1.23, df = 1 (P = 0.27); I² = 19%						
Test for overall effect: Z = 0.69 (P = 0.49)						
Total (95% CI)		**297**		**312**	**100.0%**	**0.94 [0.36 , 2.45]**
Total events:	9		9			
Heterogeneity: Chi² = 2.63, df = 4 (P = 0.62); I² = 0%						
Test for overall effect: Z = 0.13 (P = 0.90)						
Test for subgroup differences: Chi² = 0.88, df = 2 (P = 0.64), I² = 0%						



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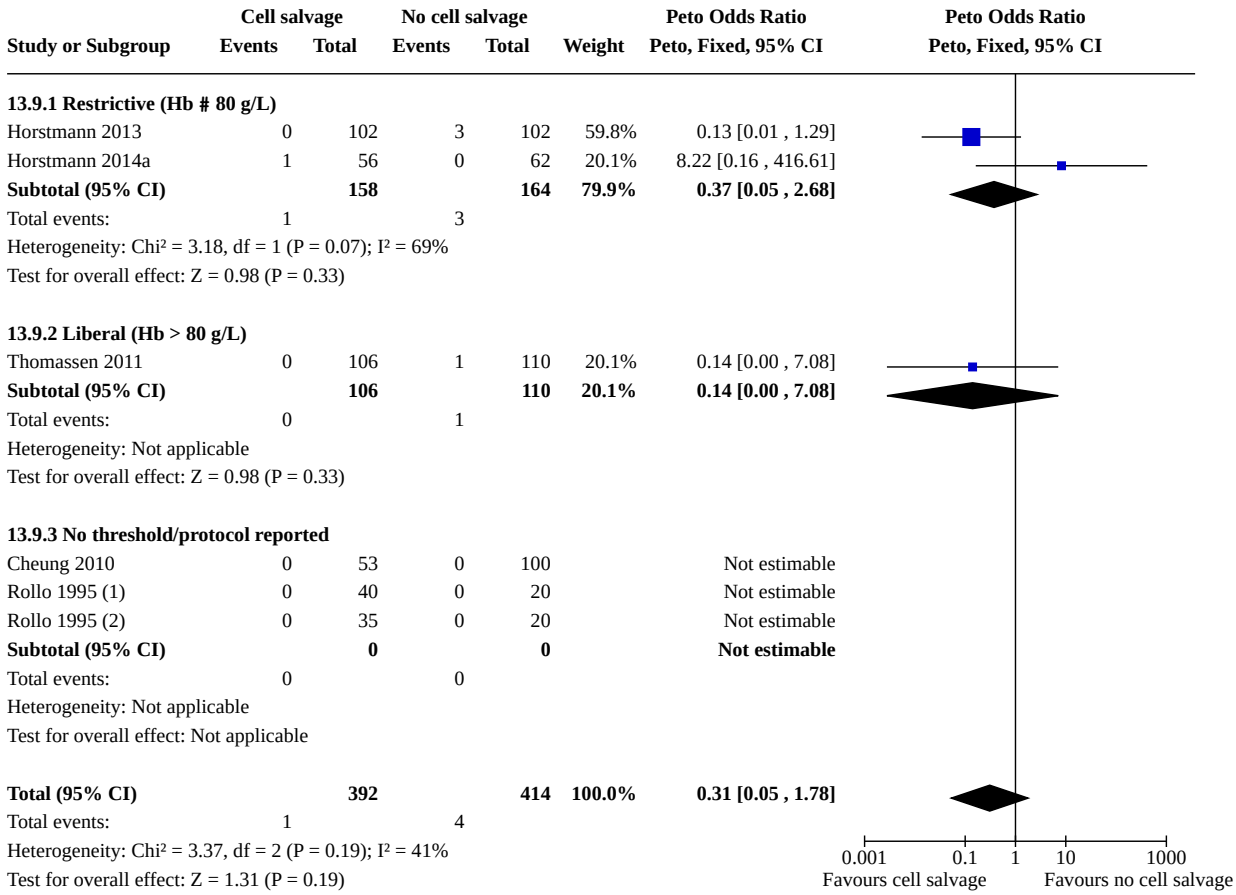
Analysis 13.9. Comparison 13: Orthopaedic (hip) (subgroup: transfusion threshold), Outcome 9: Prosthetic joint infection (PJI)



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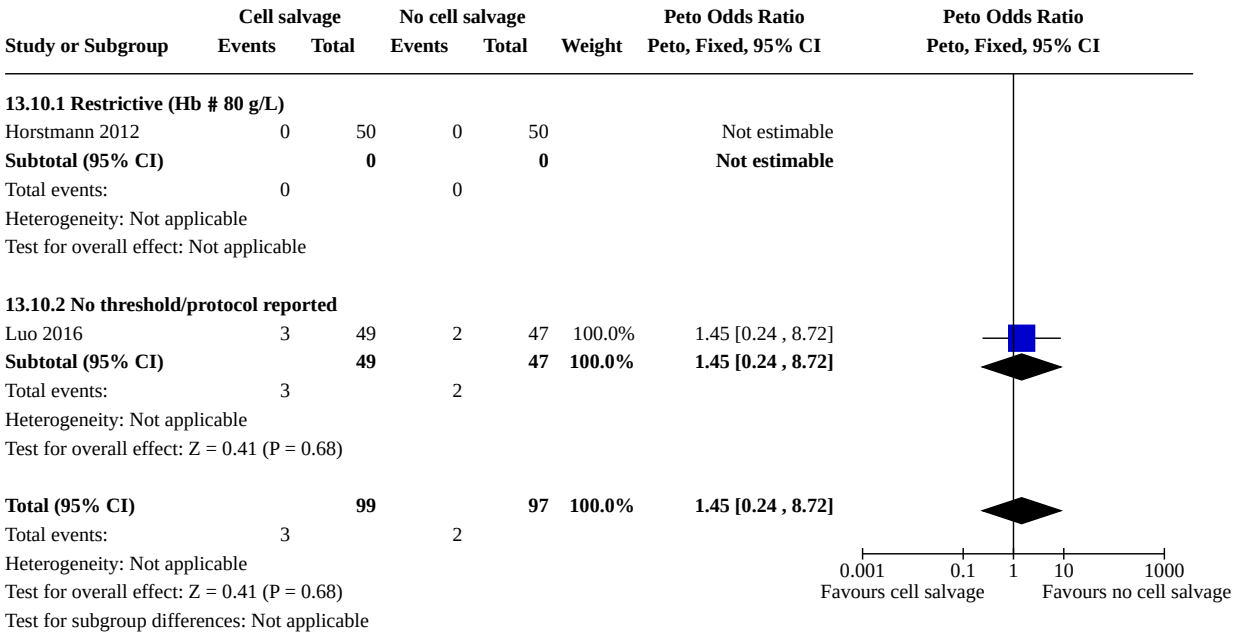
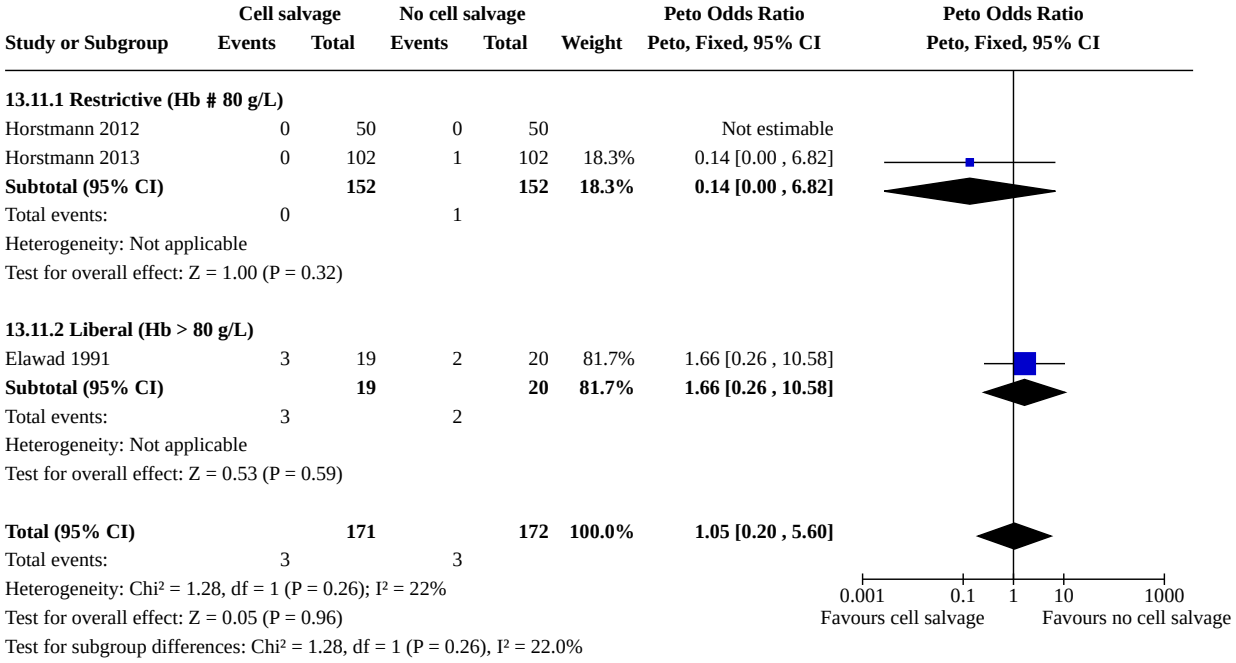
Analysis 13.10. Comparison 13: Orthopaedic (hip) (subgroup: transfusion threshold), Outcome 10: Thrombosis (VTE)



Analysis 13.11. Comparison 13: Orthopaedic (hip) (subgroup: transfusion threshold), Outcome 11: DVT



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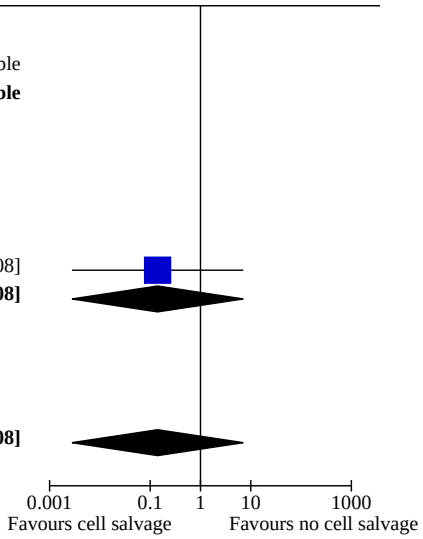
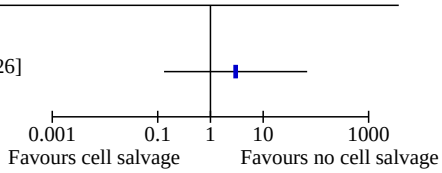
Analysis 13.12. Comparison 13: Orthopaedic (hip) (subgroup: transfusion threshold), Outcome 12: PE

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
13.12.1 Restrictive (Hb # 80 g/L)						
Horstmann 2012	0	50	0	50		Not estimable
Subtotal (95% CI)		**0**		**0**		**Not estimable**
Total events:	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Not applicable						
13.12.2 Liberal (Hb > 80 g/L)						
Thomassen 2011	0	106	1	110	100.0%	0.14 [0.00 , 7.08]
Subtotal (95% CI)		**106**		**110**	**100.0%**	**0.14 [0.00 , 7.08]**
Total events:	0		1			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.98 (P = 0.33)						
Total (95% CI)		**156**		**160**	**100.0%**	**0.14 [0.00 , 7.08]**
Total events:	0		1			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.98 (P = 0.33)						
Test for subgroup differences: Not applicable						



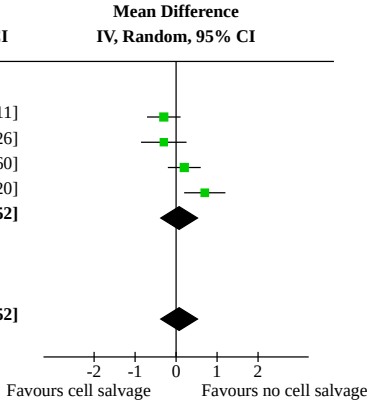
Analysis 13.13. Comparison 13: Orthopaedic (hip) (subgroup: transfusion threshold), Outcome 13: CVA (stroke)

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Risk Ratio M-H, Random, 95% CI
13.13.1 Liberal (Hb > 80 g/L)					
Ekback 1995	1	15	0	15	3.00 [0.13 , 68.26]



Analysis 13.14. Comparison 13: Orthopaedic (hip) (subgroup: transfusion threshold), Outcome 14: Hospital LOS (days)

Study or Subgroup	Cell salvage Mean	Cell salvage SD	Cell salvage Total	No cell salvage Mean	No cell salvage SD	No cell salvage Total	Weight	Mean Difference IV, Random, 95% CI
13.14.1 Restrictive (Hb # 80 g/L)								
Horstmann 2012	4.3	0.7	50	4.6	1.3	50	26.7%	-0.30 [-0.71 , 0.11]
Horstmann 2013	4.8	1.7	102	5.1	2.3	102	22.5%	-0.30 [-0.86 , 0.26]
Horstmann 2014a	4.5	1.2	56	4.3	1	62	26.9%	0.20 [-0.20 , 0.60]
Kleinert 2012	6.7	1.4	40	6	1.1627	80	23.9%	0.70 [0.20 , 1.20]
Subtotal (95% CI)			**248**			**294**	**100.0%**	**0.07 [-0.37 , 0.52]**
Heterogeneity: Tau² = 0.15; Chi² = 11.27, df = 3 (P = 0.01); I² = 73%								
Test for overall effect: Z = 0.32 (P = 0.75)								
Total (95% CI)			**248**			**294**	**100.0%**	**0.07 [-0.37 , 0.52]**
Heterogeneity: Tau² = 0.15; Chi² = 11.27, df = 3 (P = 0.01); I² = 73%								
Test for overall effect: Z = 0.32 (P = 0.75)								
Test for subgroup differences: Not applicable								



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Comparison 14. Orthopaedic (knee) (subgroup: timing)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
14.1 Transfusions	21	2214	Risk Ratio (M-H, Random, 95% CI)	0.49 [0.37, 0.66]
14.1.1 Postoperative	20	1939	Risk Ratio (M-H, Random, 95% CI)	0.45 [0.32, 0.63]
14.1.2 Intra- and postoperative	2	275	Risk Ratio (M-H, Random, 95% CI)	0.82 [0.67, 1.01]
14.2 Volume of transfusion (units) (PPR)	5	563	Mean Difference (IV, Random, 95% CI)	-0.87 [-1.09, -0.64]
14.2.1 Postoperative	5	428	Mean Difference (IV, Random, 95% CI)	-0.84 [-1.13, -0.55]
14.2.2 Intra- and postoperative	1	135	Mean Difference (IV, Random, 95% CI)	-0.93 [-1.29, -0.57]
14.3 Volume of transfusion (units) (PPT)	3	221	Mean Difference (IV, Random, 95% CI)	-0.54 [-0.90, -0.19]
14.3.1 Postoperative	3	130	Mean Difference (IV, Random, 95% CI)	-0.37 [-0.81, 0.07]
14.3.2 Intra- and postoperative	1	91	Mean Difference (IV, Random, 95% CI)	-0.89 [-1.16, -0.62]
14.4 Blood loss (ml)	9	629	Mean Difference (IV, Random, 95% CI)	-79.01 [-170.27, 12.24]
14.4.1 Postoperative	9	629	Mean Difference (IV, Random, 95% CI)	-79.01 [-170.27, 12.24]
14.5 Reoperation for bleeding	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
14.5.1 Postoperative	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
14.6 Infection	5	730	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.74 [0.28, 1.94]
14.6.1 Postoperative	5	595	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.86 [0.29, 2.52]
14.6.2 Intra- and postoperative	1	135	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.43 [0.05, 3.57]
14.7 Wound complication	6	734	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.42 [0.61, 3.31]
14.7.1 Postoperative	6	734	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.42 [0.61, 3.31]
14.8 Prosthetic joint infection (PJI)	4	663	Risk Difference (M-H, Random, 95% CI)	0.00 [-0.01, 0.01]
14.8.1 Postoperative	4	528	Risk Difference (M-H, Random, 95% CI)	0.00 [-0.01, 0.01]
14.8.2 Intra- and postoperative	1	135	Risk Difference (M-H, Random, 95% CI)	0.00 [-0.03, 0.03]

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Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
14.9 DVT	9	793	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.29 [0.56, 2.95]
14.9.1 Postoperative	9	793	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.29 [0.56, 2.95]
14.10 PE	6	574	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.51 [0.10, 2.52]
14.10.1 Postoperative	6	574	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.51 [0.10, 2.52]
14.11 MACE	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
14.11.1 Postoperative	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
14.12 MI	1		Peto Odds Ratio (Peto, Fixed, 95% CI)	Totals not selected
14.12.1 Postoperative	1		Peto Odds Ratio (Peto, Fixed, 95% CI)	Totals not selected
14.13 CVA (stroke)	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
14.13.1 Postoperative	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
14.14 Hospital LOS (days)	4	255	Mean Difference (IV, Random, 95% CI)	-0.79 [-2.30, 0.72]
14.14.1 Postoperative	4	255	Mean Difference (IV, Random, 95% CI)	-0.79 [-2.30, 0.72]

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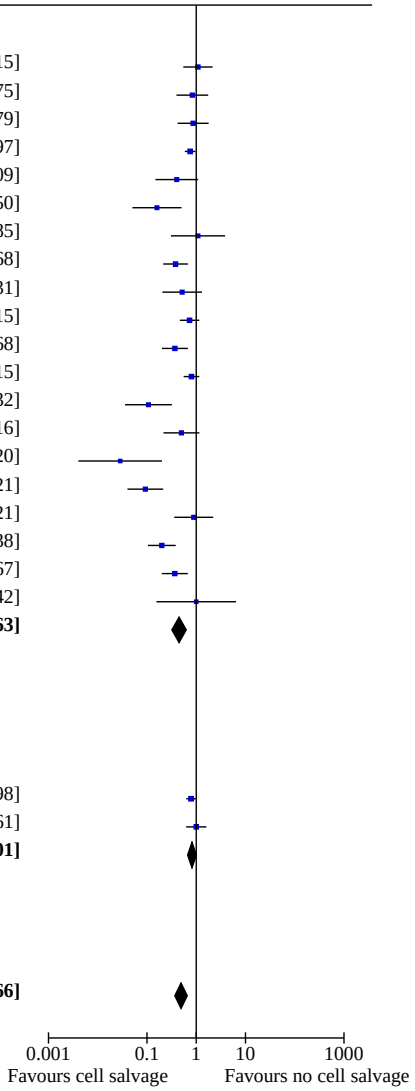
Analysis 14.1. Comparison 14: Orthopaedic (knee) (subgroup: timing), Outcome 1: Transfusions

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Risk Ratio M-H, Random, 95% CI
14.1.1 Postoperative						
Abuzakuk 2007	13	52	12	52	4.9%	1.08 [0.55 , 2.15]
Adalberth 1998	8	24	10	25	4.7%	0.83 [0.40 , 1.75]
Amin 2008	12	92	13	86	4.8%	0.86 [0.42 , 1.79]
Blatsoukas 2010	42	71	33	42	6.5%	0.75 [0.59 , 0.97]
Cheng 2005	4	26	13	34	3.8%	0.40 [0.15 , 1.09]
Dramis 2006	3	32	10	17	3.3%	0.16 [0.05 , 0.50]
Dutton 2012	4	23	4	25	3.0%	1.09 [0.31 , 3.85]
Heddle 1992	10	39	27	40	5.4%	0.38 [0.21 , 0.68]
Horstmann 2014b	6	59	11	56	4.0%	0.52 [0.21 , 1.31]
Laszczyca 2015	15	38	34	63	5.8%	0.73 [0.46 , 1.15]
Majkowski 1991	7	20	19	20	5.3%	0.37 [0.20 , 0.68]
Munteanu 2009	24	50	30	50	6.2%	0.80 [0.55 , 1.15]
Newman 1997	3	35	28	35	3.5%	0.11 [0.04 , 0.32]
Rosencher 1994	6	20	6	10	4.3%	0.50 [0.22 , 1.16]
Sait 1999	1	60	35	60	1.7%	0.03 [0.00 , 0.20]
Šarkanoviü 2013	5	55	56	57	4.4%	0.09 [0.04 , 0.21]
Schnurr 2018	8	100	9	100	4.1%	0.89 [0.36 , 2.21]
Shenolikar 1997	8	50	40	50	5.1%	0.20 [0.10 , 0.38]
Thomas 2001	12	115	33	116	5.2%	0.37 [0.20 , 0.67]
Touzopoulos 2021	2	20	2	20	1.8%	1.00 [0.16 , 6.42]
Subtotal (95% CI)		**981**		**958**	**87.7%**	**0.45 [0.32 , 0.63]**
Total events:	193		425			
Heterogeneity: Tau² = 0.40; Chi² = 90.28, df = 19 (P < 0.00001); I² = 79%						
Test for overall effect: Z = 4.71 (P < 0.00001)						
14.1.2 Intra- and postoperative						
Blatsoukas 2010	57	92	34	43	6.6%	0.78 [0.63 , 0.98]
Cip 2013	23	70	23	70	5.8%	1.00 [0.62 , 1.61]
Subtotal (95% CI)		**162**		**113**	**12.3%**	**0.82 [0.67 , 1.01]**
Total events:	80		57			
Heterogeneity: Tau² = 0.00; Chi² = 1.02, df = 1 (P = 0.31); I² = 2%						
Test for overall effect: Z = 1.90 (P = 0.06)						
Total (95% CI)		**1143**		**1071**	**100.0%**	**0.49 [0.37 , 0.66]**
Total events:	273		482			
Heterogeneity: Tau² = 0.32; Chi² = 104.98, df = 21 (P < 0.00001); I² = 80%						
Test for overall effect: Z = 4.81 (P < 0.00001)						
Test for subgroup differences: Chi² = 9.13, df = 1 (P = 0.003), I² = 89.1%						



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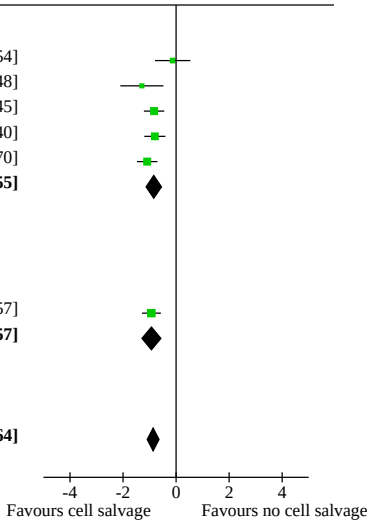
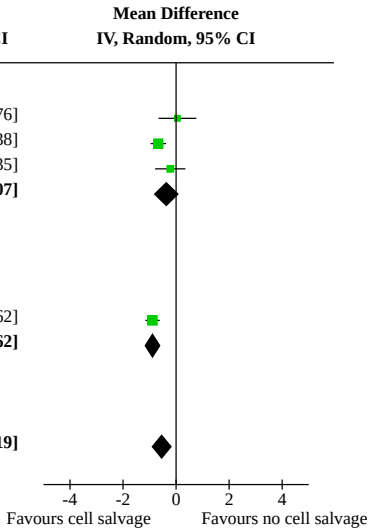
Analysis 14.2. Comparison 14: Orthopaedic (knee) (subgroup: timing), Outcome 2: Volume of transfusion (units) (PPR)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
14.2.1 Postoperative								
Adalberth 1998	0.75	1.11	24	0.88	1.27	25	9.2%	-0.13 [-0.80 , 0.54]
Altinel 2007	1	1.12	16	2.29	1.22	16	6.6%	-1.29 [-2.10 , -0.48]
Blatsoukas 2010	0.91	0.96	71	1.74	1.03	42	20.9%	-0.83 [-1.21 , -0.45]
Heddle 1992	0.4	0.8	39	1.2	1	40	19.8%	-0.80 [-1.20 , -0.40]
Kirkos 2006	0.54	0.86	78	1.63	1.5	77	20.7%	-1.09 [-1.48 , -0.70]
Subtotal (95% CI)			**228**			**200**	**77.2%**	**-0.84 [-1.13 , -0.55]**
Heterogeneity: Tau² = 0.05; Chi² = 7.16, df = 4 (P = 0.13); I² = 44%								
Test for overall effect: Z = 5.69 (P < 0.00001)								
14.2.2 Intra- and postoperative								
Blatsoukas 2010	0.81	0.88	92	1.74	1.03	43	22.8%	-0.93 [-1.29 , -0.57]
Subtotal (95% CI)			**92**			**43**	**22.8%**	**-0.93 [-1.29 , -0.57]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 5.11 (P < 0.00001)								
Total (95% CI)			**320**			**243**	**100.0%**	**-0.87 [-1.09 , -0.64]**
Heterogeneity: Tau² = 0.02; Chi² = 7.27, df = 5 (P = 0.20); I² = 31%								
Test for overall effect: Z = 7.63 (P < 0.00001)								
Test for subgroup differences: Chi² = 0.14, df = 1 (P = 0.70), I² = 0%								



Analysis 14.3. Comparison 14: Orthopaedic (knee) (subgroup: timing), Outcome 3: Volume of transfusion (units) (PPT)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
14.3.1 Postoperative								
Adalberth 1998	2.25	0.46	8	2.2	1.03	10	15.2%	0.05 [-0.66 , 0.76]
Blatsoukas 2010	1.54	0.76	42	2.21	0.52	33	32.1%	-0.67 [-0.96 , -0.38]
Heddle 1992	1.56	0.83	10	1.78	0.66	27	19.7%	-0.22 [-0.79 , 0.35]
Subtotal (95% CI)			**60**			**70**	**67.0%**	**-0.37 [-0.81 , 0.07]**
Heterogeneity: Tau² = 0.08; Chi² = 4.52, df = 2 (P = 0.10); I² = 56%								
Test for overall effect: Z = 1.65 (P = 0.10)								
14.3.2 Intra- and postoperative								
Blatsoukas 2010	1.31	0.77	57	2.2	0.55	34	33.0%	-0.89 [-1.16 , -0.62]
Subtotal (95% CI)			**57**			**34**	**33.0%**	**-0.89 [-1.16 , -0.62]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 6.41 (P < 0.00001)								
Total (95% CI)			**117**			**104**	**100.0%**	**-0.54 [-0.90 , -0.19]**
Heterogeneity: Tau² = 0.08; Chi² = 8.80, df = 3 (P = 0.03); I² = 66%								
Test for overall effect: Z = 3.04 (P = 0.002)								
Test for subgroup differences: Chi² = 3.89, df = 1 (P = 0.05), I² = 74.3%								



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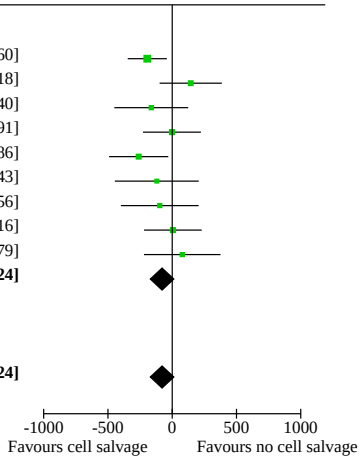
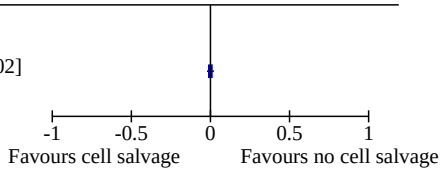
Analysis 14.4. Comparison 14: Orthopaedic (knee) (subgroup: timing), Outcome 4: Blood loss (ml)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
14.4.1 Postoperative								
Abuzakuk 2007	673	355	52	867	434	52	21.1%	-194.00 [-346.40 , -41.60]
Adalberth 1998	881	426.16	24	737	438.78	25	11.1%	144.00 [-98.18 , 386.18]
Altinel 2007	725.6	309.8	16	888.5	497.8	16	8.4%	-162.90 [-450.20 , 124.40]
Heddle 1992	1006	534	39	1008	484	40	12.4%	-2.00 [-226.91 , 222.91]
Horstmann 2014b	1576	635	59	1837	624	56	12.0%	-261.00 [-491.14 , -30.86]
Majkowski 1991	1020	540	20	1140	513	20	6.8%	-120.00 [-446.43 , 206.43]
Munteanu 2009	2521	890	50	2618	632	50	7.7%	-97.00 [-399.56 , 205.56]
Newman 1997	896	545	35	891	401	35	12.5%	5.00 [-219.16 , 229.16]
Touzopoulos 2021	1341	501	20	1263	459	20	7.9%	78.00 [-219.79 , 375.79]
Subtotal (95% CI)			**315**			**314**	**100.0%**	**-79.01 [-170.27 , 12.24]**
Heterogeneity: Tau² = 4248.84; Chi² = 10.27, df = 8 (P = 0.25); I² = 22%								
Test for overall effect: Z = 1.70 (P = 0.09)								
Total (95% CI)			**315**			**314**	**100.0%**	**-79.01 [-170.27 , 12.24]**
Heterogeneity: Tau² = 4248.84; Chi² = 10.27, df = 8 (P = 0.25); I² = 22%								
Test for overall effect: Z = 1.70 (P = 0.09)								
Test for subgroup differences: Not applicable								



Analysis 14.5. Comparison 14: Orthopaedic (knee) (subgroup: timing), Outcome 5: Reoperation for bleeding

Study or Subgroup	Cell salvage Events	Total	No cell salvage Events	Total	Risk Difference M-H, Random, 95% CI
14.5.1 Postoperative					
Amin 2008	0	92	0	86	0.00 [-0.02 , 0.02]



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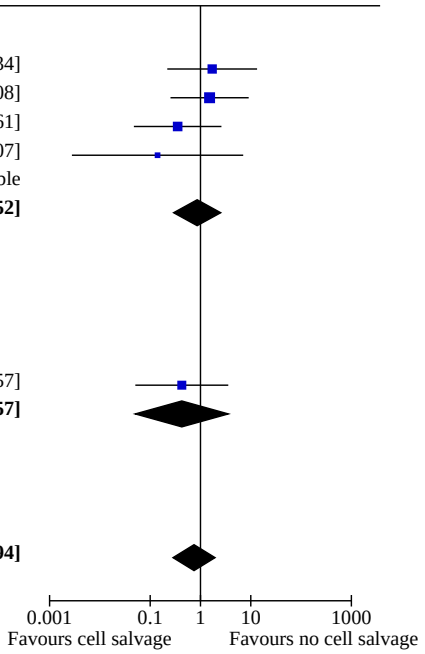
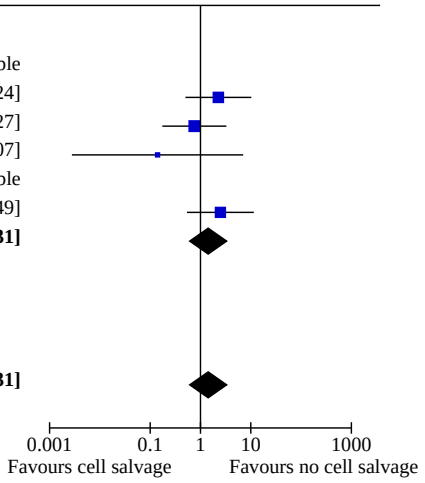
Analysis 14.6. Comparison 14: Orthopaedic (knee) (subgroup: timing), Outcome 6: Infection

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
14.6.1 Postoperative						
Blatsoukas 2010	3	71	1	42	21.8%	1.71 [0.22 , 13.34]
Munteanu 2009	3	50	2	50	28.8%	1.52 [0.25 , 9.08]
Newman 1997	1	35	3	35	23.0%	0.35 [0.05 , 2.61]
Šarkanoviü 2013	0	55	1	57	6.0%	0.14 [0.00 , 7.07]
Schnurr 2018	0	100	0	100		Not estimable
Subtotal (95% CI)		**311**		**284**	**79.6%**	**0.86 [0.29 , 2.52]**
Total events:	7		7			
Heterogeneity: Chi² = 2.40, df = 3 (P = 0.49); I² = 0%						
Test for overall effect: Z = 0.28 (P = 0.78)						
14.6.2 Intra- and postoperative						
Blatsoukas 2010	2	92	2	43	20.4%	0.43 [0.05 , 3.57]
Subtotal (95% CI)		**92**		**43**	**20.4%**	**0.43 [0.05 , 3.57]**
Total events:	2		2			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.79 (P = 0.43)						
Total (95% CI)		**403**		**327**	**100.0%**	**0.74 [0.28 , 1.94]**
Total events:	9		9			
Heterogeneity: Chi² = 2.74, df = 4 (P = 0.60); I² = 0%						
Test for overall effect: Z = 0.60 (P = 0.55)						
Test for subgroup differences: Chi² = 0.33, df = 1 (P = 0.56), I² = 0%						



Analysis 14.7. Comparison 14: Orthopaedic (knee) (subgroup: timing), Outcome 7: Wound complication

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
14.7.1 Postoperative						
Abuzakuk 2007	0	52	0	52		Not estimable
Amin 2008	5	92	2	86	31.4%	2.27 [0.50 , 10.24]
Majkowski 1991	4	20	5	20	33.3%	0.76 [0.17 , 3.27]
Šarkanoviü 2013	0	55	1	57	4.7%	0.14 [0.00 , 7.07]
Schnurr 2018	0	100	0	100		Not estimable
Shenolikar 1997	5	50	2	50	30.6%	2.49 [0.54 , 11.49]
Subtotal (95% CI)		**369**		**365**	**100.0%**	**1.42 [0.61 , 3.31]**
Total events:	14		10			
Heterogeneity: Chi² = 2.94, df = 3 (P = 0.40); I² = 0%						
Test for overall effect: Z = 0.82 (P = 0.41)						
Total (95% CI)		**369**		**365**	**100.0%**	**1.42 [0.61 , 3.31]**
Total events:	14		10			
Heterogeneity: Chi² = 2.94, df = 3 (P = 0.40); I² = 0%						
Test for overall effect: Z = 0.82 (P = 0.41)						
Test for subgroup differences: Not applicable						



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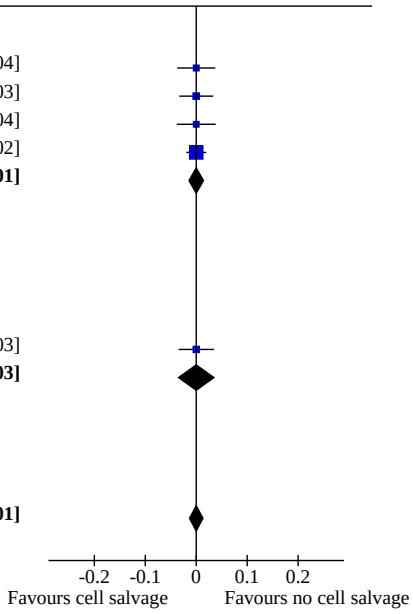
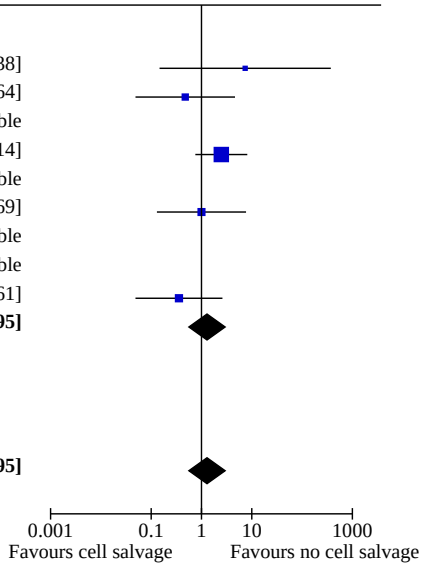
Analysis 14.8. Comparison 14: Orthopaedic (knee) (subgroup: timing), Outcome 8: Prosthetic joint infection (PJI)

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Risk Difference M-H, Random, 95% CI
14.8.1 Postoperative						
Blatsoukas 2010	0	71	0	42	12.4%	0.00 [-0.04 , 0.04]
Horstmann 2014b	0	56	0	59	15.5%	0.00 [-0.03 , 0.03]
Munteanu 2009	0	50	0	50	11.8%	0.00 [-0.04 , 0.04]
Schnurr 2018	0	100	0	100	46.0%	0.00 [-0.02 , 0.02]
Subtotal (95% CI)		**277**		**251**	**85.6%**	**0.00 [-0.01 , 0.01]**
Total events:	0		0			
Heterogeneity: Tau² = 0.00; Chi² = 0.00, df = 3 (P = 1.00); I² = 0%						
Test for overall effect: Z = 0.00 (P = 1.00)						
14.8.2 Intra- and postoperative						
Blatsoukas 2010	0	92	0	43	14.4%	0.00 [-0.03 , 0.03]
Subtotal (95% CI)		**92**		**43**	**14.4%**	**0.00 [-0.03 , 0.03]**
Total events:	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.00 (P = 1.00)						
Total (95% CI)		**369**		**294**	**100.0%**	**0.00 [-0.01 , 0.01]**
Total events:	0		0			
Heterogeneity: Tau² = 0.00; Chi² = 0.00, df = 4 (P = 1.00); I² = 0%						
Test for overall effect: Z = 0.00 (P = 1.00)						
Test for subgroup differences: Chi² = 0.00, df = 1 (P = 1.00), I² = 0%						



Analysis 14.9. Comparison 14: Orthopaedic (knee) (subgroup: timing), Outcome 9: DVT

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
14.9.1 Postoperative						
Adalberth 1998	1	30	0	30	4.5%	7.39 [0.15 , 372.38]
Amin 2008	1	92	2	86	13.2%	0.48 [0.05 , 4.64]
Cheng 2005	0	24	0	34		Not estimable
Heddle 1992	9	28	5	32	48.5%	2.48 [0.75 , 8.14]
Horstmann 2014b	0	59	0	56		Not estimable
Majkowski 1991	2	20	2	20	16.5%	1.00 [0.13 , 7.69]
Newman 1997	0	35	0	35		Not estimable
Šarkanoviü 2013	0	55	0	57		Not estimable
Shenolikar 1997	1	50	3	50	17.3%	0.36 [0.05 , 2.61]
Subtotal (95% CI)		**393**		**400**	**100.0%**	**1.29 [0.56 , 2.95]**
Total events:	14		12			
Heterogeneity: Chi² = 4.32, df = 4 (P = 0.36); I² = 7%						
Test for overall effect: Z = 0.60 (P = 0.55)						
Total (95% CI)		**393**		**400**	**100.0%**	**1.29 [0.56 , 2.95]**
Total events:	14		12			
Heterogeneity: Chi² = 4.32, df = 4 (P = 0.36); I² = 7%						
Test for overall effect: Z = 0.60 (P = 0.55)						
Test for subgroup differences: Not applicable						



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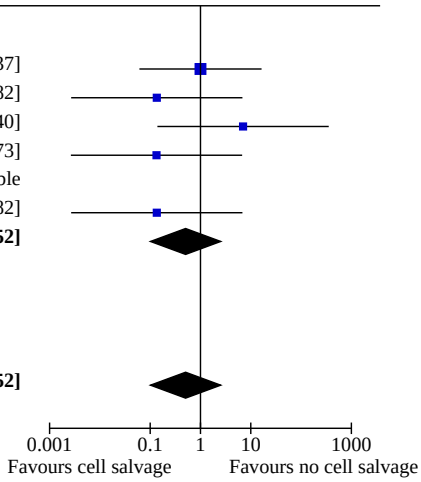
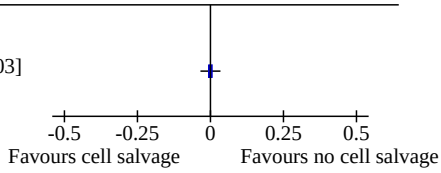
Analysis 14.10. Comparison 14: Orthopaedic (knee) (subgroup: timing), Outcome 10: PE

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
14.10.1 Postoperative						
Adalberth 1998	1	30	1	30	33.0%	1.00 [0.06 , 16.37]
Altinel 2007	0	16	1	16	16.8%	0.14 [0.00 , 6.82]
Horstmann 2014b	1	59	0	56	16.8%	7.02 [0.14 , 354.40]
Kirkos 2006	0	78	1	77	16.8%	0.13 [0.00 , 6.73]
Šarkanoviü 2013	0	55	0	57		Not estimable
Shenolikar 1997	0	50	1	50	16.8%	0.14 [0.00 , 6.82]
Subtotal (95% CI)		**288**		**286**	**100.0%**	**0.51 [0.10 , 2.52]**
Total events:	2		4			
Heterogeneity: Chi² = 3.27, df = 4 (P = 0.51); I² = 0%						
Test for overall effect: Z = 0.83 (P = 0.41)						
Total (95% CI)		**288**		**286**	**100.0%**	**0.51 [0.10 , 2.52]**
Total events:	2		4			
Heterogeneity: Chi² = 3.27, df = 4 (P = 0.51); I² = 0%						
Test for overall effect: Z = 0.83 (P = 0.41)						
Test for subgroup differences: Not applicable						



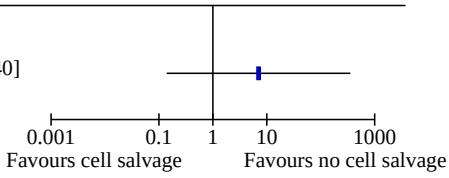
Analysis 14.11. Comparison 14: Orthopaedic (knee) (subgroup: timing), Outcome 11: MACE

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Risk Difference M-H, Random, 95% CI
14.11.1 Postoperative					
Šarkanoviü 2013	0	55	0	57	0.00 [-0.03 , 0.03]



Analysis 14.12. Comparison 14: Orthopaedic (knee) (subgroup: timing), Outcome 12: MI

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Peto Odds Ratio Peto, Fixed, 95% CI
14.12.1 Postoperative					
Horstmann 2014b	1	59	0	56	7.02 [0.14 , 354.40]



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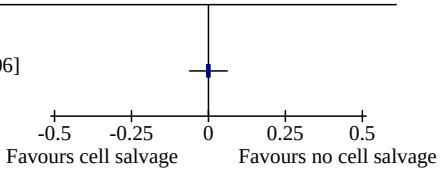
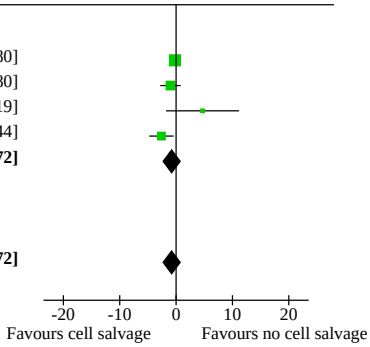
Analysis 14.13. Comparison 14: Orthopaedic (knee) (subgroup: timing), Outcome 13: CVA (stroke)

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Risk Difference M-H, Random, 95% CI
14.13.1 Postoperative					
Adalberth 1998	0	30	0	30	0.00 [-0.06 , 0.06]



Analysis 14.14. Comparison 14: Orthopaedic (knee) (subgroup: timing), Outcome 14: Hospital LOS (days)

Study or Subgroup	Cell salvage Mean	Cell salvage SD	Cell salvage Total	No cell salvage Mean	No cell salvage SD	No cell salvage Total	Weight	Mean Difference IV, Random, 95% CI
14.14.1 Postoperative								
Abuzakuk 2007	8.1	2.4	52	8.3	2.8	52	41.1%	-0.20 [-1.20 , 0.80]
Adalberth 1998	11	2.5	24	12	3.83	25	29.2%	-1.00 [-2.80 , 0.80]
Altinel 2007	21.2	11.3	16	16.5	6.9	16	4.9%	4.70 [-1.79 , 11.19]
Newman 1997	12.6	3.8	35	15.2	5.3	35	24.8%	-2.60 [-4.76 , -0.44]
Subtotal (95% CI)			**127**			**128**	**100.0%**	**-0.79 [-2.30 , 0.72]**
Heterogeneity: Tau² = 1.18; Chi² = 6.65, df = 3 (P = 0.08); I² = 55%								
Test for overall effect: Z = 1.02 (P = 0.31)								
Total (95% CI)			**127**			**128**	**100.0%**	**-0.79 [-2.30 , 0.72]**
Heterogeneity: Tau² = 1.18; Chi² = 6.65, df = 3 (P = 0.08); I² = 55%								
Test for overall effect: Z = 1.02 (P = 0.31)								
Test for subgroup differences: Not applicable								



Comparison 15. Orthopaedic (knee) (subgroup: transfusion threshold)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
15.1 Transfusions	21	2214	Risk Ratio (M-H, Random, 95% CI)	0.49 [0.37, 0.66]
15.1.1 Restrictive (Hb ≦ 80 g/L)	6	834	Risk Ratio (M-H, Random, 95% CI)	0.81 [0.65, 1.01]
15.1.2 Liberal (Hb > 80 g/L)	12	1142	Risk Ratio (M-H, Random, 95% CI)	0.44 [0.29, 0.64]
15.1.3 No threshold/protocol reported	3	238	Risk Ratio (M-H, Random, 95% CI)	0.16 [0.02, 1.32]
15.2 Volume of transfusion (units) (PPR)	5	563	Mean Difference (IV, Random, 95% CI)	-0.87 [-1.09, -0.64]
15.2.2 Liberal (Hb > 80 g/L)	5	563	Mean Difference (IV, Random, 95% CI)	-0.87 [-1.09, -0.64]
15.3 Volume of transfusion (units) (PPT)	3	221	Mean Difference (IV, Random, 95% CI)	-0.54 [-0.90, -0.19]
15.3.1 Liberal (Hb > 80 g/L)	3	221	Mean Difference (IV, Random, 95% CI)	-0.54 [-0.90, -0.19]

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Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
15.4 Blood loss (mL)	9	629	Mean Difference (IV, Random, 95% CI)	-79.01 [-170.27, 12.24]
15.4.1 Restrictive (Hb ≦ 80 g/L)	2	215	Mean Difference (IV, Random, 95% CI)	-200.89 [-384.06, -17.72]
15.4.2 Liberal (Hb > 80 g/L)	6	344	Mean Difference (IV, Random, 95% CI)	-56.24 [-175.85, 63.37]
15.4.3 No threshold/protocol reported	1	70	Mean Difference (IV, Random, 95% CI)	5.00 [-219.16, 229.16]
15.5 Reoperation for bleeding	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
15.5.1 Restrictive (Hb ≦ 80 g/L)	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
15.6 Infection	5	730	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.74 [0.28, 1.94]
15.6.1 Restrictive (Hb ≦ 80 g/L)	2	300	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.52 [0.25, 9.08]
15.6.2 Liberal (Hb > 80 g/L)	2	360	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.70 [0.17, 2.77]
15.6.3 No threshold/protocol reported	1	70	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.35 [0.05, 2.61]
15.7 Wound complication	6	734	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.42 [0.61, 3.31]
15.7.1 Restrictive (Hb ≦ 80 g/L)	2	378	Peto Odds Ratio (Peto, Fixed, 95% CI)	2.27 [0.50, 10.24]
15.7.2 Liberal (Hb > 80 g/L)	4	356	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.15 [0.41, 3.19]
15.8 Prosthetic joint infection (PJI)	4	663	Risk Difference (M-H, Random, 95% CI)	0.00 [-0.01, 0.01]
15.8.1 Restrictive (Hb ≦ 80 g/L)	3	415	Risk Difference (M-H, Random, 95% CI)	0.00 [-0.02, 0.02]
15.8.2 Liberal (Hb > 80 g/L)	1	248	Risk Difference (M-H, Random, 95% CI)	0.00 [-0.03, 0.03]
15.9 DVT	9	793	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.29 [0.56, 2.95]
15.9.1 Restrictive (Hb ≦ 80 g/L)	2	293	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.48 [0.05, 4.64]

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Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
15.9.2 Liberal (Hb > 80 g/L)	6	430	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.50 [0.62, 3.65]
15.9.3 No threshold/protocol reported	1	0	Peto Odds Ratio (Peto, Fixed, 95% CI)	Not estimable
15.10 PE	6	574	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.51 [0.10, 2.52]
15.10.1 Restrictive (Hb ≦ 80 g/L)	1	115	Peto Odds Ratio (Peto, Fixed, 95% CI)	7.02 [0.14, 354.40]
15.10.2 Liberal (Hb > 80 g/L)	5	459	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.30 [0.05, 1.73]
15.11 MACE	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
15.11.1 Liberal (Hb > 80 g/L)	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
15.12 MI	1		Peto Odds Ratio (Peto, Fixed, 95% CI)	Totals not selected
15.12.1 Restrictive (Hb ≦ 80 g/L)	1		Peto Odds Ratio (Peto, Fixed, 95% CI)	Totals not selected
15.13 CVA (stroke)	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
15.13.1 Liberal (Hb > 80 g/L)	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
15.14 Hospital LOS (days)	4	255	Mean Difference (IV, Random, 95% CI)	-0.79 [-2.30, 0.72]
15.14.1 Liberal (Hb > 80 g/L)	3	185	Mean Difference (IV, Random, 95% CI)	-0.28 [-1.59, 1.03]
15.14.2 No threshold/protocol reported	1	70	Mean Difference (IV, Random, 95% CI)	-2.60 [-4.76, -0.44]

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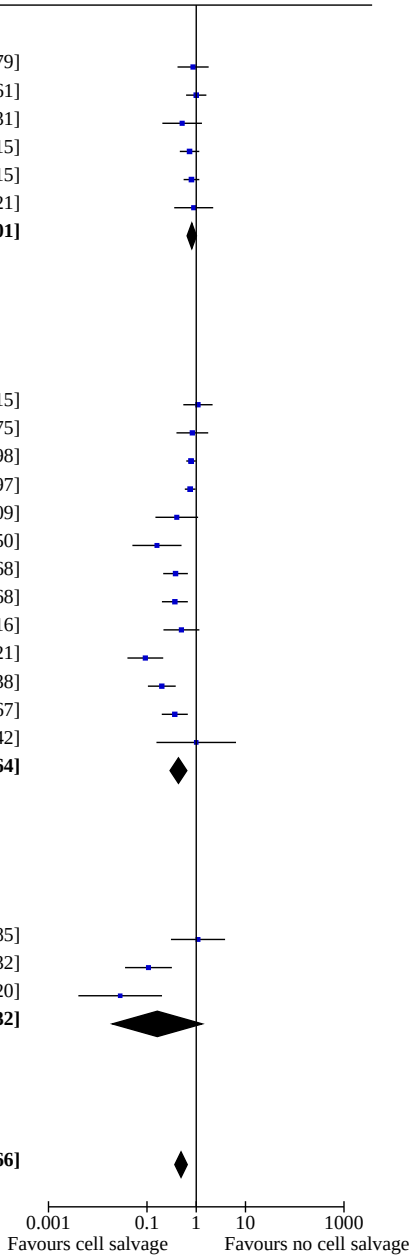
Analysis 15.1. Comparison 15: Orthopaedic (knee) (subgroup: transfusion threshold), Outcome 1: Transfusions

Study or Subgroup	Cell salvage Events	Total	No cell salvage Events	Total	Weight	Risk Ratio M-H, Random, 95% CI
15.1.1 Restrictive (Hb # 80 g/L)						
Amin 2008	12	92	13	86	4.8%	0.86 [0.42 , 1.79]
Cip 2013	23	70	23	70	5.8%	1.00 [0.62 , 1.61]
Horstmann 2014b	6	59	11	56	4.0%	0.52 [0.21 , 1.31]
Laszczyca 2015	15	38	34	63	5.8%	0.73 [0.46 , 1.15]
Munteanu 2009	24	50	30	50	6.2%	0.80 [0.55 , 1.15]
Schnurr 2018	8	100	9	100	4.1%	0.89 [0.36 , 2.21]
Subtotal (95% CI)		**409**		**425**	**30.7%**	**0.81 [0.65 , 1.01]**
Total events:	88		120			
Heterogeneity: Tau² = 0.00; Chi² = 1.93, df = 5 (P = 0.86); I² = 0%						
Test for overall effect: Z = 1.87 (P = 0.06)						
15.1.2 Liberal (Hb > 80 g/L)						
Abuzakuk 2007	13	52	12	52	4.9%	1.08 [0.55 , 2.15]
Adalberth 1998	8	24	10	25	4.7%	0.83 [0.40 , 1.75]
Blatsoukas 2010 (1)	57	92	34	43	6.6%	0.78 [0.63 , 0.98]
Blatsoukas 2010 (2)	42	71	33	42	6.5%	0.75 [0.59 , 0.97]
Cheng 2005	4	26	13	34	3.8%	0.40 [0.15 , 1.09]
Dramis 2006	3	32	10	17	3.3%	0.16 [0.05 , 0.50]
Heddle 1992	10	39	27	40	5.4%	0.38 [0.21 , 0.68]
Majkowski 1991	7	20	19	20	5.3%	0.37 [0.20 , 0.68]
Rosencher 1994	6	20	6	10	4.3%	0.50 [0.22 , 1.16]
Šarkanoviü 2013	5	55	56	57	4.4%	0.09 [0.04 , 0.21]
Shenolikar 1997	8	50	40	50	5.1%	0.20 [0.10 , 0.38]
Thomas 2001	12	115	33	116	5.2%	0.37 [0.20 , 0.67]
Touzopoulos 2021	2	20	2	20	1.8%	1.00 [0.16 , 6.42]
Subtotal (95% CI)		**616**		**526**	**61.3%**	**0.44 [0.29 , 0.64]**
Total events:	177		295			
Heterogeneity: Tau² = 0.37; Chi² = 73.52, df = 12 (P < 0.00001); I² = 84%						
Test for overall effect: Z = 4.17 (P < 0.0001)						
15.1.3 No threshold/protocol reported						
Dutton 2012	4	23	4	25	3.0%	1.09 [0.31 , 3.85]
Newman 1997	3	35	28	35	3.5%	0.11 [0.04 , 0.32]
Sait 1999	1	60	35	60	1.7%	0.03 [0.00 , 0.20]
Subtotal (95% CI)		**118**		**120**	**8.1%**	**0.16 [0.02 , 1.32]**
Total events:	8		67			
Heterogeneity: Tau² = 2.89; Chi² = 13.64, df = 2 (P = 0.001); I² = 85%						
Test for overall effect: Z = 1.70 (P = 0.09)						
Total (95% CI)		**1143**		**1071**	**100.0%**	**0.49 [0.37 , 0.66]**
Total events:	273		482			
Heterogeneity: Tau² = 0.32; Chi² = 104.98, df = 21 (P < 0.00001); I² = 80%						
Test for overall effect: Z = 4.81 (P < 0.00001)						
Test for subgroup differences: Chi² = 9.32, df = 2 (P = 0.009), I² = 78.5%						



Footnotes

(1) both intra & post-op collection

(2) post-op collection only

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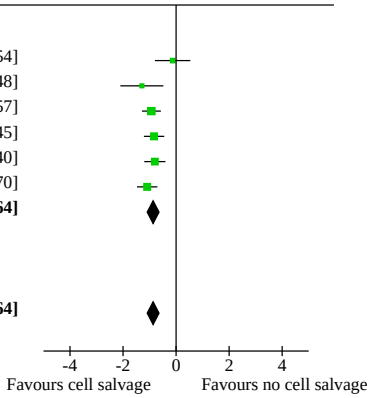
Analysis 15.2. Comparison 15: Orthopaedic (knee) (subgroup: transfusion threshold), Outcome 2: Volume of transfusion (units) (PPR)

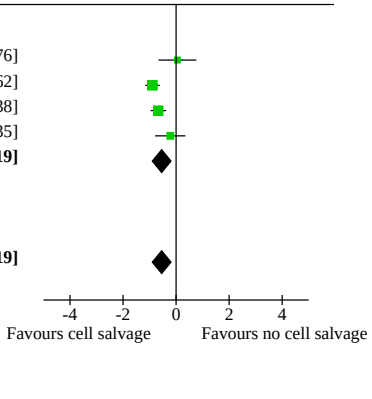
Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
15.2.2 Liberal (Hb > 80 g/L)								
Adalberth 1998	0.75	1.11	24	0.88	1.27	25	9.2%	-0.13 [-0.80 , 0.54]
Altinel 2007	1	1.12	16	2.29	1.22	16	6.6%	-1.29 [-2.10 , -0.48]
Blatsoukas 2010 (1)	0.81	0.88	92	1.74	1.03	43	22.8%	-0.93 [-1.29 , -0.57]
Blatsoukas 2010 (2)	0.91	0.96	71	1.74	1.03	42	20.9%	-0.83 [-1.21 , -0.45]
Heddle 1992	0.4	0.8	39	1.2	1	40	19.8%	-0.80 [-1.20 , -0.40]
Kirkos 2006	0.54	0.86	78	1.63	1.5	77	20.7%	-1.09 [-1.48 , -0.70]
Subtotal (95% CI)			**320**			**243**	**100.0%**	**-0.87 [-1.09 , -0.64]**
Heterogeneity: Tau² = 0.02; Chi² = 7.27, df = 5 (P = 0.20); I² = 31%								
Test for overall effect: Z = 7.63 (P < 0.00001)								
Total (95% CI)			**320**			**243**	**100.0%**	**-0.87 [-1.09 , -0.64]**
Heterogeneity: Tau² = 0.02; Chi² = 7.27, df = 5 (P = 0.20); I² = 31%								
Test for overall effect: Z = 7.63 (P < 0.00001)								
Test for subgroup differences: Not applicable								



Footnotes
(1) both intra & post-op collection
(2) post-op collection only

Analysis 15.3. Comparison 15: Orthopaedic (knee) (subgroup: transfusion threshold), Outcome 3: Volume of transfusion (units) (PPT)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
15.3.1 Liberal (Hb > 80 g/L)								
Adalberth 1998	2.25	0.46	8	2.2	1.03	10	15.2%	0.05 [-0.66 , 0.76]
Blatsoukas 2010 (1)	1.31	0.77	57	2.2	0.55	34	33.0%	-0.89 [-1.16 , -0.62]
Blatsoukas 2010 (2)	1.54	0.76	42	2.21	0.52	33	32.1%	-0.67 [-0.96 , -0.38]
Heddle 1992	1.56	0.83	10	1.78	0.66	27	19.7%	-0.22 [-0.79 , 0.35]
Subtotal (95% CI)			**117**			**104**	**100.0%**	**-0.54 [-0.90 , -0.19]**
Heterogeneity: Tau² = 0.08; Chi² = 8.80, df = 3 (P = 0.03); I² = 66%								
Test for overall effect: Z = 3.04 (P = 0.002)								
Total (95% CI)			**117**			**104**	**100.0%**	**-0.54 [-0.90 , -0.19]**
Heterogeneity: Tau² = 0.08; Chi² = 8.80, df = 3 (P = 0.03); I² = 66%								
Test for overall effect: Z = 3.04 (P = 0.002)								
Test for subgroup differences: Not applicable								



Footnotes
(1) both intra & post-op collection
(2) post-op collection only

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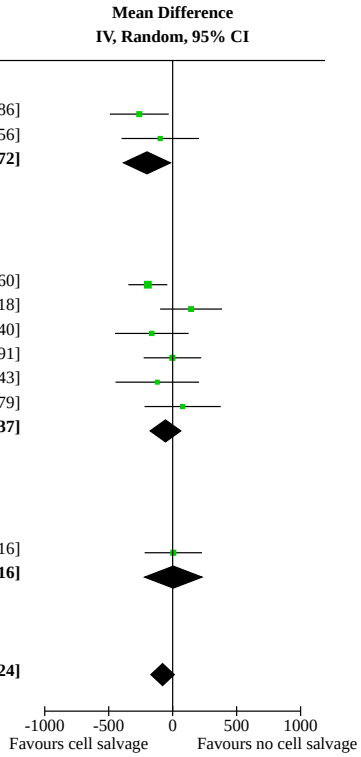
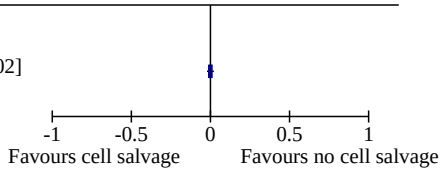
Analysis 15.4. Comparison 15: Orthopaedic (knee) (subgroup: transfusion threshold), Outcome 4: Blood loss (mL)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
15.4.1 Restrictive (Hb # 80 g/L)								
Horstmann 2014b	1576	635	59	1837	624	56	12.0%	-261.00 [-491.14 , -30.86]
Munteanu 2009	2521	890	50	2618	632	50	7.7%	-97.00 [-399.56 , 205.56]
Subtotal (95% CI)			**109**			**106**	**19.7%**	**-200.89 [-384.06 , -17.72]**
Heterogeneity: Tau² = 0.00; Chi² = 0.71, df = 1 (P = 0.40); I² = 0%								
Test for overall effect: Z = 2.15 (P = 0.03)								
15.4.2 Liberal (Hb > 80 g/L)								
Abuzakuk 2007	673	355	52	867	434	52	21.1%	-194.00 [-346.40 , -41.60]
Adalberth 1998	881	426.16	24	737	438.78	25	11.1%	144.00 [-98.18 , 386.18]
Altinel 2007	725.6	309.8	16	888.5	497.8	16	8.4%	-162.90 [-450.20 , 124.40]
Heddle 1992	1006	534	39	1008	484	40	12.4%	-2.00 [-226.91 , 222.91]
Majkowski 1991	1020	540	20	1140	513	20	6.8%	-120.00 [-446.43 , 206.43]
Touzopoulos 2021	1341	501	20	1263	459	20	7.9%	78.00 [-219.79 , 375.79]
Subtotal (95% CI)			**171**			**173**	**67.7%**	**-56.24 [-175.85 , 63.37]**
Heterogeneity: Tau² = 6983.04; Chi² = 7.33, df = 5 (P = 0.20); I² = 32%								
Test for overall effect: Z = 0.92 (P = 0.36)								
15.4.3 No threshold/protocol reported								
Newman 1997	896	545	35	891	401	35	12.5%	5.00 [-219.16 , 229.16]
Subtotal (95% CI)			**35**			**35**	**12.5%**	**5.00 [-219.16 , 229.16]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.04 (P = 0.97)								
Total (95% CI)			**315**			**314**	**100.0%**	**-79.01 [-170.27 , 12.24]**
Heterogeneity: Tau² = 4248.84; Chi² = 10.27, df = 8 (P = 0.25); I² = 22%								
Test for overall effect: Z = 1.70 (P = 0.09)								
Test for subgroup differences: Chi² = 2.38, df = 2 (P = 0.30), I² = 15.8%								



Analysis 15.5. Comparison 15: Orthopaedic (knee) (subgroup: transfusion threshold), Outcome 5: Reoperation for bleeding

Study or Subgroup	Cell salvage Events	Total	No cell salvage Events	Total	Risk Difference M-H, Random, 95% CI
15.5.1 Restrictive (Hb # 80 g/L)					
Amin 2008	0	92	0	86	0.00 [-0.02 , 0.02]



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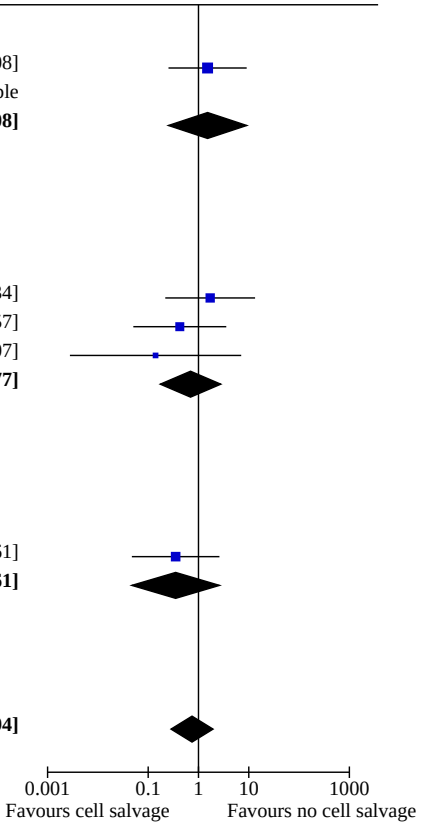
Analysis 15.6. Comparison 15: Orthopaedic (knee) (subgroup: transfusion threshold), Outcome 6: Infection

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
15.6.1 Restrictive (Hb # 80 g/L)						
Munteanu 2009	3	50	2	50	28.8%	1.52 [0.25 , 9.08]
Schnurr 2018	0	100	0	100		Not estimable
Subtotal (95% CI)		**150**		**150**	**28.8%**	**1.52 [0.25 , 9.08]**
Total events:	3		2			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.46 (P = 0.65)						
15.6.2 Liberal (Hb > 80 g/L)						
Blatsoukas 2010 (1)	3	71	1	42	21.8%	1.71 [0.22 , 13.34]
Blatsoukas 2010 (2)	2	92	2	43	20.4%	0.43 [0.05 , 3.57]
Šarkanoviü 2013	0	55	1	57	6.0%	0.14 [0.00 , 7.07]
Subtotal (95% CI)		**218**		**142**	**48.2%**	**0.70 [0.17 , 2.77]**
Total events:	5		4			
Heterogeneity: Chi² = 1.58, df = 2 (P = 0.45); I² = 0%						
Test for overall effect: Z = 0.52 (P = 0.61)						
15.6.3 No threshold/protocol reported						
Newman 1997	1	35	3	35	23.0%	0.35 [0.05 , 2.61]
Subtotal (95% CI)		**35**		**35**	**23.0%**	**0.35 [0.05 , 2.61]**
Total events:	1		3			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.02 (P = 0.31)						
Total (95% CI)		**403**		**327**	**100.0%**	**0.74 [0.28 , 1.94]**
Total events:	9		9			
Heterogeneity: Chi² = 2.74, df = 4 (P = 0.60); I² = 0%						
Test for overall effect: Z = 0.60 (P = 0.55)						
Test for subgroup differences: Chi² = 1.16, df = 2 (P = 0.56), I² = 0%						



Footnotes

(1) post-op collection only

(2) both intra & post-op collection

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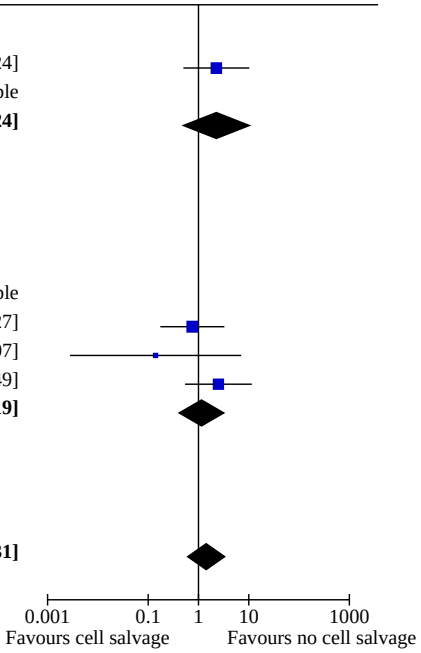
Analysis 15.7. Comparison 15: Orthopaedic (knee) (subgroup: transfusion threshold), Outcome 7: Wound complication

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
15.7.1 Restrictive (Hb # 80 g/L)						
Amin 2008	5	92	2	86	31.4%	2.27 [0.50 , 10.24]
Schnurr 2018	0	100	0	100		Not estimable
Subtotal (95% CI)		**192**		**186**	**31.4%**	**2.27 [0.50 , 10.24]**
Total events:	5		2			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.06 (P = 0.29)						
15.7.2 Liberal (Hb > 80 g/L)						
Abuzakuk 2007	0	52	0	52		Not estimable
Majkowski 1991	4	20	5	20	33.3%	0.76 [0.17 , 3.27]
Šarkanoviü 2013	0	55	1	57	4.7%	0.14 [0.00 , 7.07]
Shenolikar 1997	5	50	2	50	30.6%	2.49 [0.54 , 11.49]
Subtotal (95% CI)		**177**		**179**	**68.6%**	**1.15 [0.41 , 3.19]**
Total events:	9		8			
Heterogeneity: Chi² = 2.40, df = 2 (P = 0.30); I² = 17%						
Test for overall effect: Z = 0.27 (P = 0.79)						
Total (95% CI)		**369**		**365**	**100.0%**	**1.42 [0.61 , 3.31]**
Total events:	14		10			
Heterogeneity: Chi² = 2.94, df = 3 (P = 0.40); I² = 0%						
Test for overall effect: Z = 0.82 (P = 0.41)						
Test for subgroup differences: Chi² = 0.54, df = 1 (P = 0.46), I² = 0%						



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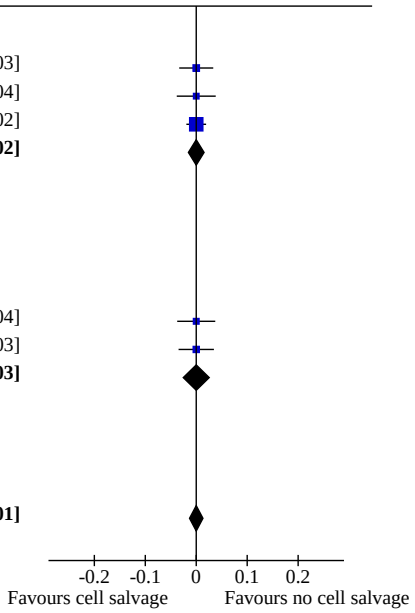
Analysis 15.8. Comparison 15: Orthopaedic (knee) (subgroup: transfusion threshold), Outcome 8: Prosthetic joint infection (PJI)

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Risk Difference M-H, Random, 95% CI
15.8.1 Restrictive (Hb # 80 g/L)						
Horstmann 2014b	0	56	0	59	15.5%	0.00 [-0.03 , 0.03]
Munteanu 2009	0	50	0	50	11.8%	0.00 [-0.04 , 0.04]
Schnurr 2018	0	100	0	100	46.0%	0.00 [-0.02 , 0.02]
Subtotal (95% CI)		**206**		**209**	**73.3%**	**0.00 [-0.02 , 0.02]**
Total events:	0		0			
Heterogeneity: Tau² = 0.00; Chi² = 0.00, df = 2 (P = 1.00); I² = 0%						
Test for overall effect: Z = 0.00 (P = 1.00)						
15.8.2 Liberal (Hb > 80 g/L)						
Blatsoukas 2010 (1)	0	71	0	42	12.4%	0.00 [-0.04 , 0.04]
Blatsoukas 2010 (2)	0	92	0	43	14.4%	0.00 [-0.03 , 0.03]
Subtotal (95% CI)		**163**		**85**	**26.7%**	**0.00 [-0.03 , 0.03]**
Total events:	0		0			
Heterogeneity: Tau² = 0.00; Chi² = 0.00, df = 1 (P = 1.00); I² = 0%						
Test for overall effect: Z = 0.00 (P = 1.00)						
Total (95% CI)		**369**		**294**	**100.0%**	**0.00 [-0.01 , 0.01]**
Total events:	0		0			
Heterogeneity: Tau² = 0.00; Chi² = 0.00, df = 4 (P = 1.00); I² = 0%						
Test for overall effect: Z = 0.00 (P = 1.00)						
Test for subgroup differences: Chi² = 0.00, df = 1 (P = 1.00), I² = 0%						



Footnotes

(1) post-op collection only

(2) both intra & post-op collection

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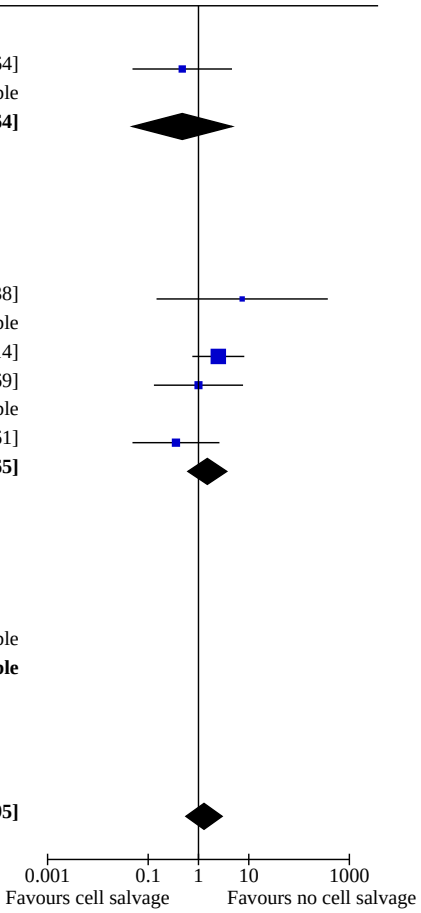
Analysis 15.9. Comparison 15: Orthopaedic (knee) (subgroup: transfusion threshold), Outcome 9: DVT

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
15.9.1 Restrictive (Hb # 80 g/L)						
Amin 2008	1	92	2	86	13.2%	0.48 [0.05 , 4.64]
Horstmann 2014b	0	59	0	56		Not estimable
Subtotal (95% CI)		**151**		**142**	**13.2%**	**0.48 [0.05 , 4.64]**
Total events:	1		2			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.64 (P = 0.52)						
15.9.2 Liberal (Hb > 80 g/L)						
Adalberth 1998	1	30	0	30	4.5%	7.39 [0.15 , 372.38]
Cheng 2005	0	24	0	34		Not estimable
Heddle 1992	9	28	5	32	48.5%	2.48 [0.75 , 8.14]
Majkowski 1991	2	20	2	20	16.5%	1.00 [0.13 , 7.69]
Šarkanoviü 2013	0	55	0	57		Not estimable
Shenolikar 1997	1	50	3	50	17.3%	0.36 [0.05 , 2.61]
Subtotal (95% CI)		**207**		**223**	**86.8%**	**1.50 [0.62 , 3.65]**
Total events:	13		10			
Heterogeneity: Chi² = 3.47, df = 3 (P = 0.32); I² = 14%						
Test for overall effect: Z = 0.89 (P = 0.37)						
15.9.3 No threshold/protocol reported						
Newman 1997	0	35	0	35		Not estimable
Subtotal (95% CI)		**0**		**0**		**Not estimable**
Total events:	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Not applicable						
Total (95% CI)		**393**		**400**	**100.0%**	**1.29 [0.56 , 2.95]**
Total events:	14		12			
Heterogeneity: Chi² = 4.32, df = 4 (P = 0.36); I² = 7%						
Test for overall effect: Z = 0.60 (P = 0.55)						
Test for subgroup differences: Chi² = 0.85, df = 1 (P = 0.36), I² = 0%						



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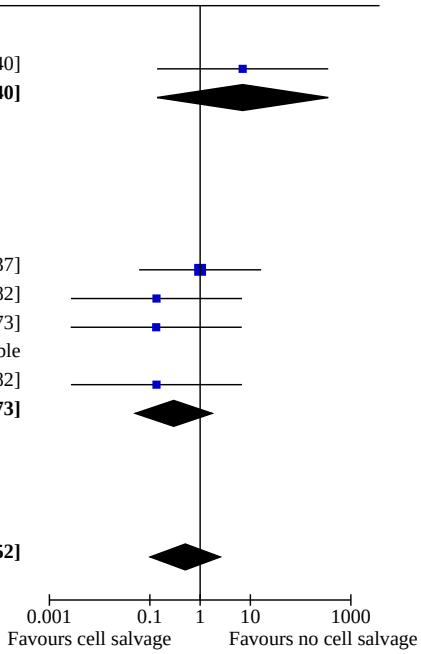
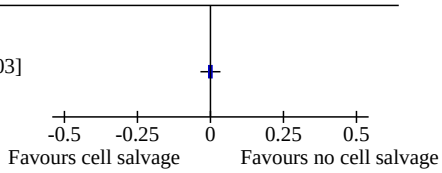
Analysis 15.10. Comparison 15: Orthopaedic (knee) (subgroup: transfusion threshold), Outcome 10: PE

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
15.10.1 Restrictive (Hb # 80 g/L)						
Horstmann 2014b	1	59	0	56	16.8%	7.02 [0.14 , 354.40]
Subtotal (95% CI)		**59**		**56**	**16.8%**	**7.02 [0.14 , 354.40]**
Total events:	1		0			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.97 (P = 0.33)						
15.10.2 Liberal (Hb > 80 g/L)						
Adalberth 1998	1	30	1	30	33.0%	1.00 [0.06 , 16.37]
Altinel 2007	0	16	1	16	16.8%	0.14 [0.00 , 6.82]
Kirkos 2006	0	78	1	77	16.8%	0.13 [0.00 , 6.73]
Šarkanoviü 2013	0	55	0	57		Not estimable
Shenolikar 1997	0	50	1	50	16.8%	0.14 [0.00 , 6.82]
Subtotal (95% CI)		**229**		**230**	**83.2%**	**0.30 [0.05 , 1.73]**
Total events:	1		4			
Heterogeneity: Chi² = 1.19, df = 3 (P = 0.75); I² = 0%						
Test for overall effect: Z = 1.35 (P = 0.18)						
Total (95% CI)		**288**		**286**	**100.0%**	**0.51 [0.10 , 2.52]**
Total events:	2		4			
Heterogeneity: Chi² = 3.27, df = 4 (P = 0.51); I² = 0%						
Test for overall effect: Z = 0.83 (P = 0.41)						
Test for subgroup differences: Chi² = 2.08, df = 1 (P = 0.15), I² = 51.8%						



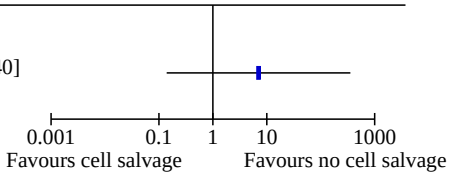
Analysis 15.11. Comparison 15: Orthopaedic (knee) (subgroup: transfusion threshold), Outcome 11: MACE

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Risk Difference M-H, Random, 95% CI
15.11.1 Liberal (Hb > 80 g/L)					
Šarkanoviü 2013	0	55	0	57	0.00 [-0.03 , 0.03]



Analysis 15.12. Comparison 15: Orthopaedic (knee) (subgroup: transfusion threshold), Outcome 12: MI

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Peto Odds Ratio Peto, Fixed, 95% CI
15.12.1 Restrictive (Hb # 80 g/L)					
Horstmann 2014b	1	59	0	56	7.02 [0.14 , 354.40]



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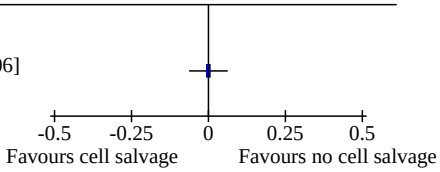
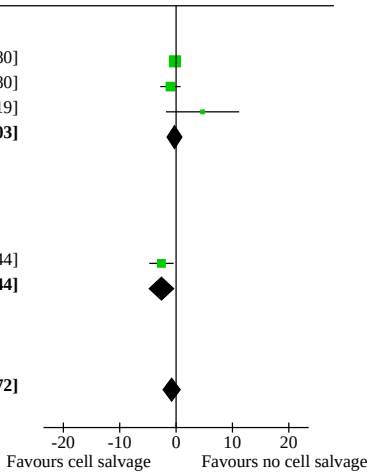
Analysis 15.13. Comparison 15: Orthopaedic (knee) (subgroup: transfusion threshold), Outcome 13: CVA (stroke)

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Risk Difference M-H, Random, 95% CI
15.13.1 Liberal (Hb > 80 g/L)					
Adalberth 1998	0	30	0	30	0.00 [-0.06 , 0.06]



Analysis 15.14. Comparison 15: Orthopaedic (knee) (subgroup: transfusion threshold), Outcome 14: Hospital LOS (days)

Study or Subgroup	Cell salvage Mean	Cell salvage SD	Cell salvage Total	No cell salvage Mean	No cell salvage SD	No cell salvage Total	Weight	Mean Difference IV, Random, 95% CI
15.14.1 Liberal (Hb > 80 g/L)								
Abuzakuk 2007	8.1	2.4	52	8.3	2.8	52	41.1%	-0.20 [-1.20 , 0.80]
Adalberth 1998	11	2.5	24	12	3.83	25	29.2%	-1.00 [-2.80 , 0.80]
Altinel 2007	21.2	11.3	16	16.5	6.9	16	4.9%	4.70 [-1.79 , 11.19]
Subtotal (95% CI)			**92**			**93**	**75.2%**	**-0.28 [-1.59 , 1.03]**
Heterogeneity: Tau² = 0.46; Chi² = 2.90, df = 2 (P = 0.23); I² = 31%								
Test for overall effect: Z = 0.42 (P = 0.67)								
15.14.2 No threshold/protocol reported								
Newman 1997	12.6	3.8	35	15.2	5.3	35	24.8%	-2.60 [-4.76 , -0.44]
Subtotal (95% CI)			**35**			**35**	**24.8%**	**-2.60 [-4.76 , -0.44]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 2.36 (P = 0.02)								
Total (95% CI)			**127**			**128**	**100.0%**	**-0.79 [-2.30 , 0.72]**
Heterogeneity: Tau² = 1.18; Chi² = 6.65, df = 3 (P = 0.08); I² = 55%								
Test for overall effect: Z = 1.02 (P = 0.31)								
Test for subgroup differences: Chi² = 3.23, df = 1 (P = 0.07), I² = 69.1%								



Comparison 16. Orthopaedic (spinal) (subgroup: timing)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
16.1 Transfusions	3	194	Risk Ratio (M-H, Random, 95% CI)	0.44 [0.31, 0.63]
16.1.1 Intraoperative	2	144	Risk Ratio (M-H, Random, 95% CI)	0.43 [0.26, 0.71]
16.1.2 Postoperative	1	50	Risk Ratio (M-H, Random, 95% CI)	0.50 [0.05, 5.17]
16.2 Volume of transfusion (units) (PPR)	3	208	Mean Difference (IV, Random, 95% CI)	-0.99 [-2.49, 0.50]
16.2.1 Intraoperative	2	145	Mean Difference (IV, Random, 95% CI)	-1.39 [-3.48, 0.71]
16.2.2 Postoperative	1	63	Mean Difference (IV, Random, 95% CI)	-0.21 [-0.63, 0.21]
16.3 Volume of transfusion (units) (PPT)	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
16.3.1 Intraoperative	1		Mean Difference (IV, Random, 95% CI)	Totals not selected

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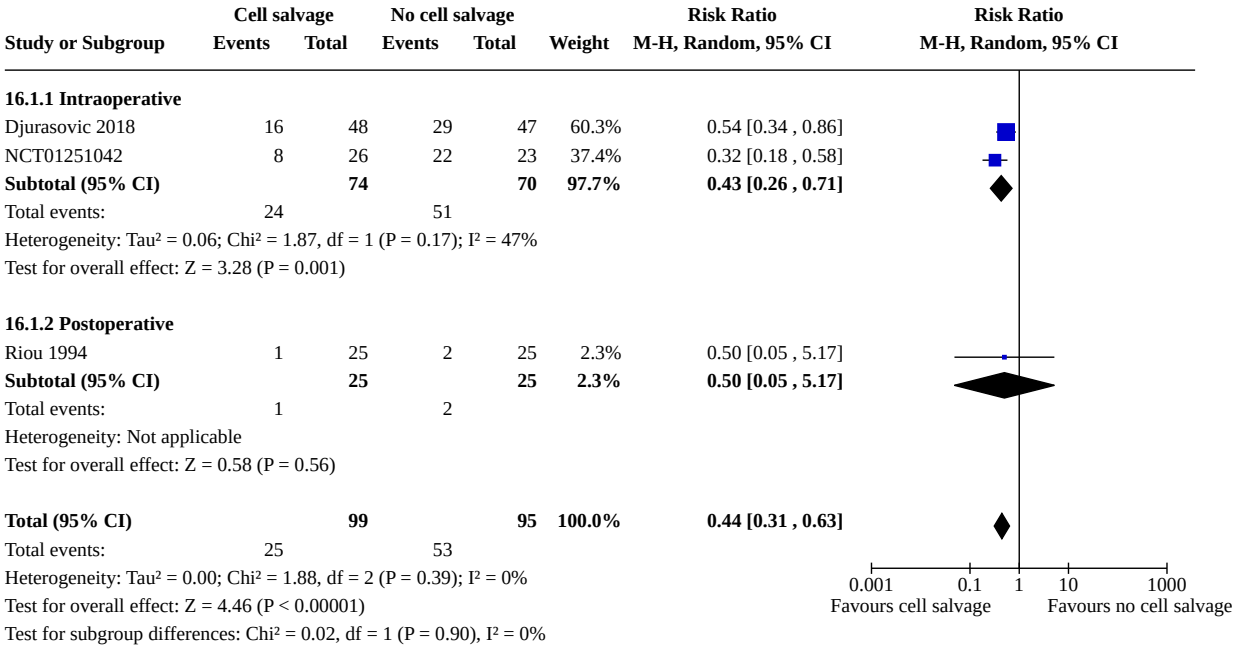
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
16.4 Blood loss (mL)	3	208	Mean Difference (IV, Random, 95% CI)	-121.37 [-245.90, 3.15]
16.4.1 Intraoperative	2	145	Mean Difference (IV, Random, 95% CI)	-111.92 [-238.45, 14.60]
16.4.2 Postoperative	1	63	Mean Difference (IV, Random, 95% CI)	-413.00 [-1115.93, 289.93]
16.5 Infection	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
16.5.1 Postoperative	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
16.6 Wound complication	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
16.6.1 Intraoperative	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
16.7 PE	1		Peto Odds Ratio (Peto, Fixed, 95% CI)	Totals not selected
16.7.1 Postoperative	1		Peto Odds Ratio (Peto, Fixed, 95% CI)	Totals not selected

Analysis 16.1. Comparison 16: Orthopaedic (spinal) (subgroup: timing), Outcome 1: Transfusions



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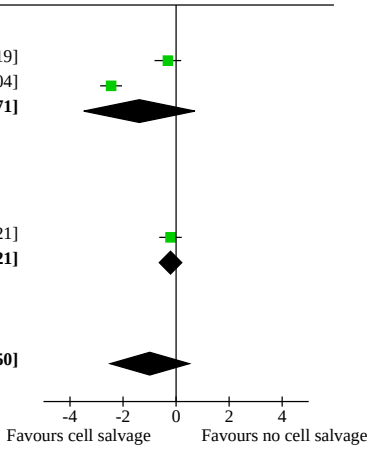
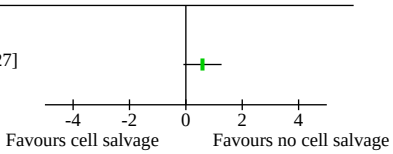
Analysis 16.2. Comparison 16: Orthopaedic (spinal) (subgroup: timing), Outcome 2: Volume of transfusion (units) (PPR)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
16.2.1 Intraoperative								
Djurasovic 2018	0.79	1.3	48	1.1	1.2	47	33.1%	-0.31 [-0.81 , 0.19]
Savvidou 2009	0.58	0.67	25	3.03	0.81	25	33.5%	-2.45 [-2.86 , -2.04]
Subtotal (95% CI)			**73**			**72**	**66.6%**	**-1.39 [-3.48 , 0.71]**
Heterogeneity: Tau² = 2.23; Chi² = 41.62, df = 1 (P < 0.00001); I² = 98%								
Test for overall effect: Z = 1.29 (P = 0.20)								
16.2.2 Postoperative								
Nemani 2019	0.57	0.89	30	0.78	0.82	33	33.4%	-0.21 [-0.63 , 0.21]
Subtotal (95% CI)			**30**			**33**	**33.4%**	**-0.21 [-0.63 , 0.21]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.97 (P = 0.33)								
Total (95% CI)			**103**			**105**	**100.0%**	**-0.99 [-2.49 , 0.50]**
Heterogeneity: Tau² = 1.69; Chi² = 67.64, df = 2 (P < 0.00001); I² = 97%								
Test for overall effect: Z = 1.30 (P = 0.19)								
Test for subgroup differences: Chi² = 1.16, df = 1 (P = 0.28), I² = 13.7%								



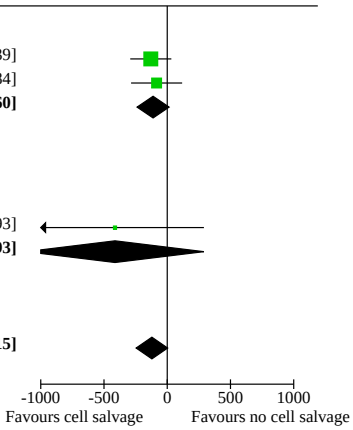
Analysis 16.3. Comparison 16: Orthopaedic (spinal) (subgroup: timing), Outcome 3: Volume of transfusion (units) (PPT)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Mean Difference IV, Random, 95% CI
16.3.1 Intraoperative							
Djurasovic 2018	2.37	1.14	16	1.78	1.05	29	0.59 [-0.09 , 1.27]



Analysis 16.4. Comparison 16: Orthopaedic (spinal) (subgroup: timing), Outcome 4: Blood loss (mL)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
16.4.1 Intraoperative								
Djurasovic 2018	611.8	387.9	48	741.8	418.7	47	58.8%	-130.00 [-292.39 , 32.39]
Savvidou 2009	1028	323	25	1112	401	25	38.1%	-84.00 [-285.84 , 117.84]
Subtotal (95% CI)			**73**			**72**	**96.9%**	**-111.92 [-238.45 , 14.60]**
Heterogeneity: Tau² = 0.00; Chi² = 0.12, df = 1 (P = 0.73); I² = 0%								
Test for overall effect: Z = 1.73 (P = 0.08)								
16.4.2 Postoperative								
Nemani 2019	1862	1325	30	2275	1521	33	3.1%	-413.00 [-1115.93 , 289.93]
Subtotal (95% CI)			**30**			**33**	**3.1%**	**-413.00 [-1115.93 , 289.93]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 1.15 (P = 0.25)								
Total (95% CI)			**103**			**105**	**100.0%**	**-121.37 [-245.90 , 3.15]**
Heterogeneity: Tau² = 0.00; Chi² = 0.80, df = 2 (P = 0.67); I² = 0%								
Test for overall effect: Z = 1.91 (P = 0.06)								
Test for subgroup differences: Chi² = 0.68, df = 1 (P = 0.41), I² = 0%								



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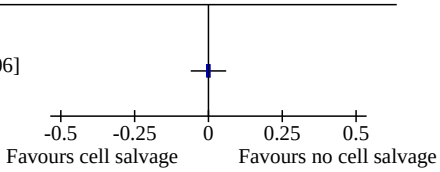
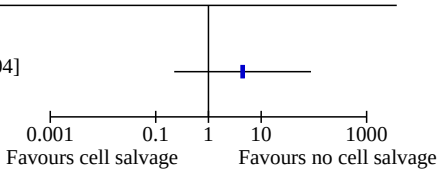
Analysis 16.5. Comparison 16: Orthopaedic (spinal) (subgroup: timing), Outcome 5: Infection

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Risk Difference M-H, Random, 95% CI
16.5.1 Postoperative					
Nemani 2019	0	30	0	33	0.00 [-0.06 , 0.06]



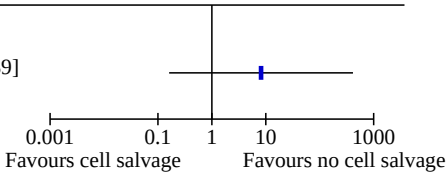
Analysis 16.6. Comparison 16: Orthopaedic (spinal) (subgroup: timing), Outcome 6: Wound complication

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Risk Ratio M-H, Random, 95% CI
16.6.1 Intraoperative					
NCT01251042	2	26	0	23	4.44 [0.22 , 88.04]



Analysis 16.7. Comparison 16: Orthopaedic (spinal) (subgroup: timing), Outcome 7: PE

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Peto Odds Ratio Peto, Fixed, 95% CI
16.7.1 Postoperative					
Nemani 2019	1	30	0	33	8.17 [0.16 , 413.39]



Comparison 17. Orthopaedic (spinal) (subgroup: transfusion threshold)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
17.1 Transfusions	3	194	Risk Ratio (M-H, Random, 95% CI)	0.44 [0.31, 0.63]
17.1.1 Restrictive (Hb ≦ 80 g/L)	1	95	Risk Ratio (M-H, Random, 95% CI)	0.54 [0.34, 0.86]
17.1.2 Liberal (Hb > 80 g/L)	1	50	Risk Ratio (M-H, Random, 95% CI)	0.50 [0.05, 5.17]
17.1.3 No threshold/protocol reported	1	49	Risk Ratio (M-H, Random, 95% CI)	0.32 [0.18, 0.58]
17.2 Volume of transfusion (units) (PPR)	3	208	Mean Difference (IV, Random, 95% CI)	-0.99 [-2.49, 0.50]
17.2.1 Restrictive (Hb ≦ 80 g/L)	3	208	Mean Difference (IV, Random, 95% CI)	-0.99 [-2.49, 0.50]

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Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
17.3 Volume of transfusion (units) (PPT)	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
17.3.1 Restrictive (Hb ≦ 80 g/L)	1		Mean Difference (IV, Random, 95% CI)	Totals not selected
17.4 Blood loss (mL)	3	208	Mean Difference (IV, Random, 95% CI)	-121.37 [-245.90, 3.15]
17.4.1 Restrictive (Hb ≦ 80 g/L)	3	208	Mean Difference (IV, Random, 95% CI)	-121.37 [-245.90, 3.15]
17.5 Infection	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
17.5.1 Restrictive (Hb ≦ 80 g/L)	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
17.6 Wound complication	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
17.6.1 No threshold/protocol reported	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
17.7 PE	1		Peto Odds Ratio (Peto, Fixed, 95% CI)	Totals not selected
17.7.1 Restrictive (Hb ≦ 80 g/L)	1		Peto Odds Ratio (Peto, Fixed, 95% CI)	Totals not selected

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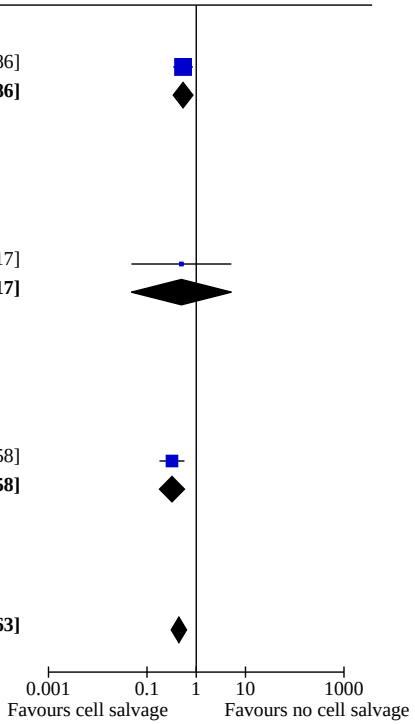
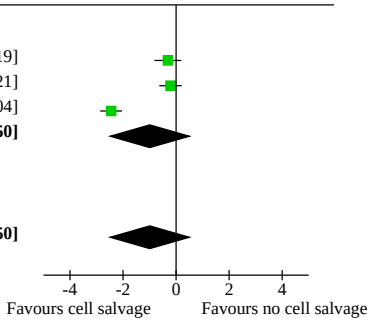
Analysis 17.1. Comparison 17: Orthopaedic (spinal) (subgroup: transfusion threshold), Outcome 1: Transfusions

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Risk Ratio M-H, Random, 95% CI
17.1.1 Restrictive (Hb # 80 g/L)						
Djurasovic 2018	16	48	29	47	60.3%	0.54 [0.34 , 0.86]
Subtotal (95% CI)		**48**		**47**	**60.3%**	**0.54 [0.34 , 0.86]**
Total events:	16		29			
Heterogeneity: Not applicable						
Test for overall effect: Z = 2.63 (P = 0.009)						
17.1.2 Liberal (Hb > 80 g/L)						
Riou 1994	1	25	2	25	2.3%	0.50 [0.05 , 5.17]
Subtotal (95% CI)		**25**		**25**	**2.3%**	**0.50 [0.05 , 5.17]**
Total events:	1		2			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.58 (P = 0.56)						
17.1.3 No threshold/protocol reported						
NCT01251042	8	26	22	23	37.4%	0.32 [0.18 , 0.58]
Subtotal (95% CI)		**26**		**23**	**37.4%**	**0.32 [0.18 , 0.58]**
Total events:	8		22			
Heterogeneity: Not applicable						
Test for overall effect: Z = 3.81 (P = 0.0001)						
Total (95% CI)		**99**		**95**	**100.0%**	**0.44 [0.31 , 0.63]**
Total events:	25		53			
Heterogeneity: Tau² = 0.00; Chi² = 1.88, df = 2 (P = 0.39); I² = 0%						
Test for overall effect: Z = 4.46 (P < 0.00001)						
Test for subgroup differences: Chi² = 1.88, df = 2 (P = 0.39), I² = 0%						



Analysis 17.2. Comparison 17: Orthopaedic (spinal) (subgroup: transfusion threshold), Outcome 2: Volume of transfusion (units) (PPR)

Study or Subgroup	Cell salvage Mean	Cell salvage SD	Cell salvage Total	No cell salvage Mean	No cell salvage SD	No cell salvage Total	Weight	Mean Difference IV, Random, 95% CI
17.2.1 Restrictive (Hb # 80 g/L)								
Djurasovic 2018	0.79	1.3	48	1.1	1.2	47	33.1%	-0.31 [-0.81 , 0.19]
Nemani 2019	0.57	0.89	30	0.78	0.82	33	33.4%	-0.21 [-0.63 , 0.21]
Savvidou 2009	0.58	0.67	25	3.03	0.81	25	33.5%	-2.45 [-2.86 , -2.04]
Subtotal (95% CI)			**103**			**105**	**100.0%**	**-0.99 [-2.49 , 0.50]**
Heterogeneity: Tau² = 1.69; Chi² = 67.64, df = 2 (P < 0.00001); I² = 97%								
Test for overall effect: Z = 1.30 (P = 0.19)								
Total (95% CI)			**103**			**105**	**100.0%**	**-0.99 [-2.49 , 0.50]**
Heterogeneity: Tau² = 1.69; Chi² = 67.64, df = 2 (P < 0.00001); I² = 97%								
Test for overall effect: Z = 1.30 (P = 0.19)								
Test for subgroup differences: Not applicable								



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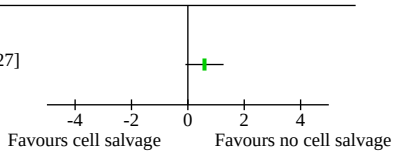
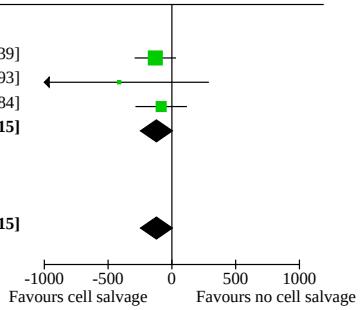
Analysis 17.3. Comparison 17: Orthopaedic (spinal) (subgroup: transfusion threshold), Outcome 3: Volume of transfusion (units) (PPT)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Mean Difference IV, Random, 95% CI
17.3.1 Restrictive (Hb # 80 g/L)							
Djurasovic 2018	2.37	1.14	16	1.78	1.05	29	0.59 [-0.09 , 1.27]



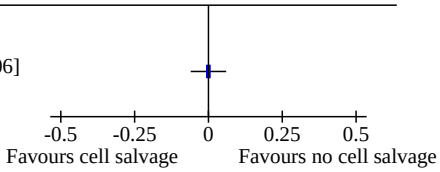
Analysis 17.4. Comparison 17: Orthopaedic (spinal) (subgroup: transfusion threshold), Outcome 4: Blood loss (mL)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
17.4.1 Restrictive (Hb # 80 g/L)								
Djurasovic 2018	611.8	387.9	48	741.8	418.7	47	58.8%	-130.00 [-292.39 , 32.39]
Nemani 2019	1862	1325	30	2275	1521	33	3.1%	-413.00 [-1115.93 , 289.93]
Savvidou 2009	1028	323	25	1112	401	25	38.1%	-84.00 [-285.84 , 117.84]
Subtotal (95% CI)			**103**			**105**	**100.0%**	**-121.37 [-245.90 , 3.15]**
Heterogeneity: Tau² = 0.00; Chi² = 0.80, df = 2 (P = 0.67); I² = 0%								
Test for overall effect: Z = 1.91 (P = 0.06)								
Total (95% CI)			**103**			**105**	**100.0%**	**-121.37 [-245.90 , 3.15]**
Heterogeneity: Tau² = 0.00; Chi² = 0.80, df = 2 (P = 0.67); I² = 0%								
Test for overall effect: Z = 1.91 (P = 0.06)								
Test for subgroup differences: Not applicable								



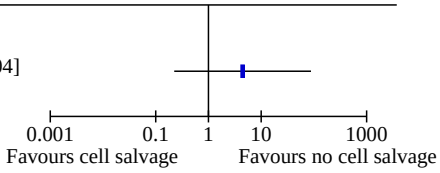
Analysis 17.5. Comparison 17: Orthopaedic (spinal) (subgroup: transfusion threshold), Outcome 5: Infection

Study or Subgroup	Cell salvage Events	Total	No cell salvage Events	Total	Risk Difference M-H, Random, 95% CI
17.5.1 Restrictive (Hb # 80 g/L)					
Nemani 2019	0	30	0	33	0.00 [-0.06 , 0.06]



Analysis 17.6. Comparison 17: Orthopaedic (spinal) (subgroup: transfusion threshold), Outcome 6: Wound complication

Study or Subgroup	Cell salvage Events	Total	No cell salvage Events	Total	Risk Ratio M-H, Random, 95% CI
17.6.1 No threshold/protocol reported					
NCT01251042	2	26	0	23	4.44 [0.22 , 88.04]



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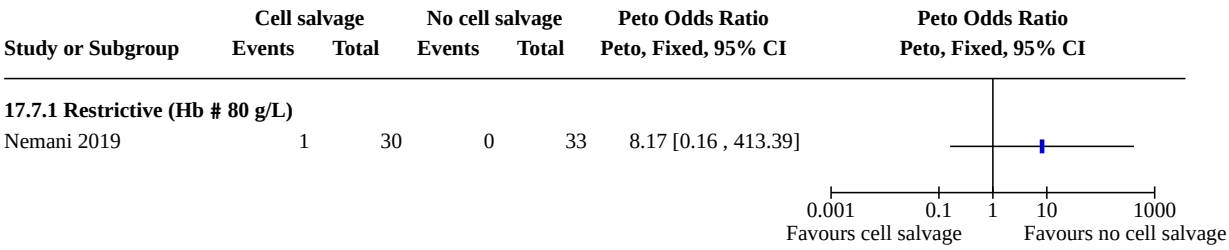
Analysis 17.7. Comparison 17: Orthopaedic (spinal) (subgroup: transfusion threshold), Outcome 7: PE



Comparison 18. Orthopaedic (mixed) (subgroup: timing)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
18.1 Transfusions	11	4011	Risk Ratio (M-H, Random, 95% CI)	0.64 [0.45, 0.90]
18.1.1 Intraoperative	1	40	Risk Ratio (M-H, Random, 95% CI)	0.62 [0.38, 1.02]
18.1.2 Postoperative	7	1349	Risk Ratio (M-H, Random, 95% CI)	0.60 [0.40, 0.90]
18.1.3 Intra- and postoperative	3	2622	Risk Ratio (M-H, Random, 95% CI)	0.74 [0.34, 1.59]
18.2 Volume of transfusion (units) (PPR)	5	2687	Mean Difference (IV, Random, 95% CI)	-0.38 [-0.85, 0.08]
18.2.1 Intraoperative	1	40	Mean Difference (IV, Random, 95% CI)	-0.68 [-0.98, -0.38]
18.2.2 Postoperative	2	146	Mean Difference (IV, Random, 95% CI)	-0.28 [-1.27, 0.71]
18.2.3 Intra- and postoperative	2	2501	Mean Difference (IV, Random, 95% CI)	-0.32 [-1.16, 0.52]
18.3 Volume of transfusion (units) (PPT)	5	395	Mean Difference (IV, Random, 95% CI)	-0.24 [-0.73, 0.24]
18.3.1 Intraoperative	1	26	Mean Difference (IV, Random, 95% CI)	-0.58 [-0.72, -0.44]
18.3.2 Postoperative	2	65	Mean Difference (IV, Random, 95% CI)	-0.02 [-1.00, 0.97]
18.3.3 Intra- and postoperative	2	304	Mean Difference (IV, Random, 95% CI)	-0.23 [-1.03, 0.58]
18.4 Mortality	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
18.4.1 Postoperative	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
18.5 Blood loss (mL)	2	99	Mean Difference (IV, Random, 95% CI)	-28.78 [-97.43, 39.88]
18.5.1 Intraoperative	1	40	Mean Difference (IV, Random, 95% CI)	-30.30 [-100.75, 40.15]

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Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
18.5.2 Intra- and postoperative	1	59	Mean Difference (IV, Random, 95% CI)	0.00 [-306.24, 306.24]
18.6 Infection	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
18.6.1 Postoperative	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
18.7 Wound complication	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
18.7.1 Postoperative	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
18.8 Prosthetic joint infection (PJI)	3	826	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.25 [0.44, 3.51]
18.8.1 Postoperative	3	826	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.25 [0.44, 3.51]
18.9 Thrombosis (VTE)	2	278	Risk Difference (M-H, Random, 95% CI)	0.00 [-0.02, 0.02]
18.9.1 Postoperative	2	278	Risk Difference (M-H, Random, 95% CI)	0.00 [-0.02, 0.02]
18.10 DVT	4	3295	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.41 [0.09, 1.92]
18.10.1 Postoperative	3	853	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.99 [0.09, 10.99]
18.10.2 Intra- and postoperative	1	2442	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.22 [0.03, 1.67]
18.11 PE	4	3295	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.86 [0.48, 7.27]
18.11.1 Postoperative	3	853	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.44 [0.18, 11.64]
18.11.2 Intra- and postoperative	1	2442	Peto Odds Ratio (Peto, Fixed, 95% CI)	2.25 [0.37, 13.57]
18.12 MI	2	3017	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.62 [0.17, 2.22]
18.12.1 Postoperative	1	575	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.05 [0.00, 3.13]
18.12.2 Intra- and postoperative	1	2442	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.81 [0.21, 3.08]
18.13 Hospital LOS (days)	2	160	Mean Difference (IV, Random, 95% CI)	-0.02 [-1.94, 1.90]
18.13.1 Postoperative	2	160	Mean Difference (IV, Random, 95% CI)	-0.02 [-1.94, 1.90]

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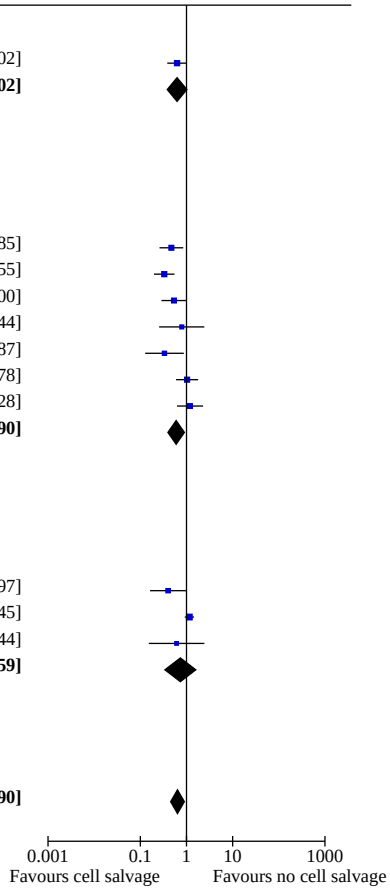
Analysis 18.1. Comparison 18: Orthopaedic (mixed) (subgroup: timing), Outcome 1: Transfusions

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Risk Ratio M-H, Random, 95% CI
18.1.1 Intraoperative						
Zhang 2008	10	20	16	20	11.2%	0.63 [0.38 , 1.02]
Subtotal (95% CI)		**20**		**20**	**11.2%**	**0.63 [0.38 , 1.02]**
Total events:	10		16			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.88 (P = 0.06)						
18.1.2 Postoperative						
Atay 2010	10	37	23	40	10.1%	0.47 [0.26 , 0.85]
Gannon 1991	16	124	45	115	11.0%	0.33 [0.20 , 0.55]
Healy 1994	14	75	15	43	9.8%	0.54 [0.29 , 1.00]
Mauerhan 1993	5	57	6	54	5.6%	0.79 [0.26 , 2.44]
Moonen 2007	5	80	15	80	6.7%	0.33 [0.13 , 0.87]
So-Osman 2006	22	47	10	22	10.6%	1.03 [0.59 , 1.78]
Thomassen 2014	29	385	12	190	9.6%	1.19 [0.62 , 2.28]
Subtotal (95% CI)		**805**		**544**	**63.5%**	**0.60 [0.40 , 0.90]**
Total events:	101		126			
Heterogeneity: $Tau^2 = 0.18$; $Chi^2 = 15.77$, df = 6 (P = 0.02); $I^2 = 62\%$						
Test for overall effect: Z = 2.46 (P = 0.01)						
18.1.3 Intra- and postoperative						
Koopman-van Gemert 1993b	5	29	13	30	7.3%	0.40 [0.16 , 0.97]
So-Osman 2014	183	1481	103	961	13.7%	1.15 [0.92 , 1.45]
Springer 2016	3	60	5	61	4.3%	0.61 [0.15 , 2.44]
Subtotal (95% CI)		**1570**		**1052**	**25.3%**	**0.74 [0.34 , 1.59]**
Total events:	191		121			
Heterogeneity: $Tau^2 = 0.29$; $Chi^2 = 5.72$, df = 2 (P = 0.06); $I^2 = 65\%$						
Test for overall effect: Z = 0.78 (P = 0.43)						
Total (95% CI)		**2395**		**1616**	**100.0%**	**0.64 [0.45 , 0.90]**
Total events:	302		263			
Heterogeneity: $Tau^2 = 0.21$; $Chi^2 = 35.09$, df = 10 (P = 0.0001); $I^2 = 72\%$						
Test for overall effect: Z = 2.58 (P = 0.010)						
Test for subgroup differences: $Chi^2 = 0.22$, df = 2 (P = 0.89), $I^2 = 0\%$						



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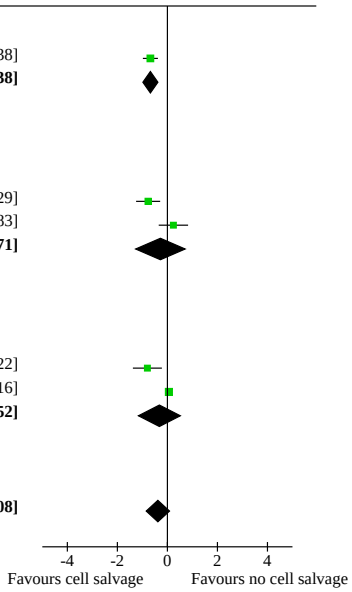
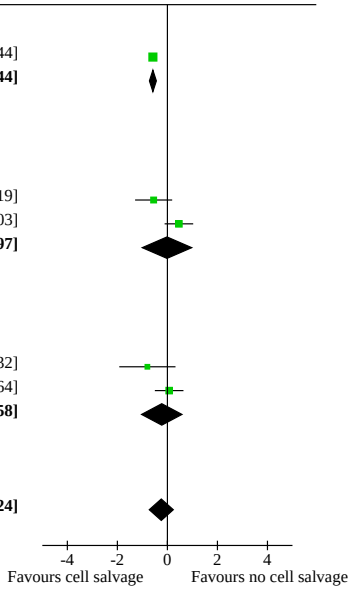
Analysis 18.2. Comparison 18: Orthopaedic (mixed) (subgroup: timing), Outcome 2: Volume of transfusion (units) (PPR)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
18.2.1 Intraoperative								
Zhang 2008	0.36	0.38	20	1.04	0.57	20	21.9%	-0.68 [-0.98 , -0.38]
Subtotal (95% CI)			**20**			**20**	**21.9%**	**-0.68 [-0.98 , -0.38]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 4.44 (P < 0.00001)								
18.2.2 Postoperative								
Atay 2010	0.4	0.83	37	1.17	1.29	40	19.2%	-0.77 [-1.25 , -0.29]
So-Osman 2006	1.1	1.33	47	0.86	1.07	22	17.4%	0.24 [-0.35 , 0.83]
Subtotal (95% CI)			**84**			**62**	**36.6%**	**-0.28 [-1.27 , 0.71]**
Heterogeneity: Tau² = 0.44; Chi² = 6.81, df = 1 (P = 0.009); I² = 85%								
Test for overall effect: Z = 0.55 (P = 0.58)								
18.2.3 Intra- and postoperative								
Koopman-van Gemert 1993b	0.3	0.8	29	1.1	1.4	30	17.6%	-0.80 [-1.38 , -0.22]
So-Osman 2014	0.34	1.37	1481	0.28	1.04	961	23.9%	0.06 [-0.04 , 0.16]
Subtotal (95% CI)			**1510**			**991**	**41.5%**	**-0.32 [-1.16 , 0.52]**
Heterogeneity: Tau² = 0.32; Chi² = 8.24, df = 1 (P = 0.004); I² = 88%								
Test for overall effect: Z = 0.75 (P = 0.45)								
Total (95% CI)			**1614**			**1073**	**100.0%**	**-0.38 [-0.85 , 0.08]**
Heterogeneity: Tau² = 0.23; Chi² = 37.95, df = 4 (P < 0.00001); I² = 89%								
Test for overall effect: Z = 1.61 (P = 0.11)								
Test for subgroup differences: Chi² = 1.10, df = 2 (P = 0.58), I² = 0%								



Analysis 18.3. Comparison 18: Orthopaedic (mixed) (subgroup: timing), Outcome 3: Volume of transfusion (units) (PPT)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
18.3.1 Intraoperative								
Zhang 2008	0.72	0.14	10	1.3	0.22	16	29.2%	-0.58 [-0.72 , -0.44]
Subtotal (95% CI)			**10**			**16**	**29.2%**	**-0.58 [-0.72 , -0.44]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 8.21 (P < 0.00001)								
18.3.2 Postoperative								
Atay 2010	1.49	0.97	10	2.04	1.06	23	17.5%	-0.55 [-1.29 , 0.19]
So-Osman 2006	2.36	0.89	22	1.9	0.7	10	21.0%	0.46 [-0.11 , 1.03]
Subtotal (95% CI)			**32**			**33**	**38.5%**	**-0.02 [-1.00 , 0.97]**
Heterogeneity: Tau² = 0.40; Chi² = 4.48, df = 1 (P = 0.03); I² = 78%								
Test for overall effect: Z = 0.03 (P = 0.97)								
18.3.3 Intra- and postoperative								
Koopman-van Gemert 1993b	1.74	1.16	5	2.54	0.88	13	11.3%	-0.80 [-1.92 , 0.32]
So-Osman 2014	2.72	2.97	183	2.65	1.95	103	21.0%	0.07 [-0.50 , 0.64]
Subtotal (95% CI)			**188**			**116**	**32.3%**	**-0.23 [-1.03 , 0.58]**
Heterogeneity: Tau² = 0.17; Chi² = 1.83, df = 1 (P = 0.18); I² = 45%								
Test for overall effect: Z = 0.55 (P = 0.58)								
Total (95% CI)			**230**			**165**	**100.0%**	**-0.24 [-0.73 , 0.24]**
Heterogeneity: Tau² = 0.20; Chi² = 16.23, df = 4 (P = 0.003); I² = 75%								
Test for overall effect: Z = 1.00 (P = 0.32)								
Test for subgroup differences: Chi² = 1.90, df = 2 (P = 0.39), I² = 0%								



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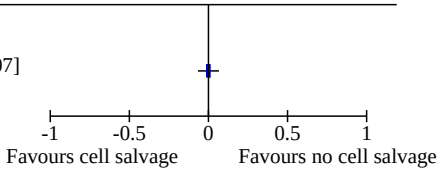
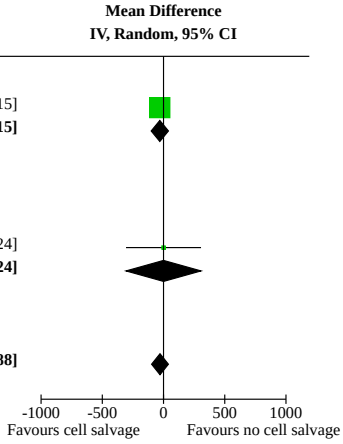
Analysis 18.4. Comparison 18: Orthopaedic (mixed) (subgroup: timing), Outcome 4: Mortality

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Risk Difference M-H, Random, 95% CI
18.4.1 Postoperative					
So-Osman 2006	0	47	0	22	0.00 [-0.07 , 0.07]



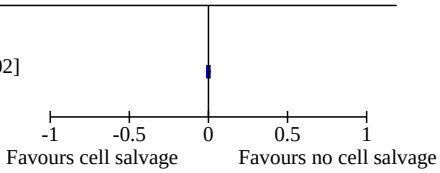
Analysis 18.5. Comparison 18: Orthopaedic (mixed) (subgroup: timing), Outcome 5: Blood loss (mL)

Study or Subgroup	Cell salvage Mean	Cell salvage SD	Cell salvage Total	No cell salvage Mean	No cell salvage SD	No cell salvage Total	Weight	Mean Difference IV, Random, 95% CI
18.5.1 Intraoperative								
Zhang 2008	1380.1	115.2	20	1410.4	112.1	20	95.0%	-30.30 [-100.75 , 40.15]
Subtotal (95% CI)			**20**			**20**	**95.0%**	**-30.30 [-100.75 , 40.15]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.84 (P = 0.40)								
18.5.2 Intra- and postoperative								
Koopman-van Gemert 1993b	1200	600	29	1200	600	30	5.0%	0.00 [-306.24 , 306.24]
Subtotal (95% CI)			**29**			**30**	**5.0%**	**0.00 [-306.24 , 306.24]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.00 (P = 1.00)								
Total (95% CI)			**49**			**50**	**100.0%**	**-28.78 [-97.43 , 39.88]**
Heterogeneity: Tau² = 0.00; Chi² = 0.04, df = 1 (P = 0.85); I² = 0%								
Test for overall effect: Z = 0.82 (P = 0.41)								
Test for subgroup differences: Chi² = 0.04, df = 1 (P = 0.85), I² = 0%								



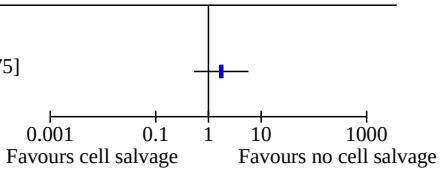
Analysis 18.6. Comparison 18: Orthopaedic (mixed) (subgroup: timing), Outcome 6: Infection

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Risk Difference M-H, Random, 95% CI
18.6.1 Postoperative					
Gannon 1991	0	124	0	115	0.00 [-0.02 , 0.02]



Analysis 18.7. Comparison 18: Orthopaedic (mixed) (subgroup: timing), Outcome 7: Wound complication

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Risk Ratio M-H, Random, 95% CI
18.7.1 Postoperative					
Moonen 2007	7	80	4	80	1.75 [0.53 , 5.75]



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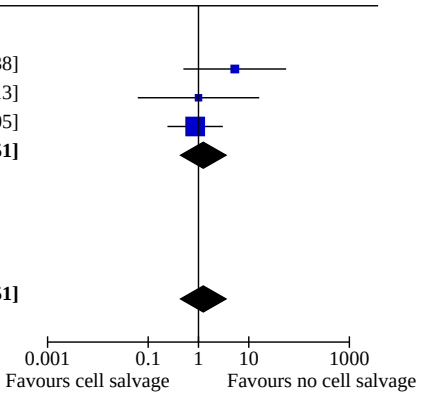
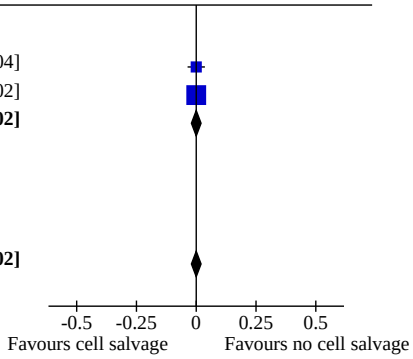
Analysis 18.8. Comparison 18: Orthopaedic (mixed) (subgroup: timing), Outcome 8: Prosthetic joint infection (PJI)

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
18.8.1 Postoperative						
Mac 1993	3	56	0	35	19.4%	5.27 [0.50 , 55.38]
Moonen 2007	1	80	1	80	13.9%	1.00 [0.06 , 16.13]
Thomassen 2014	7	385	4	190	66.8%	0.86 [0.24 , 3.05]
Subtotal (95% CI)		**521**		**305**	**100.0%**	**1.25 [0.44 , 3.51]**
Total events:	11		5			
Heterogeneity: Chi² = 1.80, df = 2 (P = 0.41); I² = 0%						
Test for overall effect: Z = 0.42 (P = 0.68)						
Total (95% CI)		**521**		**305**	**100.0%**	**1.25 [0.44 , 3.51]**
Total events:	11		5			
Heterogeneity: Chi² = 1.80, df = 2 (P = 0.41); I² = 0%						
Test for overall effect: Z = 0.42 (P = 0.68)						
Test for subgroup differences: Not applicable						



Analysis 18.9. Comparison 18: Orthopaedic (mixed) (subgroup: timing), Outcome 9: Thrombosis (VTE)

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Risk Difference M-H, Random, 95% CI
18.9.1 Postoperative						
Healy 1994	0	75	0	43	30.7%	0.00 [-0.04 , 0.04]
Moonen 2007	0	80	0	80	69.3%	0.00 [-0.02 , 0.02]
Subtotal (95% CI)		**155**		**123**	**100.0%**	**0.00 [-0.02 , 0.02]**
Total events:	0		0			
Heterogeneity: Tau² = 0.00; Chi² = 0.00, df = 1 (P = 1.00); I² = 0%						
Test for overall effect: Z = 0.00 (P = 1.00)						
Total (95% CI)		**155**		**123**	**100.0%**	**0.00 [-0.02 , 0.02]**
Total events:	0		0			
Heterogeneity: Tau² = 0.00; Chi² = 0.00, df = 1 (P = 1.00); I² = 0%						
Test for overall effect: Z = 0.00 (P = 1.00)						
Test for subgroup differences: Not applicable						



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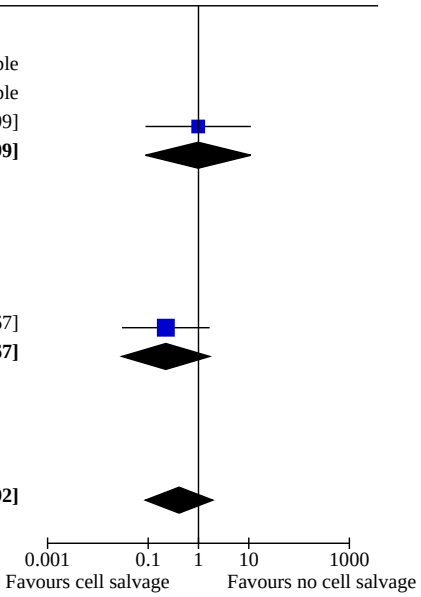
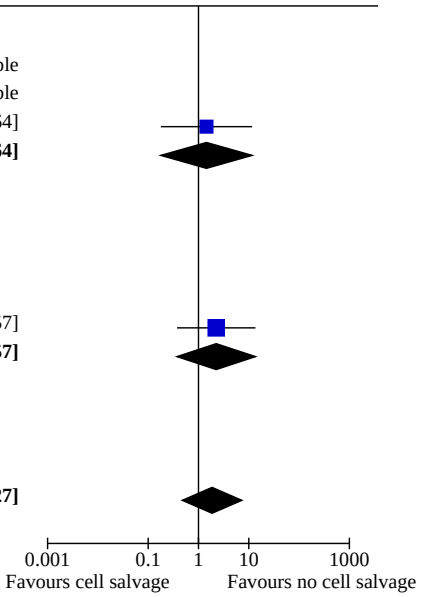
Analysis 18.10. Comparison 18: Orthopaedic (mixed) (subgroup: timing), Outcome 10: DVT

Study or Subgroup	Cell salvage Events	Total	No cell salvage Events	Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
18.10.1 Postoperative						
Healy 1994	0	75	0	43		Not estimable
Moonen 2007	0	80	0	80		Not estimable
Thomassen 2014	2	385	1	190	41.0%	0.99 [0.09 , 10.99]
Subtotal (95% CI)		**540**		**313**	**41.0%**	**0.99 [0.09 , 10.99]**
Total events:	2		1			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.01 (P = 0.99)						
18.10.2 Intra- and postoperative						
So-Osman 2014	1	1481	3	961	59.0%	0.22 [0.03 , 1.67]
Subtotal (95% CI)		**1481**		**961**	**59.0%**	**0.22 [0.03 , 1.67]**
Total events:	1		3			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.46 (P = 0.14)						
Total (95% CI)		**2021**		**1274**	**100.0%**	**0.41 [0.09 , 1.92]**
Total events:	3		4			
Heterogeneity: Chi² = 0.86, df = 1 (P = 0.35); I² = 0%						
Test for overall effect: Z = 1.13 (P = 0.26)						
Test for subgroup differences: Chi² = 0.86, df = 1 (P = 0.35), I² = 0%						



Analysis 18.11. Comparison 18: Orthopaedic (mixed) (subgroup: timing), Outcome 11: PE

Study or Subgroup	Cell salvage Events	Total	No cell salvage Events	Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
18.11.1 Postoperative						
Healy 1994	0	75	0	43		Not estimable
Moonen 2007	0	80	0	80		Not estimable
Thomassen 2014	3	385	1	190	42.5%	1.44 [0.18 , 11.64]
Subtotal (95% CI)		**540**		**313**	**42.5%**	**1.44 [0.18 , 11.64]**
Total events:	3		1			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.34 (P = 0.73)						
18.11.2 Intra- and postoperative						
So-Osman 2014	4	1481	1	961	57.5%	2.25 [0.37 , 13.57]
Subtotal (95% CI)		**1481**		**961**	**57.5%**	**2.25 [0.37 , 13.57]**
Total events:	4		1			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.89 (P = 0.38)						
Total (95% CI)		**2021**		**1274**	**100.0%**	**1.86 [0.48 , 7.27]**
Total events:	7		2			
Heterogeneity: Chi² = 0.10, df = 1 (P = 0.75); I² = 0%						
Test for overall effect: Z = 0.90 (P = 0.37)						
Test for subgroup differences: Chi² = 0.10, df = 1 (P = 0.75), I² = 0%						



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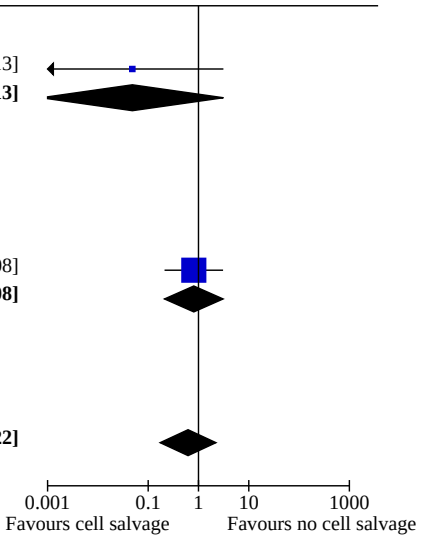
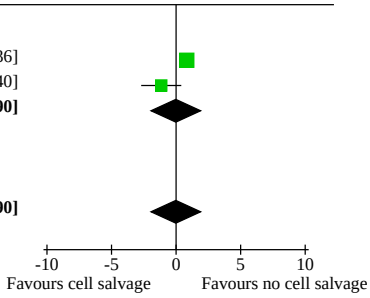
Analysis 18.12. Comparison 18: Orthopaedic (mixed) (subgroup: timing), Outcome 12: MI

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
18.12.1 Postoperative						
Thomassen 2014	0	385	1	190	9.4%	0.05 [0.00 , 3.13]
Subtotal (95% CI)		**385**		**190**	**9.4%**	**0.05 [0.00 , 3.13]**
Total events:	0		1			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.42 (P = 0.15)						
18.12.2 Intra- and postoperative						
So-Osman 2014	5	1481	4	961	90.6%	0.81 [0.21 , 3.08]
Subtotal (95% CI)		**1481**		**961**	**90.6%**	**0.81 [0.21 , 3.08]**
Total events:	5		4			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.31 (P = 0.75)						
Total (95% CI)		**1866**		**1151**	**100.0%**	**0.62 [0.17 , 2.22]**
Total events:	5		5			
Heterogeneity: Chi² = 1.59, df = 1 (P = 0.21); I² = 37%						
Test for overall effect: Z = 0.73 (P = 0.46)						
Test for subgroup differences: Chi² = 1.59, df = 1 (P = 0.21), I² = 36.9%						



Analysis 18.13. Comparison 18: Orthopaedic (mixed) (subgroup: timing), Outcome 13: Hospital LOS (days)

Study or Subgroup	Cell salvage Mean	Cell salvage SD	Cell salvage Total	No cell salvage Mean	No cell salvage SD	No cell salvage Total	Weight	Mean Difference IV, Random, 95% CI
18.13.1 Postoperative								
Mac 1993	7.09	1.74	56	6.26	0.817	35	57.1%	0.83 [0.30 , 1.36]
So-Osman 2006	7.85	3.57	47	9	2.8	22	42.9%	-1.15 [-2.70 , 0.40]
Subtotal (95% CI)			**103**			**57**	**100.0%**	**-0.02 [-1.94 , 1.90]**
Heterogeneity: Tau² = 1.61; Chi² = 5.60, df = 1 (P = 0.02); I² = 82%								
Test for overall effect: Z = 0.02 (P = 0.98)								
Total (95% CI)			**103**			**57**	**100.0%**	**-0.02 [-1.94 , 1.90]**
Heterogeneity: Tau² = 1.61; Chi² = 5.60, df = 1 (P = 0.02); I² = 82%								
Test for overall effect: Z = 0.02 (P = 0.98)								
Test for subgroup differences: Not applicable								



Comparison 19. Orthopaedic (mixed) (subgroup: transfusion threshold)

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
19.1 Transfusions	11	4011	Risk Ratio (M-H, Random, 95% CI)	0.64 [0.45, 0.90]
19.1.1 Restrictive (Hb ≦ 80 g/L)	4	3163	Risk Ratio (M-H, Random, 95% CI)	0.93 [0.63, 1.38]
19.1.2 Liberal (Hb > 80 g/L)	3	458	Risk Ratio (M-H, Random, 95% CI)	0.34 [0.23, 0.51]
19.1.3 No threshold/protocol reported	4	390	Risk Ratio (M-H, Random, 95% CI)	0.61 [0.43, 0.86]

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Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
19.2 Volume of transfusion (units) (PPR)	5	2687	Mean Difference (IV, Random, 95% CI)	-0.38 [-0.85, 0.08]
19.2.1 Restrictive (Hb ≦ 80 g/L)	3	2588	Mean Difference (IV, Random, 95% CI)	-0.15 [-0.68, 0.39]
19.2.2 Liberal (Hb > 80 g/L)	1	59	Mean Difference (IV, Random, 95% CI)	-0.80 [-1.38, -0.22]
19.2.3 No threshold/protocol reported	1	40	Mean Difference (IV, Random, 95% CI)	-0.68 [-0.98, -0.38]
19.3 Volume of transfusion (units) (PPT)	5	395	Mean Difference (IV, Random, 95% CI)	-0.24 [-0.73, 0.24]
19.3.1 Restrictive (Hb ≦ 80 g/L)	3	351	Mean Difference (IV, Random, 95% CI)	0.04 [-0.50, 0.57]
19.3.2 Liberal (Hb > 80 g/L)	1	18	Mean Difference (IV, Random, 95% CI)	-0.80 [-1.92, 0.32]
19.3.3 No threshold/protocol reported	1	26	Mean Difference (IV, Random, 95% CI)	-0.58 [-0.72, -0.44]
19.4 Mortality	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
19.4.1 Restrictive (Hb ≦ 80 g/L)	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
19.5 Blood loss (mL)	2	99	Mean Difference (IV, Random, 95% CI)	-28.78 [-97.43, 39.88]
19.5.1 Liberal (Hb > 80 g/L)	1	59	Mean Difference (IV, Random, 95% CI)	0.00 [-306.24, 306.24]
19.5.2 No threshold/protocol reported	1	40	Mean Difference (IV, Random, 95% CI)	-30.30 [-100.75, 40.15]
19.6 Infection	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
19.6.1 Liberal (Hb > 80 g/L)	1		Risk Difference (M-H, Random, 95% CI)	Totals not selected
19.7 Wound complication	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
19.7.1 Liberal (Hb > 80 g/L)	1		Risk Ratio (M-H, Random, 95% CI)	Totals not selected
19.8 Prosthetic joint infection (PJI)	3	826	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.25 [0.44, 3.51]
19.8.1 Restrictive (Hb ≦ 80 g/L)	1	575	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.86 [0.24, 3.05]

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Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
19.8.2 Liberal (Hb > 80 g/L)	1	160	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.00 [0.06, 16.13]
19.8.3 No threshold/protocol reported	1	91	Peto Odds Ratio (Peto, Fixed, 95% CI)	5.27 [0.50, 55.38]
19.9 Thrombosis (VTE)	2	278	Risk Difference (M-H, Random, 95% CI)	0.00 [-0.02, 0.02]
19.9.1 Liberal (Hb > 80 g/L)	1	160	Risk Difference (M-H, Random, 95% CI)	0.00 [-0.02, 0.02]
19.9.2 No threshold/protocol reported	1	118	Risk Difference (M-H, Random, 95% CI)	0.00 [-0.04, 0.04]
19.10 DVT	4	3295	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.41 [0.09, 1.92]
19.10.1 Restrictive (Hb ≦ 80 g/L)	2	3017	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.41 [0.09, 1.92]
19.10.2 Liberal (Hb > 80 g/L)	1	0	Peto Odds Ratio (Peto, Fixed, 95% CI)	Not estimable
19.10.3 No threshold/protocol reported	1	0	Peto Odds Ratio (Peto, Fixed, 95% CI)	Not estimable
19.11 PE	4	3295	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.86 [0.48, 7.27]
19.11.1 Restrictive (Hb ≦ 80 g/L)	2	3017	Peto Odds Ratio (Peto, Fixed, 95% CI)	1.86 [0.48, 7.27]
19.11.2 Liberal (Hb > 80 g/L)	1	0	Peto Odds Ratio (Peto, Fixed, 95% CI)	Not estimable
19.11.3 No threshold/protocol reported	1	0	Peto Odds Ratio (Peto, Fixed, 95% CI)	Not estimable
19.12 MI	2	3017	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.62 [0.17, 2.22]
19.12.1 Restrictive (Hb ≦ 80 g/L)	2	3017	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.62 [0.17, 2.22]
19.13 Hospital LOS (days)	2	160	Mean Difference (IV, Random, 95% CI)	-0.02 [-1.94, 1.90]
19.13.1 Restricitive (Hb ≦ 80 g/L)	1	69	Mean Difference (IV, Random, 95% CI)	-1.15 [-2.70, 0.40]
19.13.2 No threshold/protocol reported	1	91	Mean Difference (IV, Random, 95% CI)	0.83 [0.30, 1.36]

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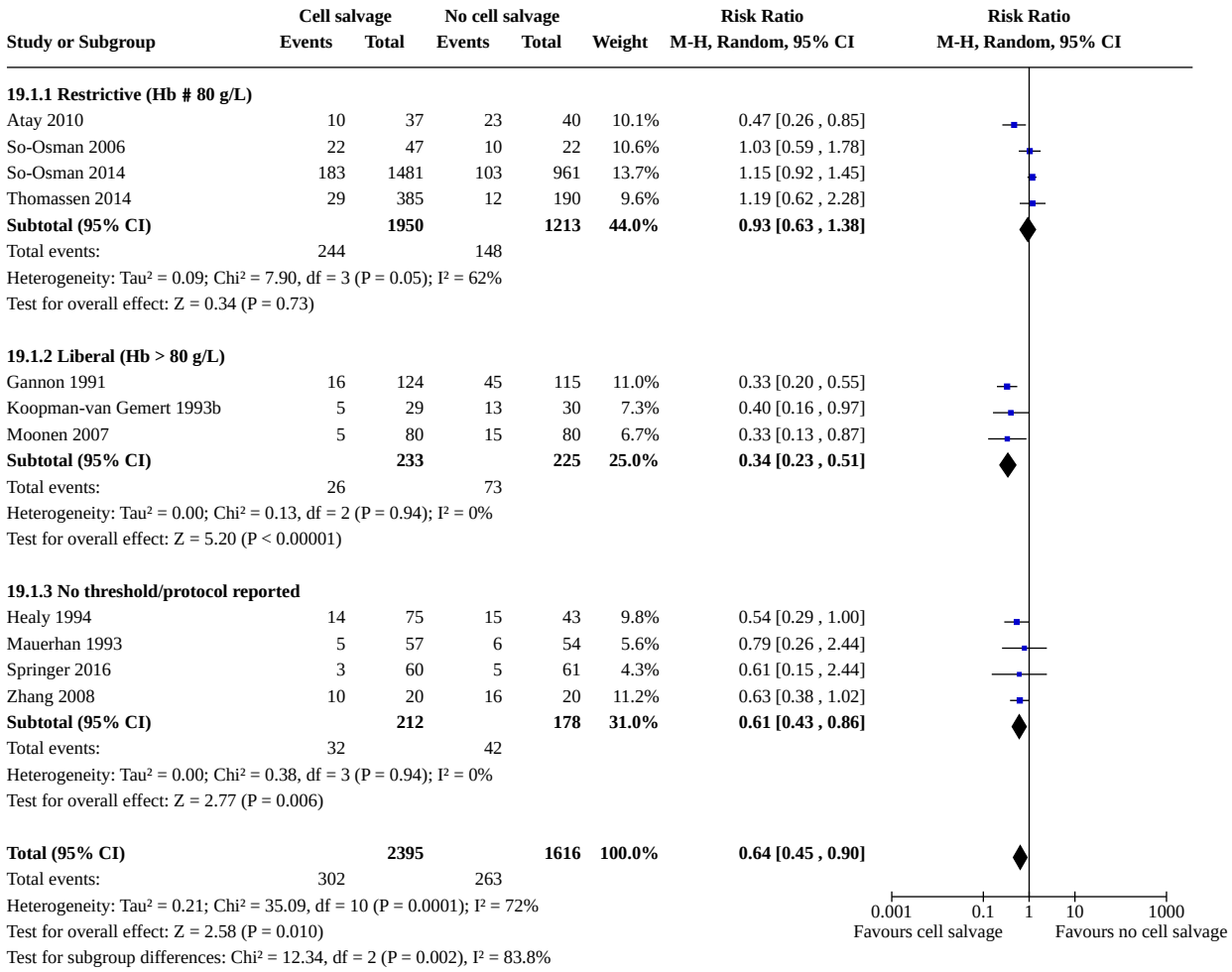
Analysis 19.1. Comparison 19: Orthopaedic (mixed) (subgroup: transfusion threshold), Outcome 1: Transfusions



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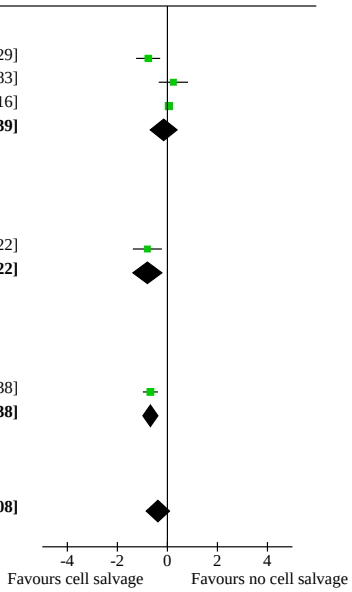
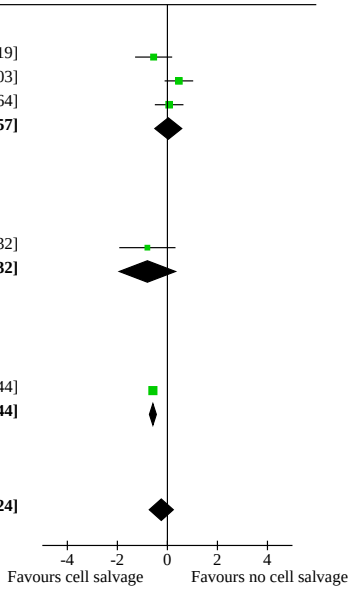
Analysis 19.2. Comparison 19: Orthopaedic (mixed) (subgroup: transfusion threshold), Outcome 2: Volume of transfusion (units) (PPR)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
19.2.1 Restrictive (Hb # 80 g/L)								
Atay 2010	0.4	0.83	37	1.17	1.29	40	19.2%	-0.77 [-1.25 , -0.29]
So-Osman 2006	1.1	1.33	47	0.86	1.07	22	17.4%	0.24 [-0.35 , 0.83]
So-Osman 2014	0.34	1.37	1481	0.28	1.04	961	23.9%	0.06 [-0.04 , 0.16]
Subtotal (95% CI)			**1565**			**1023**	**60.5%**	**-0.15 [-0.68 , 0.39]**
Heterogeneity: Tau² = 0.18; Chi² = 11.49, df = 2 (P = 0.003); I² = 83%								
Test for overall effect: Z = 0.54 (P = 0.59)								
19.2.2 Liberal (Hb > 80 g/L)								
Koopman-van Gemert 1993b	0.3	0.8	29	1.1	1.4	30	17.6%	-0.80 [-1.38 , -0.22]
Subtotal (95% CI)			**29**			**30**	**17.6%**	**-0.80 [-1.38 , -0.22]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 2.71 (P = 0.007)								
19.2.3 No threshold/protocol reported								
Zhang 2008	0.36	0.38	20	1.04	0.57	20	21.9%	-0.68 [-0.98 , -0.38]
Subtotal (95% CI)			**20**			**20**	**21.9%**	**-0.68 [-0.98 , -0.38]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 4.44 (P < 0.00001)								
Total (95% CI)			**1614**			**1073**	**100.0%**	**-0.38 [-0.85 , 0.08]**
Heterogeneity: Tau² = 0.23; Chi² = 37.95, df = 4 (P < 0.00001); I² = 89%								
Test for overall effect: Z = 1.61 (P = 0.11)								
Test for subgroup differences: Chi² = 3.46, df = 2 (P = 0.18), I² = 42.1%								



Analysis 19.3. Comparison 19: Orthopaedic (mixed) (subgroup: transfusion threshold), Outcome 3: Volume of transfusion (units) (PPT)

Study or Subgroup	Cell salvage Mean	SD	Total	No cell salvage Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
19.3.1 Restrictive (Hb # 80 g/L)								
Atay 2010	1.49	0.97	10	2.04	1.06	23	17.5%	-0.55 [-1.29 , 0.19]
So-Osman 2006	2.36	0.89	22	1.9	0.7	10	21.0%	0.46 [-0.11 , 1.03]
So-Osman 2014	2.72	2.97	183	2.65	1.95	103	21.0%	0.07 [-0.50 , 0.64]
Subtotal (95% CI)			**215**			**136**	**59.5%**	**0.04 [-0.50 , 0.57]**
Heterogeneity: Tau² = 0.12; Chi² = 4.48, df = 2 (P = 0.11); I² = 55%								
Test for overall effect: Z = 0.13 (P = 0.90)								
19.3.2 Liberal (Hb > 80 g/L)								
Koopman-van Gemert 1993b	1.74	1.16	5	2.54	0.88	13	11.3%	-0.80 [-1.92 , 0.32]
Subtotal (95% CI)			**5**			**13**	**11.3%**	**-0.80 [-1.92 , 0.32]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 1.40 (P = 0.16)								
19.3.3 No threshold/protocol reported								
Zhang 2008	0.72	0.14	10	1.3	0.22	16	29.2%	-0.58 [-0.72 , -0.44]
Subtotal (95% CI)			**10**			**16**	**29.2%**	**-0.58 [-0.72 , -0.44]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 8.21 (P < 0.00001)								
Total (95% CI)			**230**			**165**	**100.0%**	**-0.24 [-0.73 , 0.24]**
Heterogeneity: Tau² = 0.20; Chi² = 16.23, df = 4 (P = 0.003); I² = 75%								
Test for overall effect: Z = 1.00 (P = 0.32)								
Test for subgroup differences: Chi² = 4.91, df = 2 (P = 0.09), I² = 59.3%								



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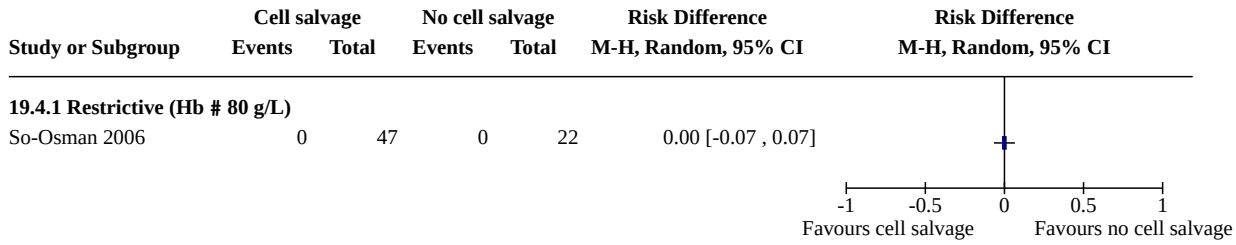
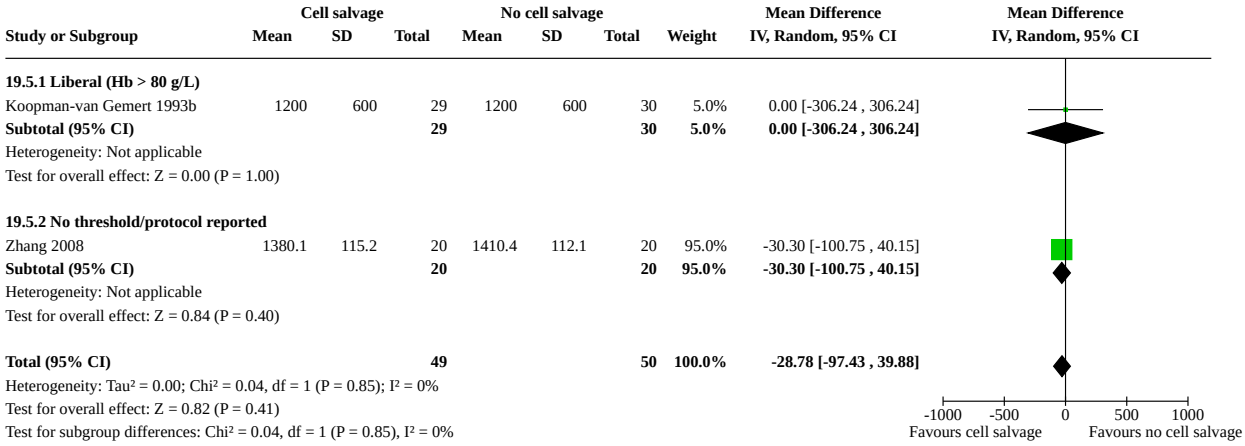
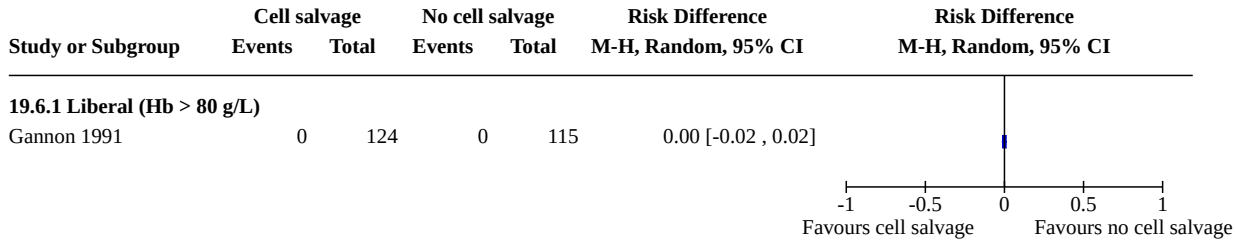
Analysis 19.4. Comparison 19: Orthopaedic (mixed) (subgroup: transfusion threshold), Outcome 4: Mortality



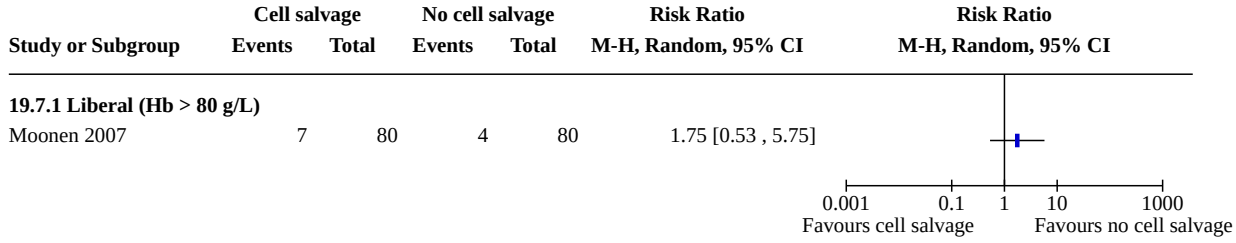
Analysis 19.5. Comparison 19: Orthopaedic (mixed) (subgroup: transfusion threshold), Outcome 5: Blood loss (mL)



Analysis 19.6. Comparison 19: Orthopaedic (mixed) (subgroup: transfusion threshold), Outcome 6: Infection



Analysis 19.7. Comparison 19: Orthopaedic (mixed) (subgroup: transfusion threshold), Outcome 7: Wound complication



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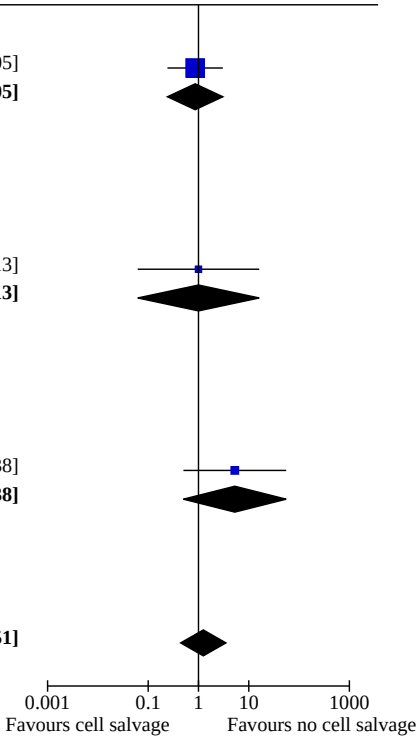
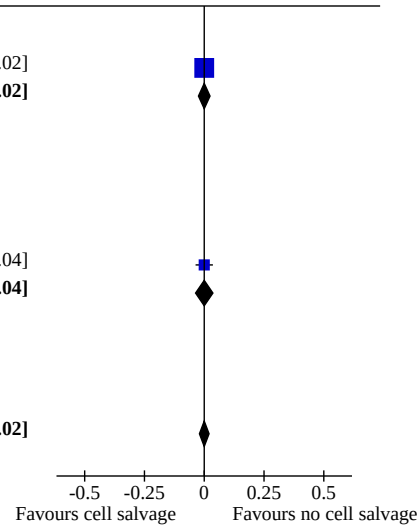
Analysis 19.8. Comparison 19: Orthopaedic (mixed) (subgroup: transfusion threshold), Outcome 8: Prosthetic joint infection (PJI)

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
19.8.1 Restrictive (Hb # 80 g/L)						
Thomassen 2014	7	385	4	190	66.8%	0.86 [0.24 , 3.05]
Subtotal (95% CI)		**385**		**190**	**66.8%**	**0.86 [0.24 , 3.05]**
Total events:	7		4			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.24 (P = 0.81)						
19.8.2 Liberal (Hb > 80 g/L)						
Moonen 2007	1	80	1	80	13.9%	1.00 [0.06 , 16.13]
Subtotal (95% CI)		**80**		**80**	**13.9%**	**1.00 [0.06 , 16.13]**
Total events:	1		1			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.00 (P = 1.00)						
19.8.3 No threshold/protocol reported						
Mac 1993	3	56	0	35	19.4%	5.27 [0.50 , 55.38]
Subtotal (95% CI)		**56**		**35**	**19.4%**	**5.27 [0.50 , 55.38]**
Total events:	3		0			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.38 (P = 0.17)						
Total (95% CI)		**521**		**305**	**100.0%**	**1.25 [0.44 , 3.51]**
Total events:	11		5			
Heterogeneity: Chi² = 1.80, df = 2 (P = 0.41); I² = 0%						
Test for overall effect: Z = 0.42 (P = 0.68)						
Test for subgroup differences: Chi² = 1.80, df = 2 (P = 0.41), I² = 0%						



Analysis 19.9. Comparison 19: Orthopaedic (mixed) (subgroup: transfusion threshold), Outcome 9: Thrombosis (VTE)

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Risk Difference M-H, Random, 95% CI
19.9.1 Liberal (Hb > 80 g/L)						
Moonen 2007	0	80	0	80	69.3%	0.00 [-0.02 , 0.02]
Subtotal (95% CI)		**80**		**80**	**69.3%**	**0.00 [-0.02 , 0.02]**
Total events:	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.00 (P = 1.00)						
19.9.2 No threshold/protocol reported						
Healy 1994	0	75	0	43	30.7%	0.00 [-0.04 , 0.04]
Subtotal (95% CI)		**75**		**43**	**30.7%**	**0.00 [-0.04 , 0.04]**
Total events:	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.00 (P = 1.00)						
Total (95% CI)		**155**		**123**	**100.0%**	**0.00 [-0.02 , 0.02]**
Total events:	0		0			
Heterogeneity: Tau² = 0.00; Chi² = 0.00, df = 1 (P = 1.00); I² = 0%						
Test for overall effect: Z = 0.00 (P = 1.00)						
Test for subgroup differences: Chi² = 0.00, df = 1 (P = 1.00), I² = 0%						



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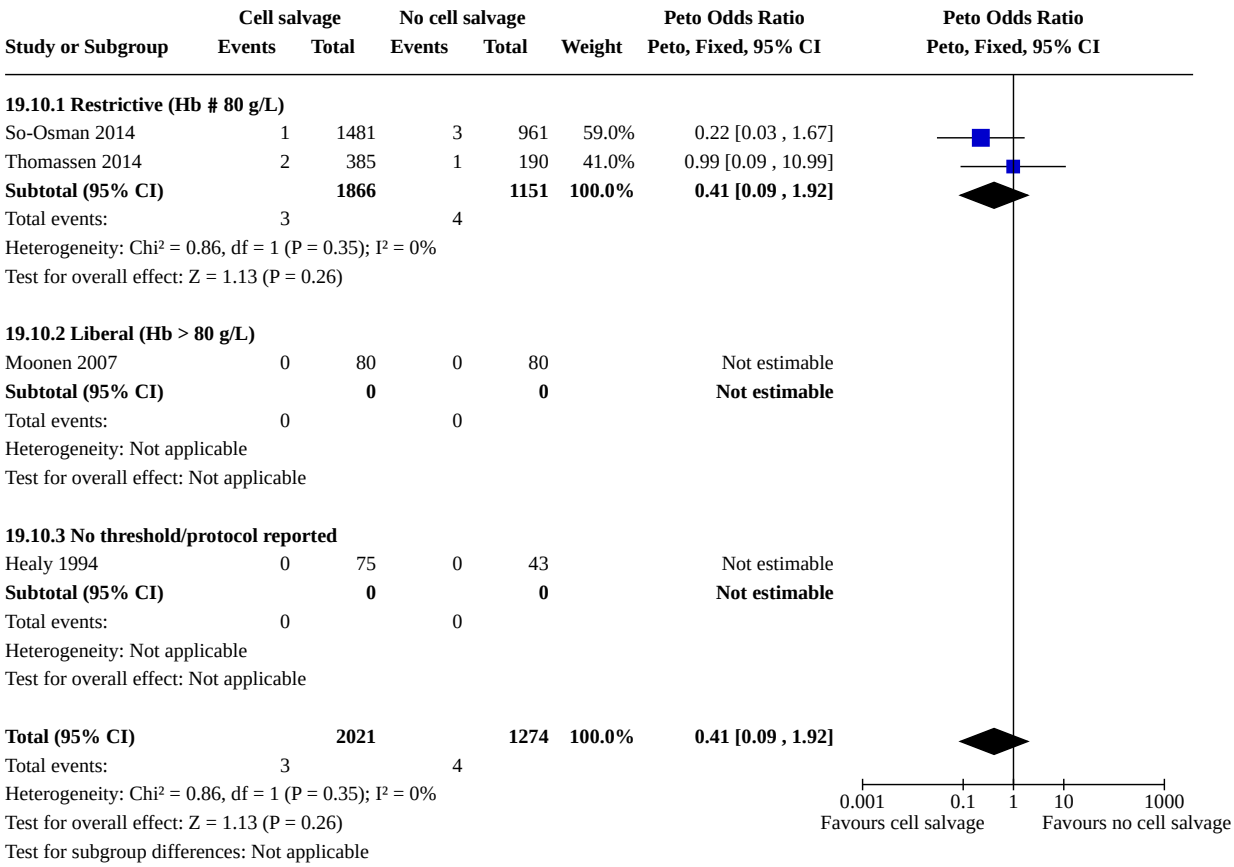
Analysis 19.10. Comparison 19: Orthopaedic (mixed) (subgroup: transfusion threshold), Outcome 10: DVT



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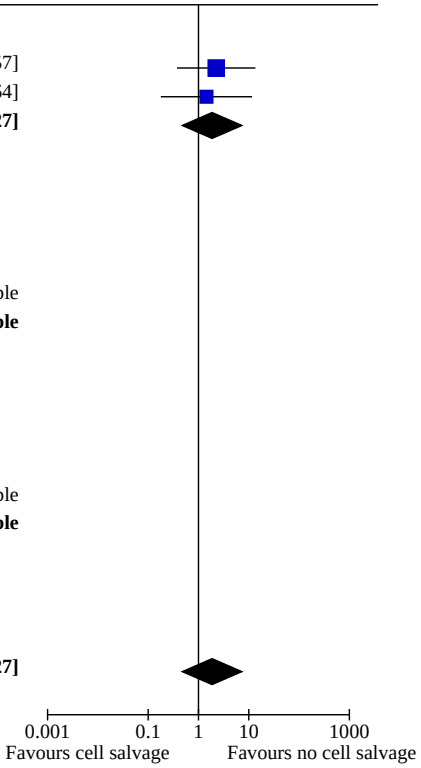
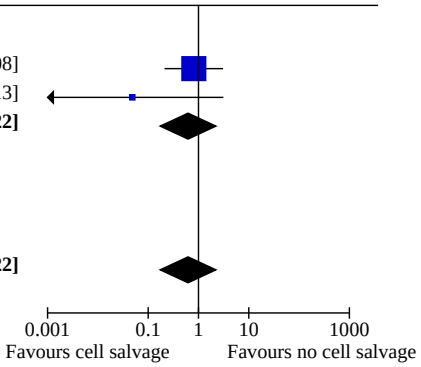
Analysis 19.11. Comparison 19: Orthopaedic (mixed) (subgroup: transfusion threshold), Outcome 11: PE

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
19.11.1 Restrictive (Hb # 80 g/L)						
So-Osman 2014	4	1481	1	961	57.5%	2.25 [0.37 , 13.57]
Thomassen 2014	3	385	1	190	42.5%	1.44 [0.18 , 11.64]
Subtotal (95% CI)		**1866**		**1151**	**100.0%**	**1.86 [0.48 , 7.27]**
Total events:	7		2			
Heterogeneity: Chi² = 0.10, df = 1 (P = 0.75); I² = 0%						
Test for overall effect: Z = 0.90 (P = 0.37)						
19.11.2 Liberal (Hb > 80 g/L)						
Moonen 2007	0	80	0	80		Not estimable
Subtotal (95% CI)		**0**		**0**		**Not estimable**
Total events:	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Not applicable						
19.11.3 No threshold/protocol reported						
Healy 1994	0	75	0	43		Not estimable
Subtotal (95% CI)		**0**		**0**		**Not estimable**
Total events:	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Not applicable						
Total (95% CI)		**2021**		**1274**	**100.0%**	**1.86 [0.48 , 7.27]**
Total events:	7		2			
Heterogeneity: Chi² = 0.10, df = 1 (P = 0.75); I² = 0%						
Test for overall effect: Z = 0.90 (P = 0.37)						
Test for subgroup differences: Not applicable						



Analysis 19.12. Comparison 19: Orthopaedic (mixed) (subgroup: transfusion threshold), Outcome 12: MI

Study or Subgroup	Cell salvage Events	Cell salvage Total	No cell salvage Events	No cell salvage Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
19.12.1 Restrictive (Hb # 80 g/L)						
So-Osman 2014	5	1481	4	961	90.6%	0.81 [0.21 , 3.08]
Thomassen 2014	0	385	1	190	9.4%	0.05 [0.00 , 3.13]
Subtotal (95% CI)		**1866**		**1151**	**100.0%**	**0.62 [0.17 , 2.22]**
Total events:	5		5			
Heterogeneity: Chi² = 1.59, df = 1 (P = 0.21); I² = 37%						
Test for overall effect: Z = 0.73 (P = 0.46)						
Total (95% CI)		**1866**		**1151**	**100.0%**	**0.62 [0.17 , 2.22]**
Total events:	5		5			
Heterogeneity: Chi² = 1.59, df = 1 (P = 0.21); I² = 37%						
Test for overall effect: Z = 0.73 (P = 0.46)						
Test for subgroup differences: Not applicable						



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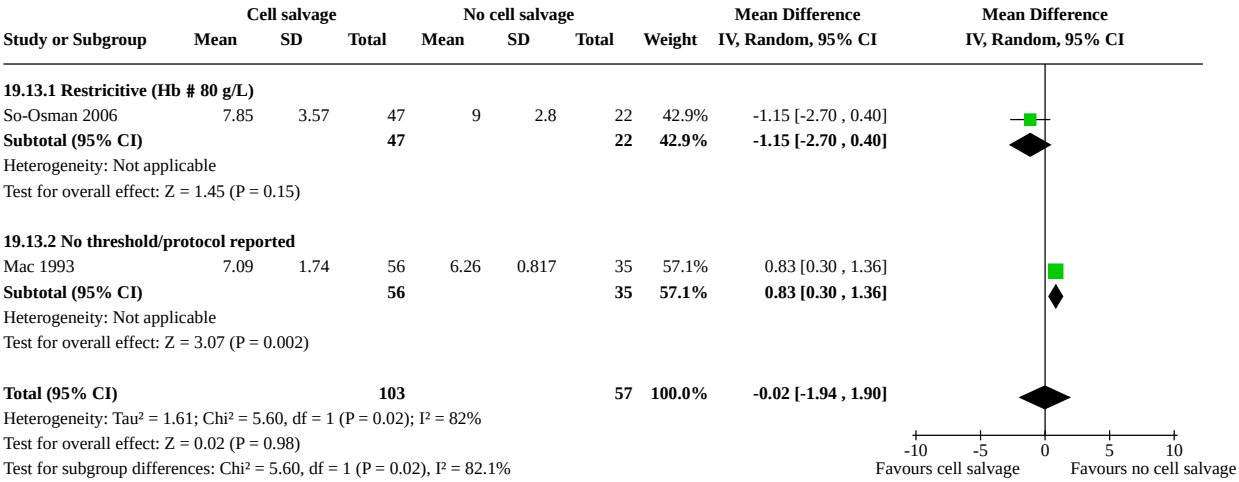
Analysis 19.13. Comparison 19: Orthopaedic (mixed) (subgroup: transfusion threshold), Outcome 13: Hospital LOS (days)



ADDITIONAL TABLES

Table 1. Non-analysable data for all outcomes

Study	Cell salvage (intervention)	No cell salvage (control)	Time point	Notes
Cancer				
Volume (units)				
Jacobi 1997	Total 10 units (n = 12)	Total 23 units (n = 12)	5 days	No spread of data, unclear how many were transfused
Hospital LOS (days)				
Jacobi 1997	Median 16 days (n = 12)	Median 16.5 days (n = 12)		No spread of data
Cardiovascular (vascular)				
Volume (units)				
Mercer 2004	Median 1 unit, IQR 0-3 (n = 40)	Median 3 units, IQR 1-5 (n = 41)	Intraoperative and postoperative	
Spark 1997	Total 11 units across 3 people (Mean: 0.48 units per person transfused; median: 3.29 units)	Total 68 units across 26 people (mean: 2.62 units per person transfused; median: 2.96 units)	In-hospital	Unable to calculate SDs due to "2+" category not specifying actual units, mean calculated from total units and number transfused. Median units reported "per case"

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Table 1. Non-analysable data for all outcomes *(Continued)*

Thompson 1990	Intraoperative: median 0 IQR 0-1 units; postoperative: median 0 IQR 0-2 units (n = 33)	Intraoperative: median 4 IQR 2-4 units; postoperative: median 1 IQR 0-2 units (n = 34)	Intraoperative and postoperative (ICU)	
Blood loss (mL)				
Mercer 2004	Median 1950 mL, IQR 775-2850 (n = 40)	Median 1270 mL, IQR 775-2850 (n = 41)	NR	
Spark 1997	Median 1800 mL, IQR 500-2800 (n = 23)	Median 1500 mL, IQR 500-3045 (n = 27)	in-hospital	
Hospital LOS (days)				
Kelley-Patteson 1993	"Average" stay 8.5 days (n = 18)	"Average" stay 8.9 days (n = 18)		No spread of data
Mercer 2004	Median 12 days, IQR 8-19 (n = 40)	Median 13 days, IQR 10-19 (n = 41)		
Spark 1997	Median 9 days, IQR 7-13 (n = 23)	Median 12 days, IQR 7-19 (n = 27)		
Thompson 1990	Median 8 days	Median 9 days		No spread of data reported
Cardiovascular (no bypass)				
Volume (units)				
Damgaard 2006	Median 1 unit, IQR 0-2, range 0-13 (n = 30)	Median 2 units, IQR 0-5, Range 0-27 (n = 29)	24 hours	
Blood loss (mL)				
Damgaard 2006	Median 655 mL, IQR 508-818 (n = 30)	Median 610 mL, IQR 450-928 (n = 30)	intraoperative	
Hospital LOS (days)				
Damgaard 2006	Median 7 days, IQR 6-8 (n = 30)	Median 7 days, IQR 6-9 (n = 29)		
Murphy 2005	Median 6 days, range 5-8.3 (n = 30)	Median 6 days, Range 5-8 (n = 31)		
Cardiovascular (with bypass)				
Volume (units)				
Adan 1988	Mean 550 mL range 0-1900 mL (n = 25)	Mean 1060 mL range 0-2000 mL (n = 25)	24 hours postoperative	Range only, no SD
Klein 2008	Total 79 units across 31 people (mean: 2.55 units)	Total 100 units across 33 people (mean: 3.03 units)	Intraoperative and postoperative	No spread of data

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Table 1. Non-analysable data for all outcomes *(Continued)*

Marberg 2010	Median 0 units, range 0-1 (n = 39)	Median 0 units, range 0-1 (n = 38)		
Schmidt 1996	Total 26 units across 15 people (mean 2.17 units, no SD)	Total 78 units across 31 people (mean 2.52, no SD)	NR	Mean calculated from total units reported, and number of people receiving transfusions
Scrascia 2012	Total 23 units across 6 people	Total 14 units across 5 people	Intra- and post-operatively (24 hours)	No SD, no spread of data
Thurer 1979	Mean 265 mL packed red cells, no SD, per patient	Mean 200 mL packed red cells, no SD, per patient	In-hospital	Unclear if mean per patient is per patient that received a transfusion, or per patient randomised
Ward 1993	Range 250-1500 mL (n = 6)	Range 250-750 mL (n = 6)	NR	No average reported
Blood loss (mL)				
Adan 1988	Mean 821 mL range 330-1790 mL (n = 25)	Mean 746 mL range 185-1420 mL (n = 25)	24 hrs postoperative	Range only, no SD
Gäbel 2013a	Median 520 range 300-1470 mL (n = 15	Median 390 range 250-660 mL (n = 15)	Postoperative	
Klein 2008	Median 400 mL, IQR 321 (n = 102)	Median 375 mL, IQR 238 (n = 111)	Intraoperative and postoperative	
Schmidt 1996	Median 760 mL, range 295-2065 (n = 53)	Median 820 mL, range 300-2670 (n = 56)		
Thurer 1979	Mean 1403 mL, no SD (n = 54)	Mean 1258 mL, no SD (n = 59)	Postoperative only	
Unsworth 1996	Uncoated: median 853 mL, IQR 595-1348 (n = 36); coated: median 770 mL, IQR 615-1000 (n = 35)	Median 898 mL, IQR 638-1195 (n = 34)	20 hours	
Zhao 2003	Median 660 +/-300 mL, range 80-1230 mL, n = 30	Median 655 +/- 280 mL; range 110-1280 (n = 30)		Unclear whether +/- is SD, IQR, 95%CI, etc. N is assumed
Hospital LOS (days)				
Gäbel 2013a	Median 7 range 3-56 hours (n = 15)	Median 6 range 3-29 hours (n = 15)		ICU stay only
Klein 2008	Median 7 days, IQR 5 (n = 102)	Median 7 days, IQR 3 (n = 111)		
Obstetrics				
Hospital LOS (days)				

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Table 1. Non-analysable data for all outcomes *(Continued)*

Khan 2017 (SALVO)	Median 2.08 days IQR 1 (n = 655)	Median 2.1 days IQR 1.21 (n = 665)		
Orthopaedic (hip)				
Transfusions				
Thomassen 2012	14% of 106 patients (14.84 people)	14% of 110 patients (15.4 people)	discharge	ITT analysis; percentages reported - do not equate to whole people, unable to confidently use data
Volume (units)				
Ayers 1995	Total 9 units across 5 people (1 primary (1%) and 4 revision (11%) surgery)	Total 67 units across 29 people (15 primary (17%) and 14 revision (35%) surgeries)	48 hours postoperative	All patients who underwent revision surgery also received intraoperative cell salvage, whereas those undergoing primary surgery did not. Unable to extract data for primary surgeries only for this outcome
Cheung 2010	Mean 0.34 (total 18 units across 53 people)	Mean 0.47 (total 47 units across 100 people)	NR	Number of units reported as total per group only, no spread of data
Lorentz 1991	Median 125 mL, range 0-1000 (n = 16)	Median 500 mL, range 0-1500 (n = 15)	Intraoperative and postoperative	
Menges 1992	Total 13 units across 8 people (mean: 1.625 units transfused; 0.9 units randomised)	28 units across 12 people (mean: 2.3 units randomised and transfused)	"Observation period"	No spread of data reported
Rollo 1995	Group 1: 1 unit total (n = 1 transfused: mean 1, SD 0); group 2: 12 units total (n = 4 transfused: mean 3, no SD)	Group 3: 0 units total (n = 0 transfused: mean 0 SD 0)	NR	
Smith 2007	Total 14 units across 6 people, mean: 0.18, range: 0-5 (n = 76)	Total 44 units across 17 people, mean: 0.54, range: 0-5 (n = 82)	7 days	No SD reported or calculable
Teetzman 2014	Mean 0.95 units range 0-4 (n = 74)	Mean 0.91 units, range 0-5 (n = 87)		
Thomassen 2012	Mean 735 mL (2.3 units), no SD (n = 106)	Mean 834 mL (2.6 units), no SD (n = 110)		
Zhao 2016	Mean 146.7 mL, no SD (n = 127)	Mean 261 mL, no SD (n = 73)		
Blood loss (mL)				

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Table 1. Non-analysable data for all outcomes *(Continued)*

Ayers 1995	Primary: mean 465 mL, range 200-1100 (n = 67); revision: mean 800 mL, range 300-2200 (n = 36)	No data	All patients who underwent revision surgery also received intraoperative cell salvage, whereas those undergoing primary surgery did not.	
Cheung 2010	Median 300 IQR 200-458 (n = 53)	Median 300 IQR 200-400 (n = 100)	intraoperative	
Ekback 1995	Mean 40% circulating blood volume, SD 11.6% (n = 15)	Mean 45% circulating blood volume, SD 7.7% (n = 15)	3 days	
Rollo 1995	Group 1: mean 656 mL, range 300-1400 (n = 35); group 2: mean 682 mL, range 400-1000 (n = 40)	Group 3: mean 746 mL, range 700-2000 (n = 40)	NR	
Hospital LOS (days)				
Cheung 2010	Median 6 IQR 5-8 days(n = 53)	Median 7 IQR 5.3-9 (n = 52; median 6 IQR 5-7 (n = 48)		
Smith 2007	Mean 6.4 days, range 4-11 (n = 76)	Mean 6.98 days, range 4-17 (n = 82)		
Teetzman 2014	Mean 7 days, range 3-14 (n = 74)	Mean 6.4 days, range 3-11 (n = 87)		
Orthopaedic (knee)				
Transfusions				
Pavelescu 2014	7.6% (unclear N)	23.1% (unclear N)	24 hours	Unknown group size, just n = 78 across 3 groups
Volume (units)				
Abuzakuk 2007	2.3 units (n = 13)	2.3 units (n = 12)	24 hours	Per person transfused, no spread of data reported
Amin 2008	Total 22 units across 12 people (mean: 1.83)	Total 26 units across 13 people (mean: 2 units)	3 days	No spread of data
Breakwell 2000	Mean 3.8 units (n = 14)	Mean 6.3 units (n = 19)	3 days postoperative	No spread of data, no N for number transfused
Cheng 2005	Median 0.15 units, range 0-1 (n = 26)	Median 0.46 units, range 0-4 (n = 34)	3 days postoperative	
Cip 2013	Mean 2.1 units (no SD), n = 23	Mean 2.1 units (no SD), n = 23	5 days postoperative	Number of units per person transfused, no

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Table 1. Non-analysable data for all outcomes *(Continued)*

				SD or other spread of data reported
Dramis 2006	Total 6 units across 3 people (mean: 2 units); average reported as 0.2 units	Total 22 units across 10 people (mean: 2.2 units); average reported as 1.3 units	48 hours	Mean calculated from total units and number of people transfused. No SD reported or calculable. Reported average assumed to be per person randomised (not just those transfused)
Dutton 2012	Mean 0.5 units (n = 23)	Mean 0.47 units (n = 25)	NR	No spread of data reported (no SD)
Horstmann 2014b	Mean: 2.16 units (n = 6)	Mean: 2.27 units (n = 11)		No spread of data, mean calculated from total units transfused/number transfused
Majowski 1991	Total 18 units across 7 people (mean: 0.9 units)	Total 50 units across 19 people (mean: 2.5 units)	48 hours	No spread of data
Munteanu 2009	Median 1 IQR 0-2 (n = 50)	Median 1.5 IQR 0-2 (n = 50)	perioperative	
Newman 1997	Median 0 units, range 0-3 (n = 35)	Median 2 units, range 0-4 (n = 35)	7 days	
Pavelescu 2014	Mean 100 mL, no SD, unclear N	Mean 33.2 mL, no SD, unclear N	24 hours	
Šarkanoviü 2013	1 unit (n = 2), 2 units (n = 3)	1 unit (n = 7), 2 units (n = 32), 3+ units (n = 17)		Unable to calculate no CS group mean and SD due to "3+" category not specifying actual units
Schnurr 2018	Mean 0.2 units, no SD (n = 100)	Mean 0.17 units, no SD (n = 100)	7 days	No SD, no spread of data
Shenolikar 1997	Total 17 units across 8 people (mean: 2.125, SD: 0.35, n = 8)	Mean 2.1 units, range 1-4 (n = 40)	7 days	Mean and SD calculated in intervention group, mean and range reported in control group (SD not calculable)
Touzopoulos 2021	Total 3 units across 2 patients (mean 1.5 units)	Total 2 units across 2 patients (mean 1 unit)	NR	Reported as total units, no spread of data
Blood loss (mL)				
Amin 2008	Mean 659 mL, range 100-1900 (n = 92)	Mean 638 mL, range 86-1470 (n = 86)	24 hours	Unclear if this is range or IQR (range presumed)

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Table 1. Non-analysable data for all outcomes *(Continued)*

Breakwell 2000	Mean 840 mL (n = 14)	Mean 800 mL (n = 19)	Intraoperative (in theatre)	No spread of data, no N for number transfused
Cheng 2005	Mean 273 mL, range 100-600 (n = 26)	Mean 280 mL, range 100-800 (n = 34)	intraoperative	
Laszczyca 2015	Mean 848 mL, no SD (n = 38)	Mean 494, no SD (n = 63)		Total blood loss, no spread of data reported
Pavelescu 2014	Mean 413.46 mL, no SD, unclear N	Mean 451.92 mL, no SD, unclear N	24 hours	
Šarkanoviü 2013	Mean 1688.61 mL, range 400-4800 (n = 55)	Mean 1970.35 mL, range 1000-5350 (n = 57)	48 hours	Unclear if this is mean or median, and range or IQR. Mean and range assumed due to presentation in other tables in this way
Schnurr 2018	Mean 1840 mL, range 590-6405 (n = 100)	Mean 1685mL, range 500-4390 (n = 100)	7 days	Unclear if this is range or IQR
Hospital LOS (days)				
Amin 2008	Mean 6.6 days, range 3-14 (n = 92)	Mean 7 days, range 3-16 (n = 86)		Unclear if this is range or IQR (presumed range)
Horstmann 2014b	Mean 6.7 days, no SD (n = 59)	Mean 6.6 days, no SD (n = 56)		No spread of data
Laszczyca 2015	Mean 10.4 days, no SD (n = 38)	Mean 11 days, no SD (n = 57)		No spread of data
Šarkanoviü 2013	Mean 6.18 days, range 2-11 (n = 55	Mean 7.67 days, range 3-14 (n = 57)		
Shenolikar 1997	Average 15.6 days, range 10-28 (n = 50)	Average 16.7 days, range 10-38 (n = 50)		Unclear if average is median or mean
Orthopaedic (mixed)				
Transfusions				
Kristensen 1992	6/18 hip, and 3/13 knee patients	NR	NR	Only reported in CS group
Volume (units)				
Gannon 1991	Mean 67 mL (n = 124)	Mean 256 mL (n = 115)	NR	No spread of data reported
Healy 1994	Total 31 units across 14 people (group 1: 10 units, 5 people, mean: 2 units; group 2: 21 units, 9 people, mean: 2.3 units)	Total 36 units across 15 people (mean: 2.4 units)	in-hospital	No spread of data reported

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Table 1. Non-analysable data for all outcomes *(Continued)*

Kristensen 1992	Hip: mean 0.61 units, range 0-2 (n = 18); knees: mean 0.31 units, range 0-2 (n = 13)	Hip: mean 2.25 units, range 0-8 (n = 16); knee: mean 3.25 units, range 0-6 (n = 9)	postoperative	No SD reported, unable to combine data from subgroups, no detail on number transfused in control group
Moonen 2007	Mean 2.2 units, range 1-4 (n = 5)	Mean 1.5, range 1-3 (n = 15)	in-hospital	
Blood loss (mL)				
Mac 1993	During surgery: mean 424.02 mL; Postoperative: mean 872.04 mL (n = 56)	During surgery: mean 314.86 mL; Postoperative: mean 826.43 mL (n = 35)	Intra- and post-operatively	No SD reported or any other spread of data
Mauerhan 1993	Mean 596 mL, range 0-1210 (n = 57)	Mean 477 mL, range 130-1205 (n = 54)	postoperative	
So-Osman 2006	Group B: median 500 mL, range 0-2400 (n = 22); group C: median 485 mL, range 0-1700 (n = 24)	Group A: median 313 mL, range 0-1625 (n = 22)	NR	
So-Osman 2014	Group 1 = 650 (median) mL 350 - 1000 (IQR), n = 214; Group 3 = 650 (median) mL 350 - 1000 (IQR), n = 206; Part 2 = 650 (median) mL 400 - 950 (IQR), n = 1061	Group 2 = 650 (median) 400-1000 (IQR), n = 125; Group 4 = 650 (median) 400-950 (IQR), n = 138; Part 2 = 700 (median) 400-1000 (IQR), n = 698	Perioperative	Reports all primary and secondary endpoints evaluated at 3 months
Hospital LOS (days)				
Thomassen 2014	Group B: 4 (median), 4-6 (IQR) days, n = 191; Group C: 4 (median), 4-5 (IQR) days, n = 194	Group A: median 4 days, IQR 4 to 6, n = 190		
Orthopaedic (spinal)				
Transfusions				
Nemani 2019	41.4% of 33 patients (12.42 people)	60% of 33 patients (19.8 people)		Percentages reported - do not equate to whole people, unable to confidently use data
Blood loss (mL)				
NCT 01251042	Mean 1015 mL range 150-3150 (n = 26)	Mean 1162 mL range 350-2800 (n = 23)	7 days	

CS: cell salvage (intervention); IQR: interquartile range; mL: millilitres; N: number of people analysed; NR: not reported; SD: standard deviation

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Table 2. Infectious events

	Intervention							Control						
Study	**N**	**Surgical site infection**	**Respiratory infection**	**UTI**	**Sepsis**	**Other infections**	**Total no. events**	**N**	**Surgical site infection**	**Respiratory infection**	**UTI**	**Sepsis**	**Other infections**	**Total no. events**
Cancer														
Galaal 2019 (TIC TOC)	26						**0**	29						**0**
TOTAL	26						**0**	29						**0**
Events PPR							**0**							**0**
CV (vascular)														
Clagett 1999	50	3	0	2			**5**	50	3	3	4			**10**
Davies 1987	25						**0**	25						**0**
Mercer 2004	40	0	4		4	1	**9**	41	1	12		9	0	**22**
Spark 1997	23		0				**0**	27		3				**3**
Thompson 1990	33	0					**0**	34	1					**1**
TOTAL	171	3	4	2	4	1	**14**	177	5	18	4	9	0	**36**
Events PPR							**0.082**							**0.203**
CV (no bypass)														
Damgaard 2006	30	0	2				**2**	29	2	3				**5**
Goel 2007	24	0					**0**	25	0					**0**
Murphy 2005	30					2	**2**	31					1	**1**
TOTAL	84	0	2			2	**4**	85	2	3			1	**6**
Events PPR							**0.048**							**0.071**

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Table 2. Infectious events *(Continued)*

CV (with bypass)														
Eng 1990	20	0					**0**	20	1					**1**
Klein 2008	102	6				2	**8**	111	5				1	**6**
Page 1989	48				0		**0**	51				0		**0**
Parrot 1991	43					0	**0**	22					0	**0**
Reyes 2011	34					5	**5**	29					4	**4**
Schaff 1978	63	1					**1**	51	3					**3**
Schmidt 1996	53	1					**1**	56	3					**3**
Shen 2016	53	3				4	**7**	50	2				4	**6**
Thurer 1979	54	0		0			**0**	59	1		1			**2**
Vermeijden 2015	364	8	30	13		7	**58**	352	8	23	9		6	**46**
Ward 1993	18	1					**1**	17	0					**0**
TOTAL	852	20	30	13	0	18	**81**	818	23	23	10	0	15	**71**
Events PPR							**0.095**							**0.087**
Orthopaedic (hip)														
Cheung 2010	53	0					**0**	100	2					**2**
Horstmann 2012	50						**0**	50						**0**
Horstmann 2013	102		2				**2**	102		0				**0**
Horstmann 2014a	56		1				**1**	62		0				**0**
Kleinert 2012	40	0	0	0	0	0	**0**	80	0	0	0	0	0	**0**
Rollo 1995	75	0				1	**1**	40	0				0	**0**

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Table 2. Infectious events *(Continued)*

Teetzman 2014	74			1		1	**2**	87	1		2		0	**3**
Thomassen 2012	106					1	**1**	110	1					**1**
TOTAL	556	0	3	1	0	3	**7**	631	4	0	2	0		**6**
Events PPR							**0.013**							**0.010**
Orthopaedic (knee)														
Amin 2008	92	3				2	**5**	86	2				2	**4**
Blatsoukas 2010	163	5					**5**	85	3					**3**
Dutton 2012	23		0				**0**	25		1				**1**
Horstmann 2014b	59		1				**1**	56		0				**0**
Munteanu 2009	50	3					**3**	50	3					**3**
Newman 1997	35		1				**1**	35			3			**3**
Šarkanoviü 2013	55	0					**0**	57	1					**1**
Schnurr 2018	100					0	**0**	100					0	**0**
Shenolikar 1997	50	1	1				**2**	50	1				1	**2**
Thomas 2001	115						**0**	116						**0**
TOTAL	742	12	3			2	**17**	660	10	1	3		3	**17**
Events PPR							**0.023**							**0.026**
Orthopaedic (spinal)														
NCT 01251042	26	1				1	**2**	23	0				0	**0**
Nemani 2019	30						**0**	33	0					**0**
TOTAL	56	1				1	**2**	56	0				0	**0**

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Table 2. Infectious events *(Continued)*

Events PPR							**0.036**							**0**
Orthopaedic (mixed)														
Gannon 1991	124				0		**0**	115				0		**0**
Mac 1993	56	2					**2**	35	0					**0**
Moonen 2007	80						**0**	80						**0**
Thomassen 2014	385	4	4				**8**	190	1	0				**1**
TOTAL	645	6	4		0		**10**	420	1	0		0		**1**
Events PPR							**0.016**							**0.002**
All surgeries														
TOTAL	**3132**	**42**	**46**	**16**	**4**	**27**	**135**	2876	45	45	19	9	19	**137**
Events PPR							**0.043**							**0.048**

CV: cardiovascular; N: number of people analysed (as reported by the study); PPR: per person randomised; UTI: urinary tract infection
"Other infections" includes studies that reported line infection, cellulitis, diverticulitis, and any other reported infection.
Infections are events as reported per study, and is **not** number of people who had an infection (one person could have multiple infectious events, all of which may have been counted individually).
Where studies clearly reported number of people who had an infection (and not number of infectious events), we have analysed the data formally, and presented them in the summary of findings tables.

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Table 3. Overview of included studies (PICO) - Cancer

Study details	Surgery type	CS detail	Intervention detail	Control detail	Outcomes reported (time point)
Galaal 2019 (TIC TOC) RCT Registration: Prospective Country: UK N = 55	Gynaecology (Ovarian cancer)	Timing of collection: intraoperative Washing: washed Transfusion threshold: No threshold System: Varied according to centre	Intraoperative Cell Salvage (ICS) N = 26	Standard Treatment (Donor blood transfusion) N = 29	• Mortality (NR) • Infection (NR)
Jacobi 1997 RCT Registration: N/A Country: Germany N = 24	Urology (Prostate cancer)	Timing of collection: intraoperative Washing: washed Transfusion threshold: No protocol System: Cell Saver® 3 plus from Haemonetics®, Munich	Group 1: autologous transfusion (Retransfusion group) N = 12	Group 2: control (Homologous blood) N = 12	• Volume (NA) • Blood loss (NR) • Mortality (in-hospital) • DVT (postoperative) • Hospital LOS (NA)

ANH: acute normovolemic haemodilution; **AT:** autotransfusion; **CABG:** cardiopulmonary bypass graft; **CS:** cell salvage; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **Hb:** haemoglobin; **Hct:** haematocrit; **LOS:** hospital length of stay; **MACE:** major adverse cardiovascular events; **MI:** myocardial infarction; **N:** planned recruitment (as reported by the study); **NA:** not analysable; **NR:** not reported; **PE:** pulmonary embolism; **PJI:** prosthetic joint infection; **RAP:** retrograde autologous prime; **RCT:** randomised controlled trial; **VTE:** venous thromboembolism
"Registration: N/A" means 'not applicable' as the study was published before 2010
"Volume" refers to mean transfusion volume
"Transfusions" refers to number of people receiving an allogeneic transfusion

Table 4. Overview of included studies (PICO) - Cardiovascular (vascular)

Study details	Population (surgery type)	CS detail	Intervention detail	Control detail	Outcomes reported (time point)
Clagett 1999 RCT Registration: N/A Country: USA N = 100	Vascular (aortic surgery: abdominal aortic aneurysm, aortofemoral bypass)	Timing of collection: intraoperative Washing: washed Transfusion threshold: Hb < 10 g/dL intraoperative; Hb < 8 g/dL postoperative; Hb < 10 g/dL cardiac System: Haemonetics Cell Saver (Haemonetics Corp, Braintree, Mass), or Cell Saver 3 Plus device or Cell Saver 5 device	Intraoperative autotransfusion (IAT) N = 50	Control N = 50	• Transfusions (intraoperative and postoperative) • Volume (intraoperative and postoperative) • Blood loss (intraoperative and postoperative) • Mortality (NR) • Wound complication (NR) • VTE/thrombosis (NR) • DVT (NR) • PE (NR) • MI (NR) • CVA/stroke (NR) • Hospital LOS

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Table 4. Overview of included studies (PICO) - Cardiovascular (vascular) *(Continued)*

Davies 1987 RCT Registration: N/A Country: Australia N = 50	Vascular (abdominal aortic aneurysm or aortofemoral graft)	Timing of collection: intraoperative Washing: unwashed Transfusion threshold: Hct < 30% System: Sorenson system (Sorensen Research Co, Salt Lake City, Utah, USA)	Group A: autotransfusion (intra- and postoperative cell salvage) N = 25	Group H: homologous transfusion without intraoperative salvage N = 25	• Volume (intraoperative and postoperative) • Blood loss (intraoperative) • Mortality (35 days) • Re-operation (NR)
Kelley-Patterson 1993 RCT Registration: N/A Country: USA N = 36	Vascular (aorto-to-bifemoral bypass)	Timing of collection: intraoperative Washing: washed Transfusion threshold: Hb < 8 g/dL System: Cell Saver Autotransfusion Device (Haemonetics Corp., Braintree, Mass.)	AFB/CS N = 18	AFB/no CS N = 18	• Transfusions (intraoperative only) • Volume (4 days) • Blood loss (NR) • Mortality (in-hospital) • MI (NR) • Hospital LOS (NA)
Mercer 2004 RCT Registration: N/A Country: UK N = 81	Vascular (abdominal aortic aneurysm)	Timing of collection: intraoperative Washing: washed Transfusion threshold: Hb < 8 g/dL System: Haemonetics Cell-saver# autologous blood recovery system (Haemonetics UK, Leeds, UK).	Intraoperative autotransfusion (IAT) N = 40	Homologous blood transfusion (HBT) N = 41	• Transfusions (intraoperative and postoperative) • Volume (NA) • Blood loss (NA) • Mortality (37 days postoperative) • Hospital LOS (NA)
Spark 1997 RCT Registration: N/A Country: UK N = 50	Vascular - Abdominal Aortic Aneurysm	Timing of collection: intraoperative Washing: washed Transfusion threshold: Hct < 25% System: COBE Baylor rapid autologous transfusion system (COBE laboratories Inc. Lakewood, Colorado, USA)	Autologous blood N = 23	Homologous blood N = 27	• Transfusions (until discharge) • Volume (NA) • Blood loss (NA) • Mortality (in-hospital) • Re-operation (in-hospital) • Infection (in-hospital) • Hospital LOS (NA)
Thompson 1990 RCT Registration: N/A Country: UK N = 67	Vascular - Abdominal Aortic Aneurysm	Timing of collection: intraoperative Washing: washed Transfusion threshold: Hb < 10 g/dL + Hct < 30% System: Haemolite® device (Haemonetics, Leeds, UK)	Cell Saver N = 33	Controls N = 34	• Volume (NA) • Mortality (30 days) • Infection (NR) • MI (6 weeks) • Hospital LOS (NA)

ANH: acute normovolemic haemodilution; **AT:** autotransfusion; **CABG:** cardiopulmonary bypass graft; **CS:** cell salvage; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **Hb:** haemoglobin; **Hct:** haematocrit; **LOS:** hospital length of stay; **MACE:** major adverse cardiovascular events; **MI:** myocardial infarction; **N:** planned recruitment (as reported by the study); **NA:** not analysable; **NR:** not reported; **PE:** pulmonary embolism; **PJI:** prosthetic joint infection; **RAP:** retrograde autologous prime; **RCT:** randomised controlled trial; **VTE:** venous thromboembolism
"Registration: N/A" means 'not applicable' as the study was published before 2010
"Volume" refers to mean transfusion volume
"Transfusions" refers to number of people receiving an allogeneic transfusion

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Table 5. Overview of included studies (PICO) - Cardiovascular (no bypass)

Study details	Population (surgery type)	CS detail	Intervention detail	Control detail	Outcomes reported (time point)
Damgaard 2006 RCT Registration: N/A Country: Denmark N = 60	Cardiothoracic (CABG) (off CPB)	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hb < 6 mmol/L or Hct < 30% System: NR	Cell saver N = 30	Control: suction blood discharged N = 30	• Transfusions (24 hours) • Volume (NA) • Blood loss (NA) • Mortality (31 days) • Re-operation (NR) • Wound complication (NR) • MI (NR) • CVA/stroke (NR) • Hospital LOS (NA)
Goel 2007 RCT Registration: N/A Country: India N = 49	Cardiothoracic (CABG) (off CPB)	Timing of collection: intraoperative Washing: washed Transfusion threshold: Hb < 9 g/dL System: Dideco, Mirandola, Italy	Group C: cell saver N = 24	Group N: non-cell saver N = 25	• Transfusions (intraoperative and in recovery room) • Volume (intraoperative and in recovery room) • Blood loss (postoperative only) • Mortality (5 days) • Re-operation (in-hospital) • Infection (in-hospital) • Wound complication (in-hospital)
Murphy 2005 RCT Registration: N/A Country: UK N = 61	Cardiothoracic (CABG) (off CPB)	Timing of collection: intraoperative Washing: washed Transfusion threshold: Hb < 8 g/dL or Hct < 23% System: Dideco Compact autotransfuser device (Dideco, Gloucester, United Kingdom)	Autotransfusion N = 30	Control N = 31	• Transfusions (intraoperative and postoperative) • Volume (intraoperative and postoperative) • Mortality (in-hospital) • Infection (NR) • Wound complication (NR) • MI (one month) • CVA/stroke (NR) • Hospital LOS (NA)
Niranjan 2006 - SUBGROUP off-CPB RCT Registration: N/A Country: UK N = 40	Cardiovascular (CABG) (off CPB)	Timing of collection: intraoperative Washing: washed Transfusion threshold: Hb < 8 g/dL System: Dideco Electa autotransfuser device (Dideco, Gloucester, United Kingdom)	Group C (Off-CPB with CSBT) N = 20	Group D (Off-CPB without CSBT) N = 20	• Volume (24 hours) • Blood loss (24 hours) • Mortality (in-hospital) • CVA/stroke (in-hospital) • Hospital LOS
Zhao 1996 RCT Registration: N/A	Cardiothoracic (CABG, valve)	Timing of collection: postoperative Washing: unwashed	Group 1: autotransfusion of shed medi-	Group 2: non ATS (banked blood only) N = 20	• Volume (48 hours) • Blood loss (24 hours)

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Table 5. Overview of included studies (PICO) - Cardiovascular (no bypass) *(Continued)*

Country: China N = 42		Transfusion threshold: No protocol System: simple recycling drainage system (Alium2050, USA)	astinal blood (ATS) N = 22		
Zhao 2017 RCT Registration: No trial registration Country: China N = 120	Cardiothoracic (CABG) (off CPB)	Timing of collection: intraoperative Washing: washed Transfusion threshold: Hb < 8 g/dL System: Dideco Electa blood cell separator (Sorin Group, Italy)	Experimental Group N = 60	Control Group N = 60	• Volume (NR) • Hospital LOS

ANH: acute normovolemic haemodilution; **AT:** autotransfusion; **CABG:** cardiopulmonary bypass graft; **CS:** cell salvage; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **Hb:** haemoglobin; **Hct:** haematocrit; **LOS:** hospital length of stay; **MACE:** major adverse cardiovascular events; **MI:** myocardial infarction; **N:** planned recruitment (as reported by the study); **NA:** not analysable; **NR:** not reported; **PE:** pulmonary embolism; **PJI:** prosthetic joint infection; **RAP:** retrograde autologous prime; **RCT:** randomised controlled trial; **VTE:** venous thromboembolism
"Registration: N/A" means 'not applicable' as the study was published before 2010
"Volume" refers to mean transfusion volume
"Transfusions" refers to number of people receiving an allogeneic transfusion

Table 6. Overview of included studies (PICO) - Cardiovascular (with bypass)

Study details	Population (surgery type)	CS detail	Intervention detail	Control detail	Outcomes reported (time point)
Adan 1988 RCT Registration: N/A Country: The Netherlands N = 50	Cardiothoracic (CABG) (on CPB)	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hb < 5 mmol/L System: Sorenson system (Sorensen Research Co, Salt Lake City, Utah, USA)	Autotransfusion (ATS group) N = 25	control N = 25	• Volume (NA) • Blood loss (NA) • Mortality ("operative mortality")
Axford 1994 RCT Registration: N/A Country: USA N = 32	Cardiothoracic (CABG, valve) (on CPB)	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hct < 25% System: Pleur-evac Autotransfusion System (model A-5005-ATS; Deknatel)	Group 1: retransfused N = 16	Group 2: banked blood only N = 16	• Transfusions (24 hours) • Volume (NR) • Blood loss (NR) • MI (NR)
Dalrymple-Hay 1999 RCT Registration: N/A Country: UK N = 112	Cardiothoracic (CABG, valve) (on CPB)	Timing of collection: postoperative Washing: washed Transfusion threshold: Hb < 10 g/dL System: Fresenius C.A.T.S. continuous autotransfusion system	Group A: autotransfusion drain N = 56	Group C: control N = 56	• Transfusions (24 hours) • Volume (24 hours) • Blood loss (24 hours) • Mortality (NR) • Re-operation (NR) • Hospital LOS

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Table 6. Overview of included studies (PICO) - Cardiovascular (with bypass) *(Continued)*

Eng 1990 RCT Registration: N/A Country: UK N = 40	Cardiothoracic (CABG) (on CPB)	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hct < 25%, Hb < 9 g/dL, Blood loss > 500ml in first 4h System: Shiley hardshell venous reservoir	Study: autotransfusion N = 20	Control: usual care (no AT) N = 20	• Transfusions (postoperative only) • Volume (postoperative only) • Mortality (NR) • Re-operation (NR) • Wound complication (NR) • Hospital LOS
Gäbel 2013a RCT Registration: No trial registration Country: Sweden N = 30	Cardiothoracic (on CPB)	Timing of collection: intraoperative Washing: unwashed Transfusion threshold: Hb < 80 g/L System: cardiotomy suction blood was collected in a separate closed uncoated cardiotomy reservoir (EL402, Medtronic, Minneapolis, USA).	Retransfusion N = 15	No-retransfusion N = 15	• Transfusions (NR) • Volume (NR) • Blood loss (NA) • Re-operation (postoperative) • Infection (NR) • VTE/thrombosis (NR) • DVT (NR) • PE (NR) • MACE (NR) • MI (NR) • CVA/stroke (NR) • Hospital LOS (NA)
Klein 2008 RCT Registration: N/A Country: UK N = 213	Cardiothoracic (CABG, valve) (on CPB)	Timing of collection: both intra- and postoperatively Washing: washed Transfusion threshold: Hb < 8 g/dL System: CATS - Fresenius Hemocare, France	Cell salvage N = 102	Control N = 111	• Transfusions (intraoperative and postoperative) • Volume (NA) • Blood loss (NA) • Mortality (postoperative) • Re-operation (NR) • Wound complication (NR) • Hospital LOS (NA)
Koopman-van Gemert 1993a RCT Registration: N/A Country: The Netherlands N = 40	Cardiothoracic (CABG) (on CPB)	Timing of collection: both intra- and postoperatively Washing: washed Transfusion threshold: Hct < 30% System: Cell saver III-plus (Haemonetics Corporation, Braintree, USA)	Group 1: perioperative autotransfusion N = 20	Group 2: homologous transfusion only N = 20	• Transfusions (intraoperative and postoperative) • Volume (intraoperative and postoperative) • Blood loss (perioperative)
Lepore 1989 RCT Registration: N/A Country: Sweden N = 135	Cardiothoracic (on CPB)	Timing of collection: postoperative Washing: unwashed Transfusion threshold: No protocol System: Dideco 742. Nordmedic. Sweden and Sorensen Receptaseal, Abbot Scand. Sweden	Autotransfusion N = 67	Control N = 68	• Transfusions (postoperative) • Volume (postoperative) • Blood loss (6 hours) • Mortality (5 days)

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Table 6. Overview of included studies (PICO) - Cardiovascular (with bypass) *(Continued)*

Marberg 2010 RCT Registration: No trial registration Country: Sweden N = 80	Cardiothoracic (CABG) (on CPB)	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hb < 80 g/L System: NR	Autotransfusion N = 40	No Autotransfusion N = 40	• Transfusions (in-hospital) • Volume (NA) • Blood loss (postoperative 12 hours) • Mortality (perioperative)
Martin 2000 RCT Registration: N/A Country: USA N = 198	Cardiothoracic (CABG, valve) (on CPB)	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hb < 80 g/L System: Atrium Medical Corporation, Hudson, NH	Reinfusion group N = 98	Control group N = 100	• Transfusions (NR) • Volume (NR) • Blood loss (perioperative) • Mortality (in-hospital) • Re-operation (NR) • MI (NR) • CVA/stroke (NR)
McShane 1987 RCT Registration: N/A Country: Ireland N = 41	Cardiothoracic (on CPB)	Timing of collection: intraoperative Washing: washed Transfusion threshold: No protocol System: Dideco Autotrans BT 795 (Dideco S.p.A., Mirandola, Italy)	Saved blood group (autotransfusion) N = 20	Donor blood group (homologous blood only) N = 21	• Mortality (immediate postoperative period)
Niranjan 2006 - SUBGROUP on-CPB RCT Registration: N/A Country: UK N = 40	Cardiovascular (CABG) (on CPB)	Timing of collection: intraoperative Washing: washed Transfusion threshold: Hb < 8 g/dL System: Dideco Electa autotransfuser device (Dideco, Gloucester, United Kingdom)	Group A (On-CPB with CSBT) N = 20	Group B (On-CPB without CSBT) N = 20	• Volume (24 hours) • Blood loss (24 hours) • Mortality (in-hospital) • CVA/stroke (in-hospital) • Hospital LOS
Page 1989 RCT Registration: N/A Country: UK N = 99	Cardiothoracic (CABG) (on CPB)	Timing of collection: intraoperative Washing: unwashed Transfusion threshold: Hct < 30% System: Bentley Catr hard-shell cardiotomy reservoir (Bentley-Edwards CVS Division, Baxter) Healthcare, Newbury, England)	Group 2: reinfusion of shed mediastinal blood N = 48	Group 1: conventional mediastinal drainage N = 51	• Transfusions (NR) • Volume (NR) • Blood loss (18 hours) • Re-operation (in-hospital) • Infection (in-hospital)
Parrot 1991 - ALL RCT Registration: N/A Country: France N = 66	Cardiothoracic (CABG) (on CPB)	Timing of collection: ALL Washing: both Transfusion threshold: Hb < 10 g/dL or Hct < 30% System: intraoperative: Haemonetics Cell Saver III (Haemonetics Corp. Braintree. MA), postoperative: PLEUR-EVAC A 4005, Deknatel, Pfizer Hospital Products, Queens Village. NY) and Haemonetics Haemolite.	Group 2 and 3 N = 44	Group 1: control N = 22	• Transfusions (intraoperative and postoperative) • Volume (intraoperative and postoperative) • Blood loss (intraoperative and postoperative) • Mortality (NR) • Infection (NR)

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Table 6. Overview of included studies (PICO) - Cardiovascular (with bypass) *(Continued)*

Parrot 1991 - SUBGROUP intraoperative only RCT Registration: N/A Country: France N = 33	Cardiothoracic (CABG) (on CPB)	Timing of collection: intraoperative Washing: unwashed Transfusion threshold: Hb < 10 g/dL or Hct < 30% System: intraoperative: Haemonetics Cell Saver III (Haemonetics Corp. Braintree. MA)	Group 2: intraoperative only N = 22	Group 1: control N = 11	• Transfusions (intraoperative and postoperative) • Volume (intraoperative and postoperative) • Blood loss (intraoperative and postoperative) • Mortality (NR) • Infection (NR)
Parrot 1991 - SUBGROUP both intra- and postoperatively RCT Registration: N/A Country: France N = 33	Cardiothoracic (CABG) (on CPB)	Timing of collection: both intra- and postoperatively Washing: both Transfusion threshold: Hb < 10 g/dL or Hct < 30% System: intraoperative: Haemonetics Cell Saver III (Haemonetics Corp. Braintree. MA), postoperative: PLEUR-EVAC A 4005, Deknatel, Pfizer Hospital Products, Queens Village. NY) and Haemonetics Haemolite.	Group 3: intraoperative and postoperative N = 22	Group 1: control N = 11	• Transfusions (intraoperative and postoperative) • Volume (intraoperative and postoperative) • Blood loss (intraoperative and postoperative) • Mortality (NR) • Infection (NR)
Pleym 2005 RCT Registration: N/A Country: Norway N = 47	Cardiothoracic (CABG) (on CPB)	Timing of collection: postoperative Washing: unwashed Transfusion threshold: No protocol System: Cardiotomy resevoir: Card. Reservoir, filtered; Sorin Biomedica UK, Ltd. Harrogate, UK)	Autotransfusion N = 23	No autotransfusion N = 24	• Transfusions (in-hospital) • Blood loss (16 hours (postoperative only)) • Mortality (in-hospital) • Re-operation (in-hospital)
Reyes 2011 RCT Registration: No trial registration Country: Spain N = 63	Cardiothoracic (on CPB)	Timing of collection: intraoperative Washing: washed Transfusion threshold: No threshold System: CATS Fresenius Hemocare, France	Cell salvage (CS) Group N = 34	Control group N = 29	• Transfusions (30 days) • Blood loss (24 hours) • Mortality (30 days) • Re-operation (30 days) • Infection (30 days) • Hospital LOS
Schaff 1978 RCT Registration: N/A Country: USA N = 114	Cardiothoracic (on CPB)	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hct < 35% System: Sorenson ATS (autotransfusion system)	Autotransfusion system (ATS) N = 63	Control N = 51	• Volume (NR) • Blood loss (NR) • Mortality (NR) • Infection (NR) • Wound complication (NR)
Schmidt 1996 RCT Registration: N/A	Cardiothoracic (CABG) (on CPB)	Timing of collection: postoperative Washing: NR	Autotransfusion group N = 53	Control group N = 56	• Transfusions (NR) • Volume (NA) • Blood loss (NA) • Infection (NR)

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Table 6. Overview of included studies (PICO) - Cardiovascular (with bypass) *(Continued)*

Country: Denmark N = 109		Transfusion threshold: Hb < 5.5 mmol/L System: NR			• MI (NR)
Schönberger 1993 RCT Registration: N/A Country: The Netherlands N = 40	Cardiovascular (CABG) (on CPB)	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hct < 25% System: NR	Group 1: AT (autotransfusion) N = 20	Group 2: control (homologous blood only) N = 20	• Transfusions (24 hours) • Volume (24 hours) • Blood loss (perioperative) • Mortality (perioperative) • Re-operation (in-hospital) • MI (in-hospital)
Scrascia 2012 RCT Registration: No trial registration Country: Italy N = 34	Cardiothoracic (CABG) (on CPB)	Timing of collection: intraoperative Washing: washed Transfusion threshold: No protocol System: Hemonetics® Cell Saver® 5 (Hemonetics Corporation, Braintree, MA USA)	Cell Salvage Group N = 17	Control Group N = 17	• Transfusions (24 hours) • Volume (NA) • Blood loss (48 hours) • Mortality (in-hospital) • Re-operation (NR) • CVA/stroke (NR) • Hospital LOS
Shen 2016 RCT Registration: Prospective Country: China N = 103	Cardiothoracic (on CPB)	Timing of collection: intraoperative Washing: washed Transfusion threshold: Hb < 8 g/dL System: Haemonetics 5+, USA	Group CS (cell salvage) N = 53	Group C (control) N = 50	• Transfusions (NR) • Volume (NR) • Blood loss (NR) • Mortality (24 hours) • Re-operation (NR) • Wound complication (NR) • MI (NR) • Hospital LOS
Shirvani 1991 RCT Registration: N/A Country: UK N = 42	Cardiothoracic (CABG)	Timing of collection: postoperative Washing: NR Transfusion threshold: Hct < 30% System: Cell Saver device not described. (Device used for reinfusion: IMED 960 Volumetric Infusion) Pump	Group 2: autotransfusion N = 21	Group 1: control N = 21	• Transfusions (NR) • Volume (NR) • Re-operation (7 days)
Thurer 1979 RCT Registration: N/A Country: USA N = 113	Cardiothoracic (on CPB)	Timing of collection: postoperative Washing: unwashed Transfusion threshold: No threshold, Hct < 30% + unstable System: Sorenson Research Corporation, Salt Lake City, UT	Autotransfused Group N = 54	Control Group N = 59	• Transfusions (in-hospital) • Volume (NA) • Blood loss (NA) • Mortality (in-hospital) • Re-operation (NR) • Infection (NA) • Wound complication (NR)

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Table 6. Overview of included studies (PICO) - Cardiovascular (with bypass) *(Continued)*

					• MI (NR)
Unsworth 1996 RCT Registration: N/A Country: UK N = 105	Cardiothoracic (CABG) (on CPB)	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hct < 25% System: NR (Cardiotomy reservoir = CATR 3500)	Group 2: uncoated autotransfusion and Group 3: coated autotransfusion (combined) N = 71	Group 1: no autotransfusion N = 34	• Transfusions (NR) • Volume (NR) • Blood loss (NA) • Mortality (NR) • Re-operation (NR)
Vermeijden 2015 RCT Registration: Retrospective (one year) Country: The Netherlands N = 716	Cardiothoracic (CABG, valve) (on CPB)	Timing of collection: intraoperative Washing: washed Transfusion threshold: Hb < 5 mmol/L System: The centers used their own CS with standard washing program (CATS [Fresenius], Brat 5 [Haemonetics, Braintree, MA], or Dideco-electa [Sorin, Milan, Italy]	Group CS & Group CS + Filter N = 364	Group Filter & Group Control N = 352	• Transfusions (in-hospital) • Volume (in-hospital) • Blood loss (perioperative) • Mortality (1 year) • Infection (discharge) • MI (NR) • CVA/stroke (NR) • Hospital LOS
Ward 1993 RCT Registration: N/A Country: USA N = 35	Cardiothoracic (CABG, valve)	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hb < 8 g/dL System: In-line autotransfusion system (Gish Biomedical, Inc, Santa Ana, CA)	Autotransfusion N = 18	Control (no autotransfusion) N = 17	• Transfusions (NR) • Volume (NA) • Blood loss (NR) • Mortality (NR) • Re-operation (NR) • Infection (NR) • Wound complication (NR) • MI (NR)
Westerberg 2004 RCT Registration: N/A Country: Sweden N = 29	Cardiothoracic (CABG) (on CPB)	Timing of collection: both intra and postoperatively Washing: NR Transfusion threshold: No protocol System: D 903 Avant, Dideco; Mirandola, Modena, Italy)	Retransfusion Group N = 12	No-Retransfusion Group N = 17	• Transfusions (NR) • Blood loss (12 hours)
Xie 2015 RCT Registration: Prospective Country: China N = 150	Cardiothoracic (on CPB)	Timing of collection: intraoperative Washing: washed Transfusion threshold: Hb < 80 g/L System: Haemonetics, USA, volume of disposable centrifuge bowl is 125mL	Group CS (cell salvage) N = 75	Group C (control) N = 75	• Transfusions (24 hours) • Volume (NR) • Blood loss (intraoperative) • Mortality (24 hours) • Hospital LOS
Zhao 2003 RCT Registration: N/A Country: China N = 60	Cardiothoracic (CABG) (on CPB)	Timing of collection: postoperative Washing: unwashed Transfusion threshold: No protocol	Group 1: shed mediastinal blood N = 30	Group 2: banked blood only N = 30	• Transfusions (NR) • Volume (NR) • Blood loss (NA)

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Table 6. Overview of included studies (PICO) - Cardiovascular (with bypass) *(Continued)*

		System: autotransfusion system (Beijing PerMed Biomedical Engineering Co., China)			

ANH: acute normovolemic haemodilution; **AT:** autotransfusion; **CABG:** cardiopulmonary bypass graft; **CS:** cell salvage; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **Hb:** haemoglobin; **Hct:** haematocrit; **LOS:** hospital length of stay; **MACE:** major adverse cardiovascular events; **MI:** myocardial infarction; **N:** planned recruitment (as reported by the study); **NA:** not analysable; **NR:** not reported; **PE:** pulmonary embolism; **PJI:** prosthetic joint infection; **RAP:** retrograde autologous prime; **RCT:** randomised controlled trial; **VTE:** venous thromboembolism
"Registration: N/A" means 'not applicable' as the study was published before 2010
"Volume" refers to mean transfusion volume
"Transfusions" refers to number of people receiving an allogeneic transfusion

Table 7. Overview of included studies (PICO) - Obstetrics

Study details	Population (surgery type)	CS detail	Intervention detail	Control detail	Outcomes reported (time point)
Khan 2017 (SALVO) RCT Registration: Prospective Country: UK N = 1356	Obstetrics (Caesarean section)	Timing of collection: intraoperative Washing: washed Transfusion threshold: No threshold System: Varied according to centre	Cell Salvage N = 669	Control N = 687	• Transfusions (intraoperative or to discharge) • Volume (intraoperative or to discharge) • Hospital LOS (NA)

ANH: acute normovolemic haemodilution; **AT:** autotransfusion; **CABG:** cardiopulmonary bypass graft; **CS:** cell salvage; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **Hb:** haemoglobin; **Hct:** haematocrit; **LOS:** hospital length of stay; **MACE:** major adverse cardiovascular events; **MI:** myocardial infarction; **N:** planned recruitment (as reported by the study); **NA:** not analysable; **NR:** not reported; **PE:** pulmonary embolism; **PJI:** prosthetic joint infection; **RAP:** retrograde autologous prime; **RCT:** randomised controlled trial; **VTE:** venous thromboembolism
"Registration: N/A" means 'not applicable' as the study was published before 2010
"Volume" refers to mean transfusion volume
"Transfusions" refers to number of people receiving an allogeneic transfusion

Table 8. Overview of included studies (PICO) - Orthopaedic (hip)

Study details	Population (surgery type)	CS detail	Intervention detail	Control detail	Outcomes reported (time point)
Ayers 1995 RCT Registration: N/A Country: USA N = 232	Orthopaedic (hip) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: No protocol System: Autovac postoperative orthopaedic Autotransfusion Canister (Boehringer Labs, Norristown, Pennsylvania) (Cell Saver (Haemonetics, Braintree, Massachusetts) also used in revision cases)	Postoperative blood salvage N = 103	Closed suction (Hemovac) drain (control) N = 129	• Transfusions (48 hours postoperative) • Volume (NA) • Blood loss (NA)
Cheung 2010 RCT Registration: Retrospective (18 months)	Orthopaedic (hip) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: No threshold System: Bellovac ABT drain (Astra Tech Ltd., Gloucesteshire, UK)	Group 1: reinfusion drain (ABT group) N = 53	Group 2: suction drain; group 3: no drain N = 100	• Transfusions (NR) • Volume (NA) • Blood loss (NA)

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Table 8. Overview of included studies (PICO) - Orthopaedic (hip) *(Continued)*

Country: UK N = 153					• Mortality (NR) • Re-operation (NR) • Infection (NR) • PJI (12 months) • Hospital LOS (NA)
Ekback 1995 RCT Registration: N/A Country: Sweden N = 30	Orthopaedic (hip) - arthroplasty	Timing of collection: intraoperative Washing: washed Transfusion threshold: Maintain erythrocyte volume fraction (EVF) > 27% System: Haemonetics Cell-saver 4, Althin model AT I000 or Shiley/Dideco STAT	Group 2: autotransfusion N = 15	Group 1: control, heterologous erythrocyte concentrate N = 15	• Volume (intraoperative and 6 hr postoperative) • Blood loss (NA) • CVA/stroke (7 days)
Elawad 1991 RCT Registration: N/A Country: Sweden N = 40	Orthopaedic (hip) - arthroplasty	Timing of collection: intraoperative Washing: washed Transfusion threshold: Hb < 85 g/L System: Electromedic Autotrans, AT-1000 autotransfusion system (Englewood, CO, U.S.A.).	Autologous/cell saver (IAT group) N = 20	Homologous/control N = 20	• Transfusions (postoperative only) • Volume (intraoperative and postoperative) • Blood loss (intraoperative and postoperative) • DVT (postoperative)
Horstmann 2012 RCT Registration: No trial registration Country: The Netherlands N = 100	Orthopaedic (hip) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hb 6.4 g/L ASA1; Hb 8 g/dL ASA2/3; Hb 9.6 g/dL ASA4 System: Bellovac Autologous Blood Transfusion (ABT) Astra Tech, Molndal, Sweden)	Autotransfusion N = 50	No drainage N = 50	• Transfusions (in-hospital) • Volume (in-hospital) • Blood loss (NR) • Infection (NA) • PJI (NA) • Wound complication (NA) • VTE/thrombosis (3 months) • DVT (3 months) • PE (3 months) • Hospital LOS
Horstmann 2013 RCT Registration: No trial registration Country: The Netherlands N = 204	Orthopaedic (hip) - arthroplasty	Timing of collection: both intra- and postoperatively Washing: unwashed Transfusion threshold: Hb 6.4 g/L ASA1; Hb 8 g/dL ASA2/3; Hb 9.6 g/dL ASA4 System: Sangvia, autologous blood salvage machine (low vacuum, 100 to 150 mmHg; Astratech, Mölndal, Sweden)	Autologous blood transfusion (ABT) (Autotransfusion) N = 102	No drainage N = 102	• Transfusions (9 days postoperative) • Volume (in-hospital) • Blood loss (NR) • Infection (NA) • PJI (3 months) • DVT (3 months) • Hospital LOS

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Table 8. Overview of included studies (PICO) - Orthopaedic (hip) *(Continued)*

Horstmann 2014a RCT Registration: No trial registration Country: The Netherlands N = 118	Orthopaedic (hip) - arthroplasty	Timing of collection: both intra- and postoperatively Washing: unwashed Transfusion threshold: Hb 6.4 g/L ASA1; Hb 8 g/dL ASA2/3; Hb 9.6 g/dL ASA4 System: Sangvia, autologous blood salvage machine (low vacuum, 100 to 150 mmHg; Astratech, Mölndal, Sweden)	ABT group (intra- and postoperative autotransfusion) N = 56	Drain group (control) N = 62	• Transfusions (postoperative) • Blood loss (NR) • Mortality (3 months) • Infection (NA) • PJI (3 months) • Hospital LOS
Kleinert 2012 RCT Registration: No trial registration Country: Switzerland N = 120	Orthopaedic (hip) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hb < 80 g/L System: Bellovac Autologous Blood Transfusion (ABT) Astra Tech, Molndal, Sweden)	Group C (reinfusion) N = 40	Group A (no drain) and B (standard drain) N = 80	• Transfusions (NR) • Infection (NR) • Wound complication (NR) • Hospital LOS
Lorentz 1991 RCT Registration: N/A Country: Germany N = 31	Orthopaedic (hip) - arthroplasty	Timing of collection: both intra and postoperatively Washing: washed Transfusion threshold: Hb < 10 g/dL System: Cell Saver III, Fa, Haemonetics	Group 3: autotransfusion N = 16	Group 4: control group N = 15	• Transfusions (intraoperative and postoperative) • Volume (NA) • Blood loss (intraoperative only)
Luo 2016 RCT Registration: No trial registration Country: China N = 91	Orthopaedic (hip) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: No protocol System: ConstaVac Blood Conservation II (CBCII, Stryker Instruments, Kalamazoo, Michigan, USA) autologous blood transfusion device	ABT Group: Drainage + retransfusion N = 49	Drain group: drainage only N = 42	• Blood loss (intraoperative and postoperative) • VTE/thrombosis (7 days postoperative)
Menges 1992 RCT Registration: N/A Country: Germany N = 26	Orthopaedic (hip) - arthroplasty	Timing of collection: intraoperative Washing: NR Transfusion threshold: Hb < 9 g/dL or Hct < 28% System: MAT (Autotrans BT 795 P, Dideco, S.p.a., Modena, Italy)	Group 2: Autotransfusion N = 14	Group 1: control N = 12	• Transfusions ("observation period") • Volume (NA) • Blood loss ("observation period")
Rollo 1995 - ALL RCT Registration: N/A Country: USA N = 115	Orthopaedic (hip) - arthroplasty	Timing of collection: all Washing: both Transfusion threshold: No threshold System: group 1: intra- and postoperatively Haemonetics (Braintree, MA); group 2: postoperative Solcotrans (Smith & Nephew Richards, Memphis, TN)	Group 1 (Cell Saver) and Group 2 (Solcotrans) N = 75	Group 3 (Hemovac) N = 40	• Transfusions (48 hours) • Volume (NA) • Blood loss (NA) • Infection (NR) • PJI (NR) • Wound complication (NR)
Rollo 1995 - SUBGROUP both intra- and postoperatively RCT	Orthopaedic (hip) - arthroplasty	Timing of collection: both intra- and postoperatively Washing: washed Transfusion threshold: No threshold System: Haemonetics, Braintree, MA	Group 1 (Cell Saver) N = 35	Group 3 (Hemovac) N = 20	• Transfusions (48 hours) • Volume (NA) • Blood loss (NA)

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Table 8. Overview of included studies (PICO) - Orthopaedic (hip) *(Continued)*

Registration: N/A Country: USA N = 55					• Infection (NR) • PJI (NR) • Wound complication (NR)
Rollo 1995 - SUBGROUP postoperative only RCT Registration: N/A Country: USA N = 60	Orthopaedic (hip) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: No threshold System: postoperative: Solcotrans (Smith & Nephew Richards, Memphis, TN)	Group 2 (Solcotrans) N = 40	Group 3 (Hemovac) (Hemovac drain (Zimmer, Warsaw, IN)) N = 20	• Transfusions (48 hours) • Volume (NA) • Blood loss (NA) • Infection (NR) • PJI (NR) • Wound complication (NR)
Smith 2007 RCT Registration: N/A Country: UK N = 158	Orthopaedic (hip) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hb < 8 g/dL System: ABTrans autologous retransfusion system (Surgical Innovations Ltd, Leeds, UK)	Group B: postoperative salvage (ABTrans autologous retransfusion system) N = 76	Group A: vacuum drain (two size 12 Medinorm vacuum drains (Van Straten, Quiershied, Germany) N = 82	• Transfusions (NR) • Volume (NA) • Wound complication (6-8 weeks) • Hospital LOS (NA)
Teetzman 2014 RCT Registration: Retrospective (3 years) Country: Norway N = 161	Orthopaedic (hip) - any hip surgery	Timing of collection: postoperative Washing: unwashed Transfusion threshold: No threshold System: Sangvia™ Blood Salvage System	Group 1: Autotransfusion of autologous blood N = 74	Group 2: allotransfusion group (allogeneic blood only) N = 87	• Transfusions (NR) • Volume (NA) • Mortality (in-hospital) • Infection (NR) • Hospital LOS (NA)
Thomassen 2012 RCT Registration: Prospective Country: The Netherlands N = 216	Orthopaedic (hip) - arthroplasty	Timing of collection: both intra- and postoperatively Washing: unwashed Transfusion threshold: Hb < 8.5 g/dL System: SangviaTM Blood Management System (Astra Tech AB, Molndal, Sweden)	Sangvia N = 106	control N = 110	• Transfusions (NA) • Volume (NA) • Blood loss (discharge) • Mortality (60 days) • PJI (60 days) • Wound complication (60 days) • PE (60 days)
Tripkovic 2008 RCT Registration: N/A Country: Croatia N = 60	Orthopaedic (hip) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hb < 100 g/L or Hct < 30% System: BIODREN system, BE.R.CO. s.p.a. (Modena, Italy)	Group 1: Reinfusion group N = 30	Group 2: Control group N = 30	• Transfusions (48 hours postoperative) • Volume (48 hours) • Blood loss (48 hours)
Zhao 2016 RCT	Orthopaedic (hip) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hb < 80 g/L	Autologous blood transfusion group	Negative pressure drainage ball group	• Transfusions (NR) • Volume (NA)

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Table 8. Overview of included studies (PICO) - Orthopaedic (hip) *(Continued)*

Registration: No trial registration Country: China N = 200	System: NR	N = 127	N = 73	• Blood loss (6 hours)

ANH: acute normovolemic haemodilution; **AT:** autotransfusion; **CABG:** cardiopulmonary bypass graft; **CS:** cell salvage; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **Hb:** haemoglobin; **Hct:** haematocrit; **LOS:** hospital length of stay; **MACE:** major adverse cardiovascular events; **MI:** myocardial infarction; **N:** planned recruitment (as reported by the study); **NA:** not analysable; **NR:** not reported; **PE:** pulmonary embolism; **PJI:** prosthetic joint infection; **RAP:** retrograde autologous prime; **RCT:** randomised controlled trial; **VTE:** venous thromboembolism
"Registration: N/A" means 'not applicable' as the study was published before 2010
"Volume" refers to mean transfusion volume
"Transfusions" refers to number of people receiving an allogeneic transfusion

Table 9. Overview of included studies (PICO) - Orthopaedic (knee)

Study details	Population (surgery type)	CS detail	Intervention detail	Control detail	Outcomes reported (time point)
Abuzakuk 2007 RCT Registration: N/A Country: UK N = 104	Orthopaedic (knee) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hb < 9 g/dL System: Bellovac Autologous Blood Transfusion System (AstraTech Healthcare, Molndal, Sweden)	Autotransfusion drain N = 52	Standard drain N = 52	• Transfusions (24 hours) • Volume (NA) • Blood loss (24 hours) • Wound complication (NR) • Hospital LOS
Adalberth 1998 RCT Registration: N/A Country: Sweden N = 49	Orthopaedic (knee) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hb decrease > 30% pre-op value or < 90 g/L System: Solcotrans (Solco Basle UK Ltd)	Autotransfusion (Solcotrans) drain N = 24	Standard (Redon) drain N = 25	• Transfusions (24 hours) • Volume (24 hours) • Blood loss (24 hours) • DVT (NR) • PE (NR) • CVA/stroke (NR) • Hospital LOS
Altinel 2007 RCT Registration: N/A Country: Turkey N = 32	Orthopaedic (knee) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hb < 9 g/dL System: ConstaVac CBC II (Stryker, Kalamazoo, MI, USA)	Study group N = 16	Control group N = 16	• Volume (24 hours) • Blood loss (24 hours) • DVT (NR) • Hospital LOS
Amin 2008 RCT Registration: N/A Country: UK N = 178	Orthopaedic (knee) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hb < 8 g/dL System: Bellovac ABT autotransfusion system (AstraTech, Mölndal, Sweden)	Autologous retransfusion drain N = 92	Standard vacuum drain N = 86	• Transfusions (3 days) • Volume (NA) • Blood loss (NA) • Re-operation (24 hours)

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Table 9. Overview of included studies (PICO) - Orthopaedic (knee) *(Continued)*

					• Wound complication (NR) • DVT (NR) • Hospital LOS (NA)
Blatsoukas 2010 - ALL RCT Registration: No trial registration Country: Greece N = 248	Orthopaedic (knee) - arthroplasty	Timing of collection: all Washing: both Transfusion threshold: Hb < 10 g/dL System: Dideco Compact Advanced (Dideco, 41037, Mirandola, Italy) (intraoperative); ConstaVac CBC II (Stryker, Kalamazoo, MI) (postoperative)	Group 1: intra and postoperative autotransfusion; group 2: postoperative only N = 163	Allogeneic transfusion only N = 85	• Transfusions (2 days) • Volume (2 days) • Infection (3 months) • PJI (3 months)
Blatsoukas 2010 - SUBGROUP both intra- and postoperatively RCT Registration: No trial registration Country: Greece N = 135	Orthopaedic (knee) - arthroplasty	Timing of collection: both intra- and postoperatively Washing: both Transfusion threshold: Hb < 10 g/dL System: Dideco Compact Advanced (Dideco, 41037, Mirandola, Italy) (intraoperative); ConstaVac CBC II (Stryker, Kalamazoo, MI) (Post-op)	Group 1: intra- and postoperative autotransfusion N = 92	Allogeneic transfusion only N = 43	• Transfusions (2 days) • Volume (2 days) • Infection (3 months) • PJI (3 months)
Blatsoukas 2010 - SUBGROUP post-op only RCT Registration: No trial registration Country: Greece N = 113	Orthopaedic (knee) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hb < 10 g/dL System: ConstaVac CBC II (Stryker, Kalamazoo, MI)	Group 2: post-op only N = 71	Allogeneic transfusion only N = 42	• Transfusions (2 days) • Volume (2 days) • Infection (3 months) • PJI (3 months)
Breakwell 2000 RCT Registration: N/A Country: UK N = 33	Orthopaedic (knee) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hb < 9 g/dL System: ConstaVac CBC II (Stryker, Kalamazoo, MI)	Group 1 = blood retrieval and autologous transfusion (study group) N = 14	Group 2 = allogeneic blood only (control group) N = 19	• Volume (NA) • Blood loss (NA)
Cheng 2005 RCT Registration: N/A Country: Hong Kong N = 60	Orthopaedic (knee) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hb < 9 g/dL System: DONOR (Van Straten Medical, Nieuwegein, the Netherlands),	Reinfusion group N = 26	Control group N = 34	• Transfusions (3 days) • Volume (NA) • Blood loss (NA) • DVT (NR)
Cip 2013 RCT Registration: No trial registration Country: Austria N = 151	Orthopaedic (knee) - arthroplasty	Timing of collection: both intra- and postoperatively Washing: washed Transfusion threshold: Hb < 8 g/dL System: OrthoPAT (Haemonetics, Braintree, USA)	Group A: autotransfusion N = 76	Group B: control (regular drain without suction) N = 75	• Transfusions (5 days) • Volume (NA) • Blood loss (NA)
Dramis 2006 RCT	Orthopaedic (knee) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hb < 9 g/dL	Group A: autotransfusion drain	Group B: standard vacuum drain)	• Transfusions (48 hours post-op)

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Table 9. Overview of included studies (PICO) - Orthopaedic (knee) *(Continued)*

Registration: N/A Country: UK N = 49		System: CellTrans (Summit Medical) reinfusion system	N = 32	N = 17	• Volume (NA)
Dutton 2012 RCT Registration: No trial registration Country: UK N = 48	Orthopaedic (knee) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: No protocol System: Bellovac Autologous Blood Transfusion System (AstraTech Healthcare, Molndal, Sweden)	Retransfusion drain N = 23	No drain N = 25	• Transfusions (NR) • Volume (NA)
Heddle 1992 RCT Registration: N/A Country: Canada N = 79	Orthopaedic (knee) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hb < 90 g/L System: Solcotrans (Solco Basle, Inc., Rockland, MA)	Solcotrans group N = 39	Control: Davol suction (Davol, Bard Canada, Mississauga, Ontario, Canada) N = 40	• Transfusions (5 days post-op) • Volume (5 days) • Blood loss (5 days) • DVT (in-hospital)
Horstmann 2014b RCT Registration: No trial registration Country: The Netherlands N = 115	Orthopaedic (knee) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hb 6.4 g/L ASA1; Hb 8 g/dL ASA2/3; Hb 9.6 g/dL ASA4 System: Bellovac Autologous Blood Transfusion (ABT) Astra Tech, Molndal, Sweden)	Autologous Blood Transfusion (ABT) group N = 59	No drainage N = 56	• Transfusions (NR) • Volume (NA) • Blood loss (intraoperative) • Infection (NA) • PJI (3 months) • DVT (3 months) • PE (3 months) • MI (3 months) • Hospital LOS (NA)
Kirkos 2006 RCT Registration: N/A Country: Greece N = 155	Orthopaedic (knee) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hb < 10 g/dL System: 'closed' system of collection and re-infusion of blood which contains a 260 micron pre-filter to prevent air and marrow fatty material from passing through into the transfusion bag	Group B: autotransfusion (reinfused within 6 hours) N = 78	Group A: standard vacuum drains N = 77	• Volume (intraoperative and post-op) • PE (24 hours)
Laszczyca 2015 RCT Registration: No trial registration Country: Poland N = 101	Orthopaedic (knee) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hb < 8 g/dL or fall of > 5 g/dL or Hb < 9 g/dL + symptoms/bleeding System: HandyVac (ATS (Unomedical) retransfusion set	RTF/RTF2: Drainage + retransfusion N = 44	DRN/DRN2: drainage only N = 57	• Transfusions (NR) • Blood loss (NA) • Hospital LOS (NA)
Majowski 1991 RCT Registration: N/A	Orthopaedic (knee) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hb < 9.5 g/dL	Study group: Autotransfusion N = 20	Control group: Standard drain N = 20	• Transfusions (48 hours) • Volume (NA)

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Table 9. Overview of included studies (PICO) - Orthopaedic (knee) *(Continued)*

Country: UK N = 40		System: Solcotrans® orthopaedic re-infusion system (Solco-Basle UK Ltd, High Wycombe, Bucks)			• Blood loss (post-op 48 hours) • Wound complication (NR) • DVT (NR)
Munteanu 2009 RCT Registration: N/A Country: Romania N = 100	Orthopaedic (knee) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hct < 24%, Hct < 27% chronic cardiac, Hct < 30% acute cardiac System: ConstaVac Stryker (CVAC)	Group 3: CVAC (Constavac) N = 50	Group 1: Control ("Martor") N = 50	• Transfusions (perioperative) • Volume (NA) • Blood loss (NR) • Infection (NR) • PJI (NR)
NCT 00839241 RCT Registration: Retrospective (1 month) Country: Poland N = 45	Orthopaedic (knee) - arthroplasty	Timing of collection: NR Washing: unwashed Transfusion threshold: No protocol System: Bellovac ABT	Autologous Blood Transfusion N = 20	Allogenic Blood Transfusion N = 25	None reported
Newman 1997 RCT Registration: N/A Country: UK N = 70	Orthopaedic (knee) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: No threshold System: Dideco 797 reinfusion system (Sorin Biomedical UK Ltd, Midhurst, UK)	Reinfusion N = 35	Homologous transfusion N = 35	• Transfusions (7 days) • Volume (NA) • Blood loss (7 days) • Infection (7 days) • DVT (7 days) • Hospital LOS
Pavelescu 2014 RCT Registration: No trial registration Country: Romania N = NR - 78 over 3 groups	Orthopaedic (knee) - arthroplasty	Timing of collection: postoperative Washing: NR Transfusion threshold: Hb < 9 g/dL System: NR	Group C: re-infusion system drainage at the end of surgery (with TXA) N = NR - 78 over 3 groups	Group B: TXA (IV) N = NR - 78 over 3 groups	• Transfusions (NA) • Volume (NA) • Blood loss (NA)
Rosencher 1994 RCT Registration: N/A Country: France N = 30	Orthopaedic (knee) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hct < 30% System: Orth-Evac (Deknatel, 600 Airport Road, Fall-River, MA, USA) or Solcotrans Plus (Solco Basle, Solco HPG, Haighan, MA, USA)	Ortho-Evac group and Solcotrans group N = 20	Control group (Temoins) N = 10	• Transfusions (NR)
Sait 1999 RCT Registration: N/A Country: UK N = 120	Orthopaedic (knee) - arthroplasty	Timing of collection: postoperative Washing: NR Transfusion threshold: No protocol System: NR	Group 2: blood conservation system N = 60	Group 1: standard drain N = 60	• Transfusions (NR)

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Table 9. Overview of included studies (PICO) - Orthopaedic (knee) *(Continued)*

Šarkanoviü 2013 RCT Registration: No trial registration Country: Serbia N = 112	Orthopaedic (knee) - arthroplasty	Timing of collection: postoperative Washing: washed Transfusion threshold: Hb < 85 g/L System: Hemonetics 5+, USA	Group 2 (autologous blood) N = 55	Group 1 (allogeneic blood) N = 57	• Transfusions (NR) • Volume (NA) • Blood loss (NA) • Infection (NR) • Wound complication (NR) • DVT (NR) • PE (NR) • MACE (NR) • Hospital LOS (NA)
Schnurr 2018 RCT Registration: No trial registration Country: Germany N = 200	Orthopaedic (knee) - arthroplasty	Timing of collection: postoperative Washing: washed Transfusion threshold: Hb < 7 g/dL, Hb < 10 g/dL + symptoms; Hb < 9 g/dL + cardiac, Hb < 10 g/dL + cardiac + symptoms System: OrthoPAT (Haemonetics, Braintree, USA)	Autologous blood transfusion (ABT) drain N = 100	Redon group N = 100	• Transfusions (7 days) • Volume (NA) • Blood loss (NA) • Infection (42 days) • PJI (42 days) • Wound complication (42 days)
Shenolikar 1997 RCT Registration: N/A Country: UK N = 100	Orthopaedic (knee) - arthroplasty	Timing of collection: postoperative Washing: washed Transfusion threshold: Hb < 9 g/dL System: Haemonetics cell saver 3 machine	Autologous group N = 50	Allogeneic group N = 50	• Transfusions (7 days) • Volume (NA) • Wound complication (3 months) • DVT (3 months) • PE (3 months) • Hospital LOS (NA)
Thomas 2001 RCT Registration: N/A Country: UK N = 231	Orthopaedic (knee) - arthroplasty	Timing of collection: postoperative Washing: washed Transfusion threshold: Hb < 9 g/dL System: Cell Saver 5 Haemonetics).	Autologous (cell salvage) N = 115	Allogenic (homologous) N = 116	• Transfusions (7 days post-op)
Touzopoulos 2021 RCT Registration: Retrospective (8 months) Country: Greece N = 40	Orthopaedic (knee) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hb < 9 g/dL System: Cell Trans Summit Medical Ltd, Gloucestershire, UK)	Group 1: Self-transfusion N = 20	Group 2: conventional drain N = 20	• Transfusions (post-op) • Volume (NA) • Blood loss (intraoperative and post-op)

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ANH: acute normovolemic haemodilution; **AT:** autotransfusion; **CABG:** cardiopulmonary bypass graft; **CS:** cell salvage; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **Hb:** haemoglobin; **Hct:** haematocrit; **LOS:** hospital length of stay; **MACE:** major adverse cardiovascular events; **MI:** myocardial infarction; **N:** planned recruitment (as reported by the study); **NA:** not analysable; **NR:** not reported; **PE:** pulmonary embolism; **PJI:** prosthetic joint infection; **RAP:** retrograde autologous prime; **RCT:** randomised controlled trial; **VTE:** venous thromboembolism
"Registration: N/A" means 'not applicable' as the study was published before 2010
"Volume" refers to mean transfusion volume
"Transfusions" refers to number of people receiving an allogeneic transfusion

Table 10. Overview of included studies (PICO) - Orthopaedic (spinal)

Study details	Population (surgery type)	CS detail	Intervention detail	Control detail	Outcomes reported (time point)
Djurasovic 2018 RCT Registration: Prospective Country: USA N = 115	Orthopaedic (spinal) - 2-3 level decompression or fusion	Timing of collection: intraoperative Washing: NR Transfusion threshold: Hb < 8 g/dL System: NR	CS (Cell Saver) N = 58	NCS (No Cell Saver) N = 57	• Transfusions (7 days) • Volume (7 days) • Blood loss (intraoperative)
Feiner 2015 RCT Registration: No trial registration Country: USA N = 77	Orthopaedic (spine) - major spinal surgery	Timing of collection: intraoperative Washing: washed Transfusion threshold: No protocol System: Fresnius-Kabi Continuous AutoTransfusion System (C.A.T.S), Germany	Group 1: cell salvage N = 29	Group 2: Washed stored allogeneic transfusion; group 3: Unwashed stored allogeneic N = 48	None reported
NCT 01251042 (#1794) RCT Registration: Retrospective (2 months) Country: Denmark N = 49	Orthopaedic (any spinal surgery)	Timing of collection: intraoperative Washing: unwashed Transfusion threshold: No protocol System: Sangvia® Blood Salvage System	Sangvia and retransfusion N = 26	Sangvia and no retransfusion N = 23	• Transfusions (7 days) • Blood loss (NA) • Wound complication (7 days)
Nemani 2019 RCT Registration: No trial registration Country: USA N = 63	Orthopaedic (spine) - correction of deformity	Timing of collection: postoperative Washing: washed Transfusion threshold: Hb < 8 g/dL System: OrthoPAT (Haemonetics)	Group 1: OrthoPAT N = 30	Group 2: Constavac, Stryker (standard subfascial closed suction drain) N = 33	• Transfusions (NA) • Volume (24 hours) • Blood loss (NR) • Infection (3 months) • PE (3 months)
Riou 1994 RCT Registration: N/A Country: France	Orthopaedic (any spinal surgery)	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hct < 25%	Solcotrans group N = 25	Control group N = 25	• Transfusions (24 hours)

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Table 10. Overview of included studies (PICO) - Orthopaedic (spinal) *(Continued)*

N = 50		System: Solcotrans Orthopedic Plus system (Solco Basle Ltd, Bucks, UK)			
Savvidou 2009 RCT Registration: N/A Country: Greece N = 50	Orthopaedic (spine) - lumbar fusion	Timing of collection: intraoperative Washing: washed Transfusion threshold: Hb < 7 g/dL, Hct < 21% System: Dideco Electa Cell Saver (Sorin Group, Modena, Italy)	Group A (perioperative cell saving technique) N = 25	Group B (control) N = 25	• Volume (NR) • Blood loss (NR)

ANH: acute normovolemic haemodilution; **AT:** autotransfusion; **CABG:** cardiopulmonary bypass graft; **CS:** cell salvage; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **Hb:** haemoglobin; **Hct:** haematocrit; **LOS:** hospital length of stay; **MACE:** major adverse cardiovascular events; **MI:** myocardial infarction; **N:** planned recruitment (as reported by the study); **NA:** not analysable; **NR:** not reported; **PE:** pulmonary embolism; **PJI:** prosthetic joint infection; **RAP:** retrograde autologous prime; **RCT:** randomised controlled trial; **VTE:** venous thromboembolism
"Registration: N/A" means 'not applicable' as the study was published before 2010
"Volume" refers to mean transfusion volume
"Transfusions" refers to number of people receiving an allogeneic transfusion

Table 11. Overview of included studies (PICO) - Orthopaedic (mixed)

Study details	Population (surgery type)	CS detail	Intervention detail	Control detail	Outcomes reported (time point)
Atay 2010 RCT Registration: N/A Country: Turkey N = 77	Orthopaedic (hip or knee) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hb < 8 g/dL or Hct < 25% System: Transolog, Heim Medizintechnik, Germany	Study group N = 37	Control group N = 40	• Transfusions (NR) • Volume (NR)
Gannon 1991 RCT Registration: N/A Country: USA N = 239	Orthopaedic (hip or knee) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hb < 9 g/dL System: Solcotrans (Solco Basle, Inc, Rockland, MA.)	Study N = 124	Control N = 115	• Transfusions (post-op 48 hours) • Volume (NA) • Infection (NR)
Healy 1994 RCT Registration: N/A Country: USA N = 128	Orthopaedic (hip/knee - arthroplasty; spine - fusion)	Timing of collection: postoperative Washing: unwashed Transfusion threshold: No protocol System: Solcotrans (Smith and Nephew, Mephis, Tennessee) or Orthevac (Deknatel, Fall River, Massachusetts)	Group 1: Orth-Evac; and group 2: Solcotrans N = 84	Group 3: banked blood (autologous or homologous); Hemovac standard wound drain N = 44	• Transfusions (in-hospital) • Volume (NA) • VTE/thrombosis (NR) • DVT (NR) • PE (NR)
Koopman-van Gemert 1993b RCT Registration: N/A Country: The Netherlands N = 60	Orthopaedic (hip - arthroplasty; spine - fusion)	Timing of collection: both intra- and postoperatively Washing: washed Transfusion threshold: Hct < 30% System: Haemonetics Haemolite-2 (Haemonetics Corporation, Braintree, USA	Group 1: perioperative autotransfusion N = 30	Group 2: homologous transfusion only N = 30	• Transfusions (intraoperative and post-op) • Volume (intraoperative and post-op)

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Table 11. Overview of included studies (PICO) - Orthopaedic (mixed) *(Continued)*

					• Blood loss (perioperative)
Kristensen 1992 RCT Registration: N/A Country: Denmark N = 56	Orthopaedic (hip/knee) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hb < 8.5 g/dL System: Solcotrans Orthopaedic (Solco Basle (UK) Ltd.)	Autologous hip, autologous knee N = 31	Homologous hip, homologous knee N = 25	• Volume (NA) • Blood loss (NA)
Mac 1993 RCT Registration: N/A Country: USA N = 91	Orthopaedic (hip or knee) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: No threshold System: Stryker Constavac	Group 1: Constavac (cell salvage group) N = 41	Group 2 = Haemovac (suction and discard blood) N = 50	• Blood loss (NA) • PJI (1 year) • Hospital LOS
Mah 1995 RCT Registration: N/A Country: Australia N = 205	Orthopaedic (hip or knee) - arthroplasty	Timing of collection: both intra- and postoperatively Washing: NR Transfusion threshold: Hb < 100 g/L System: Electromedics BT-795, Engelwood, USA	Autologous blood salvage (ABS) N = 91	no-ABS N = 114	None reported
Mauerhan 1993 RCT Registration: N/A Country: USA N = 111	Orthopaedic (hip/knee) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: No threshold System: CBC ConstaVac, Stryker Surgical, Kalamazoo, MI	Study group N = 57	Control group N = 54	• Transfusions (perioperative) • Blood loss (NA)
Moonen 2007 RCT Registration: N/A Country: The Netherlands N = 160	Orthopaedic (hip/knee) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: Hb < 9.7 g/dL System: Bellovac, AstraTech AB, Molndal, Sweden)	Reinfusion/Study group N = 80	Control group (regular drain (Abdovac, AstraTech AB)) N = 80	• Transfusions (in-hospital) • Volume (NA) • PJI (NR) • Wound complication (NR) • VTE/ thrombosis (NR) • DVT (NR) • PE (NR)
So-Osman 2006 RCT Registration: N/A Country: The Netherlands N = 69	Orthopaedic (hip/knee) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: GUIDELINE: CBO Consensus Guideline, 2004 System: DONOR system, Van Straten Medical, Nieuwegein, the Netherlands or Bellovac A.B.T., Astra Tech, Zoetermeer, the Netherlands	Group B (reinfusion system of continuous suction) & Group C (reinfusion system of intermittent suction) N = 47	Group A (standard closed suction wound drainage system) N = 22	• Transfusions (NR) • Volume (NR) • Blood loss (NA) • Mortality (NR) • Hospital LOS

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Table 11. Overview of included studies (PICO) - Orthopaedic (mixed) *(Continued)*

So-Osman 2014 RCT Registration: Retrospective (one year) Country: The Netherlands N = 2442	Orthopaedic (hip/knee) - arthroplasty	Timing of collection: both intra- and postoperatively Washing: both Transfusion threshold: GUIDELINE: Dutch national transfusion protocol System: OrthoPat Cell Saver; Bellovac-abt reinfusion drain; DONOR reinfusion drain	Part 1: Group 1 (AUTO and EPO) and group 3 (AUTO); and part 2 "AUTO" N = 1481	Part 1: Group 2 (EPO, no CS) and Group 4 (no EPO, no CS); and part 2 "Control/No AUTO" N = 961	• Transfusions (3 months) • Volume (3 months) • Blood loss (NA) • DVT (3 months) • PE (3 months) • MI (3 months)
Springer 2016 RCT Registration: Retrospective (2 months) Country: USA N = 121	Orthopaedic (hip or knee) - arthroplasty	Timing of collection: both intra- and postoperatively Washing: washed Transfusion threshold: No threshold System: OrthoPAT, Haemonetics, Braintree, MA	Reinfusion drain N = 60	Hemovac drain N = 61	• Transfusions (until discharge)
Thomassen 2014 RCT Registration: Retrospective (1 month) Country: The Netherlands N = 575	Orthopaedic (hip/knee) - arthroplasty	Timing of collection: postoperative Washing: unwashed Transfusion threshold: GUIDELINE: Dutch national transfusion protocol System: Bellovac ABT System WellSpect Healthcare, Molndal, Sweden	Groups B (6 hrs) and Group C (24 hrs) N = 385	Group A (No wound drainage) N = 190	• Transfusions (in-hospital) • PJI (6 weeks) • DVT (6 weeks) • PE (6 weeks) • MI (6 weeks) • Hospital LOS (NA)
Zhang 2008 RCT Registration: N/A Country: China N = 40	Orthopaedic (any)	Timing of collection: intraoperative Washing: washed Transfusion threshold: No protocol System: Haemonetics Company, USA	Group 2: simple autologous blood intraoperative N = 20	Group 3: untreated, no blood protective measures N = 20	• Transfusions (48 hours) • Volume (NR) • Blood loss (intraoperative)

ANH: acute normovolemic haemodilution; **AT:** autotransfusion; **CABG:** cardiopulmonary bypass graft; **CS:** cell salvage; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **Hb:** haemoglobin; **Hct:** haematocrit; **LOS:** hospital length of stay; **MACE:** major adverse cardiovascular events; **MI:** myocardial infarction; **N:** planned recruitment (as reported by the study); **NA:** not analysable; **NR:** not reported; **PE:** pulmonary embolism; **PJI:** prosthetic joint infection; **RAP:** retrograde autologous prime; **RCT:** randomised controlled trial; **VTE:** venous thromboembolism
"Registration: N/A" means 'not applicable' as the study was published before 2010
"Volume" refers to mean transfusion volume
"Transfusions" refers to number of people receiving an allogeneic transfusion

Table 12. Overview of studies awaiting classification

Study	Reason for classification	Participants (inclusion criteria)	Intervention	Comparator	Outcomes
Cardiovascular (with or without bypass)					

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Table 12. Overview of studies awaiting classification *(Continued)*

Aghdaii 2012 RCT; Iran N = 50	Unclear whether residual bypass blood in the control group was processed	30–70 years CABG with CPB	Autotransfusion	No autotransfusion	• Transfusions • Volume • Blood loss • Re-operation • Mortality
Bell 1992 RCT; UK N = 320	Unclear whether CPB blood in control group was processed before re-transfusion, and how many had it retransfused/ discarded	Cardiac surgery with CPB	IOAT (intraoperative autologous transfusion)	No IOAT	• Transfusions • ITU stay • Complications
Bouboulis 1994 RCT; UK N = 75	Mixed population: elective and urgent, no subgrouping	CABG	Autotransfusion of shed mediastinal blood	Standard chest drainage	• Transfusions • Volume • Complications • Wound infection • Reoperation • LOS • Mortality
Cavolli 2011 RCT; NR N = 40 *Abstract only*	Require more information to assess for inclusion (conference abstract only)	CABG (off pump)	Off-pump with cell saver blood transfusion (CSBT)	off-CPB without CSBT	• Blood loss • Transfusions • Volume
Damgaard 2010 RCT; Denmark N = 30	Unclear how blood remaining in bypass blood was handled	18+ years CABG using CPB	Cell saver	No cell saver	• Bleeding • Transfusions • Complications
Dietrich 1989 RCT; Germany N = 100 (4 groups, 25 each)	Unclear whether cardiotomy blood was discarded or retransfused in control group: Does not state the outcome of shed mediastinal blood collected in the cardiotomy reservoir	Myocardial revascularisation	Group 4: (same as group 3) plus shed mediastinal blood re-transfused in ICU	Group 3: pre-donation, blood remaining in oxygenator was process by cell separator.	• Volume • Transfusions • Complications • Mortality • ICU LOS • Blood loss • Re-exploration
Fragnito 1995 RCT; Italy N = 82	Mixed population: elective and urgent, no subgrouping	Myocardial revascularisation	Autotransfusion: Atrium 2550a	No autotransfusion	• Transfusions • Volume • Blood loss

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Table 12. Overview of studies awaiting classification *(Continued)*

					• Mortality
Matkovic 2010 NR; NR N = 60 *Abstract only*	Unclear study design: require more information to assess for inclusion (conference abstract only)	CABG	Cell saver	No cell saver	• Transfusions • Blood loss • Complications • Mortality
Murphy 2004 RCT; UK N = 200	Unclear how bypass blood remaining in circuit was handled in control group	18+ years CABG using CPB	Autotransfusion	No autotransfusion	• Transfusions • Volume • Blood loss • Adverse events • Mortality • LOS
Narula 2015 RCT; India N = 50 *Abstract only*	Require more information to assess for inclusion (conference abstract only)	Heart valve replacement with CPB	Intraoperative autologous donation (IAD)	Standard care	• Transfusions • Volume
NCT00950547 RCT; Italy N = 350 Start date: Aug 2009 End date: Jan 2010	Mixed population: require subgroup data for adults only	All ages Cardiac surgery	Cell salvage CardioPAT for ICU stay	Traditional Chest Drains as usual with no possibility to reinfuse lost blood	• Transfusions • Mortality
NCT02058134 RCT; Denmark N = 68 Start date: Dec 2013 End date: Dec 2015 *Terminated early*	Require more information to assess for inclusion. Completed > 2 years ago, no publications	18+ years Open-heart surgery (with cardiopulmonary bypass)	cardioPAT cell saver intra- and postoperatively	No intervention	• Transfusions
Srndic 2014 RCT; NR N = 72 (3 groups) *Abstract only*	Unable to determine details of each of the three groups and which (if any) would be a relevant comparison	Coronary artery revascularisation	No suction ECC (cell saver suction) MECC (cell saver suction)	ECC (CBP suction)	NR

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Table 12. Overview of studies awaiting classification *(Continued)*

Washington 2009 RCT; USA N = 86 *Abstract only*	Insufficient information regarding bypass blood reinfusion. Unclear patient population (age)	Cardiac surgery, CABG, valve replacement	CardioPAT postoperatively	No cell salvage postoperatively	• Transfusions • Volume
Wiefferink 2007 RCT; USA N = 30	Unclear whether control group had residual bypass blood processed or not prior to re-transfusion	Elective primary isolated myocardial revascularisation (with CPB)	Group B: mediastinal and residual CPB blood was collected and processed by a continuous autotransfusion system before re-infusion	Group A: control	• Transfusions • Volume • Blood loss
Obstetrics					
Lei 2022 RCT; China N = 130	Mixed population: elective and urgent, no subgrouping	21–45 years High risk of PPH undergoing elective or emergency Caesarean section	Intraoperative cell salvage (ICS)	No ICS	• Blood loss • Adverse events
Liu 2020 RCT; China N = 116	Mixed population: elective and urgent, no subgrouping	18+ years Elective or emergency Caesarean section	Intraoperative cell salvage (ICS)	No ICS	• Transfusions • Volume • Mortality • Complications • LOS
Rainaldi 1998 RCT; Italy N = 68	Mixed population: elective and urgent, no subgrouping	Elective or emergency Caesarean section	Intraoperative cell salvage (group 1)	Control (group 2) no ICS	• Volume • Complication • LOS
Yu 2022 NR; China N = 87	Unclear population - no mention of elective or emergency. Unclear study design (described as RCT and cross-sectional, and observational prospective cohort)	Elective or emergency Caesarean section (lower segment)	Intraoperative cell salvage (IOCS)	No IOCS	• Transfusions • Blood loss
Orthopaedic					
ChiCTR-IOR-17010508 RCT; China Expected start date: 24 Jan 2017	Very little information in trial registration. Completed. No data or publications	60–80 years Elderly patients undergoing spinal surgery	Leucocyte filter with autologous blood transfusion	Allogeneic blood transfusion	• Transfusions

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Table 12. Overview of studies awaiting classification *(Continued)*

Expected end date: 24 Feb 2017					
Güzel 2016 NR; Turkey N = 150 (3 groups, 50 each)	Unclear study design: referred to as both randomised and retrospective	Cemented TKA (mean age 67 years)	Postoperative autologous transfusion (PAT) using CellTrans	Drainage (low suction)	• Transfusions • Blood loss • Infection • DVT, PE, MI, stroke
ISRCTN24531848 RCT; UK N = 120 Start date: 1 Jan 2003 End date: 1 Dec 2004	Very little information in trial registration. Completed. No data or publications	Lower limb arthroplasty (primary total knee replacement)	Group B: wound drained autotransfusion	Group A: homologous transfusion	• Infection
ISRCTN55488814 RCT; The Netherlands N = 130 Start date: 12 May 2004 End date: 1 Feb 2006	Very little information in trial registration. Completed. No data or publications	18+ years Degenerative arthritis in hip or knee Total knee and total hip replacement	Re-infusion of postoperative, autologous wound blood within 6 hours postoperatively	No reinfusion of wound blood	• Transfusions • Transfusion reaction • Wound infection
Liang 2015 RCT; China N = 110 Start date: Jan 2012 End date: June 2013	Mixed population (above and below 18 years old). Unclear if control group used another method of cell salvage (i.e. using a non cell saver machine). *Unclear if* Shen 2013 *is an interim analysis of the same cohort as this*	Scoliosis patients undergoing primary posterior spinal fusion with segmental spinal instrumentation.	Cell saver machine for intraoperative blood salvage	No cell saver machine	• Volume • Transfusions • Blood loss
Martin 2009 NR; NR N = 150 (3 groups, 50 each) *Abstract only*	Unclear study design: no mention of randomisation in abstract More information required to determine comparator group/s	Total knee arthroplasty (TKA)	A) Three wound drainages with an autotransfusion system and suction	B) no wound drainage; C) one intraarticular wound drainage without suction	• Transfusions • Volume • Blood loss • Wound complications
Morgenschweis 2011 RCT; Germany N = 379	Lack of detail regarding intervention and comparison methods	Primary hip and knee replacement	Cell salvage	No cell salvage	• Transfusions

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Table 12. Overview of studies awaiting classification *(Continued)*

Abstract only					
NCT01468129 RCT; USA N = NR Start date: Nov 2011 Expected end date: Dec 2012	Very little information in trial registration. No data or publications	21+ years Candidate for one-stage bilateral THA (bilateral degenerative disease of hips)	Cell saver	No cell saver	NR
Ritter 1994 RCT; USA N = 415	Lack of detail regarding intervention and comparison methods	Primary total hip or total knee replacement	Autotransfusion: Solcotrans	No drainage	• Transfusions • Volume • Adverse events
Shen 2013 RCT; China N = 92 *Abstract only*	Unclear population (likely paediatric). Unclear if control group used another method of cell salvage (i.e. using a non cell saver machine) *Unclear if this is an interim analysis (or subgroup) of the same cohort as* Liang 2015	Scoliosis patients undergoing primary posterior spinal fusion with segmental spinal instrumentation	Cell Saver machine for intraoperative blood salvage	No cell saver machine	• Transfusions • Volume • Complications (transfusion related) • Blood loss
Simpson 1994 RCT; USA N = 24	Lack of detail regarding intervention and comparison methods	Elective total joint arthroplasty	Autotransfusion: Solcotrans	Standard, closed system, spring-loaded, intermittent suction device	• Blood loss
Sintes 2009 RCT; NR N = 50 *Abstract only* Interim analysis (N = 48/50)	Lack of detail regarding intervention and comparison methods	Total knee arthroplasty	Draining and reinfusion of blood using a postoperative blood recovery system (Redax Drentech Surgical)	NR	• Volume • Transfusions • Complications
Skoura 1997 RCT; Greece N = 108 *Abstract only*	Mixed population: elective and urgent, no subgrouping	Elective or emergency major orthopaedic and abdominal surgery with massive bleeding	Autotransfusion device (red cell saver)	No autotransfusion	• Volume • Blood loss
Stamenic 2009 RCT; NR N = 40	Lacks information needed to assess for inclusion	Total hip arthroplasty	Group I: Hemovac Autotransfusion system	Group II: classic wound drainage	• Volume • Complications

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Table 12. Overview of studies awaiting classification *(Continued)*
Abstract only

ANH: acute normovolemic haemodilution; **AT:** autotransfusion; **CABG:** cardiopulmonary bypass graft; **CS:** cell salvage; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **Hb:** haemoglobin; **Hct:** haematocrit; **ICU:** intensive care unit; **ITU:** intensive therapy/treatment unit; **LOS:** hospital length of stay; **MACE:** major adverse cardiovascular events; **MI:** myocardial infarction; **N:** planned recruitment (as reported by the study); **NR:** not reported; **PE:** pulmonary embolism; **PJI:** prosthetic joint infection; **RAP:** retrograde autologous prime; **RCT:** randomised controlled trial; **VTE:** venous thromboembolism
"Volume" refers to mean transfusion volume; "transfusions" refers to number of people receiving an allogeneic transfusion

Table 13. Overview of ongoing studies

Study	Participants (inclusion criteria)	Intervention	Comparator	Outcomes
Cancer				
ChiCTR1800018118 RCT; China N = 480 Expected start date: 1 Oct 2018 Expected end date: 31 July 2021	18–75 years Spinal metastasis surgery	Group 2: autotransfusion	Group 1: allogeneic transfusion	• Adverse events
NCT04922307 (RESTRICT) RCT; USA N = 240 Expected start date: 23 July 2021 Expected end date: 15 June 2026 *Suspended (funding)*	Kidney cancer (undergoing radical nephrectomy)	Blood Sparing Protocol: ANH, Cell Saver, and/or Veno-venous Bypass	Standard Blood Replacement: Allogenic blood transfusion as determined intraoperatively	• Volume • Complications
NCT05612477 RCT; Canada N = 30 Expected start date: 7 Nov 2022 Expected end date: 31 Dec 2033	18+ years Liver transplant with diagnosis of hepatocellular carcinoma	Autotransfusion: salvaged washed RBCs retransfused	No autotransfusion: salvaged washed RBCs discarded	• Safety
Cardiovascular (with or without bypass)				
DRKS00021914 RCT; Germany N = 40 Expected start date: 1 June 2020 Expected end date: NR (ongoing, recruiting)	50–80 years Isolated primary CABG utilising cardiopulmonary bypass	Arm 2: Cell saver blood	Arm 1: Cardiotomy suction blood	• Blood loss • Renal function
NCT02595385 (CONSERVE)	18–80 years	Group 2: cell salvage alone	Group 4: Control group	• Volume

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Table 13. Overview of ongoing studies *(Continued)*

RCT; UK (N. Ireland) N = 240 (4 groups) Expected start date: Feb 2015 Expected end date: Feb 2016 (still recruiting Nov 2015)	Elective single procedure cardiac surgery	Group 3: RAP + cell salvage	Group 1: RAP alone	• Adverse events
NCT04574128 RCT; Sweden N = 40 Expected start date: 1 Oct 2020 Expected end date: 30 Dec 2022	18+ years Elective CABG	Retransfusion of cardiotomy blood via the heart and lung machine	No retransfusion	• Blood loss • Transfusions • Volume • LOS
Obstetrics				
NCT03429790 RCT; China N = 120 Expected start date: 1 Nov 2018 Expected end date: 31 Dec 2020	18+ years Elective or emergency Caesarean section	Intraoperative cell salvage	No cell salvage	• Blood loss • Volume • LOS

ANH: acute normovolemic haemodilution; **CABG:** cardiopulmonary bypass graft; **LOS:** hospital length of stay; **N:** planned recruitment (as reported by the study); **NR:** not reported; **RAP:** retrograde autologous prime; **RCT:** randomised controlled trial
"Volume" refers to mean transfusion volume; "transfusions" refers to number of people receiving an allogeneic transfusion

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Table 14. Risk of bias (ROB) from blinding: assessment by outcome

Study	Objective	Subjective											
	Mortality	Transfusions	Volume	Blood loss	Re-operation	Wound complication/ infections	VTE	DVT	PE	MACE	MI	Stroke	Hospital LOS
Cancer													
Galaal 2019 (TIC TOC)	objective	high	high	NR	NR	low	low	low	low	NR	NR	NR	high
Jacobi 1997	objective	NR	low	high	NR	NR	NR	high	NR	NR	NR	NR	high
Cardiovascular (vascular)													
Clagett 1999	objective	low	low	high	NR	high	low	low	low	low	low	low	high
Davies 1987	objective	low	low	high	high	NR	NR	NR	NR	NR	NR	NR	NR
Kelley-Patteson 1993	objective	high	high	high	NR	NR	NR	NR	NR	low	low	NR	high
Mercer 2004	objective	low	low	NR	NR	low	NR	NR	NR	NR	NR	NR	high
Spark 1997	objective	high	high	high	high	low	NR	NR	NR	NR	NR	NR	NR
Thompson 1990	objective	NR	low	NR	NR	low	NR	NR	NR	NR	low	NR	high
Cardiovascular (no bypass)													
Damgaard 2006	objective	low	low	high	high	high	NR	NR	NR	low	low	low	high
Goel 2007	objective	low	low	high	high	high	NR	NR	NR	NR	NR	NR	NR
Murphy 2005	objective	low	low	NR	NR	high	NR	NR	NR	low	low	low	high
Niranjan 2006	objective	NR	low	low	NR	NR	NR	NR	NR	low	NR	low	high
Zhao 1996	NR	high	high	high	NR	NR	NR	NR	NR	NR	NR	NR	NR

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Table 14. Risk of bias (ROB) from blinding: assessment by outcome *(Continued)*

Zhao 2017	NR	NR	low	NR	NR	NR	NR	NR	NR	NR	NR	NR	high
Cardiovascular (with bypass)													
Adan 1988	objective	NR	high	high	NR	NR	NR	NR	NR	NR	NR	NR	NR
Axford 1994	objective	low	low	low	high	NR	NR	NR	NR	low	low	NR	NR
Dalrymple-Hay 1999	objective	low	low	low	high	NR	NR	NR	NR	NR	NR	NR	high
Eng 1990	objective	low	low	high	high	high	NR	NR	NR	NR	NR	NR	high
Gäbel 2013a	NR	low	low	low	high	low	low	low	low	high	low	high	high
Klein 2008	NR	low	low	NR	high	high	NR	NR	NR	NR	NR	NR	NR
Koopman-van Gemert 1993a	NR	low	low	low	NR	NR	NR	NR	NR	NR	NR	NR	NR
Lepore 1989	objective	high	high	low	NR	NR	NR	NR	NR	NR	NR	NR	NR
Marberg 2010	objective	high	high	low	high	NR	NR	NR	NR	NR	NR	NR	NR
Martin 2000	objective	low	low	low	high	NR	NR	NR	NR	low	low	low	NR
McShane 1987	objective	high	high	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Niranjan 2006	objective	NR	low	low	NR	NR	NR	NR	NR	low	NR	low	high
Page 1989	NR	low	low	low	high	high	NR	NR	NR	NR	NR	NR	NR
Parrot 1991	objective	low	low	high	NR	high	NR	NR	NR	NR	NR	NR	NR
Pleym 2005	NR	high	NR	high	high	NR	NR	NR	NR	NR	NR	NR	NR
Reyes 2011	objective	high	high	high	high	high	NR	NR	NR	NR	NR	NR	high
Schaff 1978	objective	low	low	high	high	high	NR	NR	NR	NR	NR	NR	NR
Schmidt 1996	NR	low	low	NR	NR	high	NR	NR	NR	NR	low	NR	NR
Schönberger 1993	objective	low	low	low	low	NR	NR	NR	NR	low	low	NR	NR

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Table 14. Risk of bias (ROB) from blinding: assessment by outcome *(Continued)*

Scrascia 2012	objective	high	high	high	high	NR	low	low	NR	NR	NR	low	high
Shen 2016	objective	low	low	low	high	high	NR	NR	NR	NR	low	low	high
Shirvani 1991	NR	low	low	high	high	NR	NR	NR	NR	NR	NR	NR	NR
Thurer 1979	objective	high	high	high	high	low	NR	NR	NR	low	low	NR	NR
Unsworth 1996	objective	low	low	high	high	NR	NR	NR	NR	NR	NR	NR	NR
Vermeijden 2015	objective	low	low	high	high	low	NR	NR	NR	low	low	low	high
Ward 1993	objective	low	NR	low	high	high	NR	NR	NR	low	low	NR	NR
Westerberg 2004	NR	high	NR	high	NR	NR	NR	NR	NR	NR	NR	NR	NR
Xie 2015	objective	low	low	high	low	NR	NR	NR	NR	NR	NR	NR	high
Zhao 2003	NR	high	high	high	NR	NR	NR	NR	NR	NR	NR	NR	NR
Obstetrics													
Khan 2017 (SALVO)	objective	low	low	NR	NR	NR	NR	NR	NR	NR	NR	NR	high
Orthopaedic (hip)													
Ayers 1995	NR	high	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Cheung 2010	objective	high	high	high	high	high	NR	NR	NR	NR	NR	NR	high
Ekback 1995	NR	NR	low	high	NR	NR	NR	NR	NR	NR	NR	low	NR
Elawad 1991	NR	high	high	high	NR	NR	NR	low	NR	NR	NR	NR	NR
Horstmann 2012	NR	low	low	low	NR	low	high	high	high	NR	NR	NR	high
Horstmann 2013	NR	low	low	low	NR	high	low	low	NR	NR	NR	NR	high
Horstmann 2014a	objective	low	low	low	NR	high	NR	NR	NR	NR	NR	NR	low
Kleinert 2012	NR	low	NR	high	NR	high	NR	NR	NR	NR	NR	NR	high

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Table 14. Risk of bias (ROB) from blinding: assessment by outcome *(Continued)*

Lorentz 1991	NR	low	low	high	NR	NR	NR	NR	NR	NR	NR	NR	NR
Luo 2016	NR	high	high	high	NR	NR	low	low	NR	NR	NR	NR	NR
Menges 1992	NR	high	NR	high	NR	NR	NR	NR	NR	NR	NR	NR	NR
Rollo 1995	NR	high	high	high	NR	high	NR	NR	NR	NR	NR	NR	NR
Smith 2007	NR	high	high	NR	NR	high	NR	NR	NR	NR	NR	NR	high
Teetzman 2014	objective	high	high	NR	NR	low	NR	NR	NR	NR	NR	NR	high
Thomassen 2011	objective	high	high	low	NR	low	low	low	low	low	low	low	low
Tripkovic 2008	NR	low	low	high	NR	NR	NR	NR	NR	NR	NR	NR	NR
Zhao 2016	NR	low	low	high	NR	NR	NR	NR	NR	NR	NR	NR	NR
Orthopaedic (knee)													
Abuzakuk 2007	NR	low	low	high	NR	high	NR	NR	NR	NR	NR	NR	high
Adalberth 1998	NR	low	low	high	NR	NR	NR	low	low	NR	NR	low	high
Altinel 2007	NR	low	low	low	NR	NR	NR	NR	low	NR	NR	NR	high
Amin 2008	NR	low	low	low	high	high	NR	low	NR	NR	NR	NR	high
Blatsoukas 2010	NR	low	low	NR	NR	high	NR	NR	NR	NR	NR	NR	NR
Breakwell 2000	NR	NR	low	high	NR	NR	NR	NR	NR	NR	NR	NR	NR
Cheng 2005	NR	high	high	low	NR	NR	NR	low	NR	NR	NR	NR	NR
Cip 2013	NR	low	low	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Dramis 2006	NR	low	low	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Dutton 2012	objective	high	high	NR	NR	high	NR	NR	NR	NR	NR	NR	NR
Heddle 1992	NR	high	high	high	NR	NR	low	low	NR	NR	NR	NR	NR

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Table 14. Risk of bias (ROB) from blinding: assessment by outcome *(Continued)*

Horstmann 2014b	NR	low	low	low	NR	high	low	high	low	low	low	NR	high
Kirkos 2006	NR	low	low	high	NR	NR	NR	NR	low	NR	NR	NR	NR
Laszczyca 2015	NR	high	NR	high	NR	NR	NR	NR	NR	NR	NR	NR	high
Majkowski 1991	NR	low	low	high	NR	low	low	low	NR	NR	NR	NR	NR
Munteanu 2009	NR	high	high	low	NR	high	NR	NR	NR	NR	NR	NR	NR
NCT00839241	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Newman 1997	NR	high	high	high	NR	high	low	low	NR	NR	NR	NR	high
Pavelescu 2014	NR	high	high	high	NR	NR	NR	NR	NR	NR	NR	NR	NR
Rosencher 1994	NR	high	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Sait 1999	NR	high	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Šarkanoviü 2013	NR	low	low	low	NR	high	low	low	low	low	low	low	high
Schnurr 2018	NR	low	low	low	NR	high	NR	NR	NR	NR	NR	NR	NR
Shenolikar 1997	NR	low	low	low	NR	high	low	low	low	NR	NR	NR	high
Thomas 2001	NR	low	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Touzopoulos 2021	NR	low	low	low	NR	NR	NR	NR	NR	NR	NR	NR	NR
Orthopaedic (spinal)													
Djurasovic 2018	NR	high	high	high	NR	NR	NR	NR	NR	NR	NR	NR	NR
Feiner 2015	NR	high	high	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
NCT01251042	objective	high	high	high	NR	high	NR	NR	NR	NR	NR	NR	NR
Nemani 2019	objective	low	low	high	NR	high	low	NR	low	NR	NR	NR	NR
Riou 1994	NR	low	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR

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Table 14. Risk of bias (ROB) from blinding: assessment by outcome *(Continued)*

Savvidou 2009	NR	low	low	high	NR	NR	NR	NR	NR	NR	NR	NR	NR
Orthopaedic (mixed)													
Atay 2010	NR	low	low	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Gannon 1991	NR	low	low	low	NR	high	NR	NR	NR	NR	NR	NR	NR
Healy 1994	NR	high	high	high	NR	NR	low	low	low	NR	NR	NR	NR
Koopman-van Gemert 1993b	NR	low	low	low	NR	NR	NR	NR	NR	NR	NR	NR	NR
Kristensen 1992	NR	NR	high	high	NR	NR	NR	NR	NR	NR	NR	NR	NR
Mac 1993	NR	high	NR	high	NR	low	NR	NR	NR	NR	NR	NR	high
Mah 1995	NR	high	high	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Mauerhan 1993	NR	high	high	low	NR	NR	NR	NR	NR	NR	NR	NR	NR
Moonen 2007	NR	high	NR	NR	NR	high	low	low	low	NR	NR	NR	NR
So-Osman 2006	objective	low	low	high	NR	low	NR	NR	NR	NR	NR	NR	high
So-Osman 2014	NR	low	low	high	NR	high	low	low	low	low	low	low	NR
Springer 2016	NR	high	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Thomassen 2014	NR	high	high	NR	NR	low	low	low	low	low	low	low	NR
Zhang 2008	NR	high	high	high	NR	NR	NR	NR	NR	NR	NR	NR	NR

Objective: objective outcome which is unlikely to be affected by blinding (low risk of bias); only mortality (death) was classed as objective for this review.
Low: subjective outcome with low risk of bias due to clear definitions, threshold, or diagnostic criteria, thus removing/minimising subjective decision-making (e.g. transfusion threshold specified)
High: subjective outcome with high risk of bias due to unclear or no definition or thresholds, or clearly stating that a decision was a judgement by a clinician who may have been aware of group allocation
AT: autotransfusion; **CS:** cell salvage; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **LOS:** hospital length of stay; **MACE:** major adverse cardiovascular events; **MI:** myocardial infarction; **NR:** outcome not reported; **PE:** pulmonary embolism; **PJI:** prosthetic joint infection; **RAP:** retrograde autologous prime; **RCT:** randomised controlled trial; **ROB:** risk of bias; **VTE:** venous thromboembolism
"Volume" refers to mean transfusion volume; "transfusions" refers to number of people receiving an allogeneic transfusion

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Table 15. Overview of results: aggregate (all surgeries): primary outcome only

Outcome	Total [95% CI]	Subgroup: blood salvage (collection time)			Subgroup: transfusion threshold		
		Intraoperative	Postoperative	Both	No transfusion threshold	Liberal threshold (Hb > 80 g/L)	Restrictive threshold (Hb < / = 80 g/L)
Risk of transfusion	**RR 0.66 [0.59, 0.72]** **82 RCTs, N = 12520** #○○○	**RR 0.70 [0.60, 0.82]** **20 RCTs, N = 3193** ##○○	**RR 0.58 [0.50, 0.68]** **52 RCTs, N = 5710** #○○○	RR 0.84 [0.71, 1.00] * 13 RCTs, N = 3617 ⊕⊕○○	**RR 0.64 [0.49, 0.83]** **20 RCTs, N = 3092** #○○○	**RR 0.59 [0.50, 0.69]** **35 RCTs, N = 3461** #○○○	**RR 0.72 [0.61, 0.85]** **27 RCTs, N = 5967** ##○○

Three studies reported data for more than one collection period, and so appear in more than one subgroup for timing: Blatsoukas 2010 (Orthopaedic (knee): postoperative only and both); Parrot 1991 (Cardiovascular (with bypass): intraoperative only and both); Rollo 1995 (Orthopaedic (hip): postoperative only and both).
Bolded data highlights where there was a clear intervention effect.
* neared an intervention effect (touched the line of no effect)
"Volume" refers to mean transfusion volume; "transfusions" refers to number of people receiving an allogeneic transfusion
CI: confidence interval; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **Hb:** haemoglobin; **LOS:** hospital length of stay; **MACE:** major adverse cardiovascular events; **MD:** mean difference; **MI:** myocardial infarction; **N:** number of people analysed; **PE:** pulmonary embolism; **PJI:** prosthetic joint infection; **POR:** Peto odds ratio; **PPR:** per person randomised; **PPT:** per person transfused; **RCT:** randomised controlled trial; **RD:** risk difference; **RR**: risk ratio; **VTE:** venous thromboembolism
⊕○○○ = Very low certainty; ⊕⊕○○ = Low certainty; ⊕⊕⊕○ = Moderate certainty; ⊕⊕⊕⊕ = High certainty

Table 16. Overview of results: Cancer

Outcome	Total [95% CI]	Subgroup: blood salvage (collection time)			Subgroup: transfusion threshold		
		Intraoperative	Postoperative	Both	No transfusion threshold	Liberal threshold (Hb > 80 g/L)	Restrictive threshold (Hb < / = 80 g/L)
Risk of transfusion							
Volume transfused (PPR)							
Volume transfused (PPT)							
All-cause mortality	RR 0.56 (0.11, 2.80)	RR 0.56 (0.11, 2.80)			RR 0.56 (0.11, 2.80)		

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Table 16. Overview of results: Cancer *(Continued)*

	2 RCTs, N = 79 ⊕◯◯◯	2 RCTs, N = 79 ⊕◯◯◯	2 RCTs, N = 79 ⊕◯◯◯
Blood loss	MD 155.0 (-253.39, 563.39) 1 RCT, N = 24 ⊕◯◯◯	MD 155.0 (-253.39, 563.39) 1 RCT, N = 24 ⊕◯◯◯	MD 155.0 (-253.39, 563.39) 1 RCT, N = 24 ⊕◯◯◯
Re-operation			
Infection	RR 0.77 (0.40, 1.50) 1 RCT, N = 55 ⊕◯◯◯	RR 0.77 (0.40, 1.50) 1 RCT, N = 55 ⊕◯◯◯	RR 0.77 (0.40, 1.50) 1 RCT, N = 55 ⊕◯◯◯
Wound complication			
VTE/thrombosis			
DVT	RR 0.50 (0.05, 4.81) 1 RCT, N = 24 ⊕◯◯◯	RR 0.50 (0.05, 4.81) 1 RCT, N = 24 ⊕◯◯◯	RR 0.50 (0.05, 4.81) 1 RCT, N = 24 ⊕◯◯◯
PE			
MACE			
MI			
CVA/stroke			
Hospital LOS			

Bolded data highlights where there was a clear intervention effect.
"Volume" refers to mean transfusion volume; "transfusions" refers to number of people receiving an allogeneic transfusion
CI: confidence interval; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **Hb:** haemoglobin; **LOS:** hospital length of stay; **MACE:** major adverse cardiovascular events; **MD:** mean difference; **MI:** myocardial infarction; **N:** number of people analysed; **PE:** pulmonary embolism; **PJI:** prosthetic joint infection; **POR:** Peto odds ratio; **PPR:** per person randomised; **PPT:** per person transfused; **RCT:** randomised controlled trial; **RD:** risk difference; **RR**: risk ratio; **VTE:** venous thromboembolism
⊕◯◯◯ = Very low certainty; ⊕⊕◯◯ = Low certainty; ⊕⊕⊕◯ = Moderate certainty; ⊕⊕⊕⊕ = High certainty

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Table 17. Overview of results: Cardiovascular (vascular)

Outcome	Total [95% CI]	Subgroup: blood salvage (collection time)			Subgroup: transfusion threshold		
		Intraoperative	Postoperative	Both	No transfusion threshold	Liberal threshold (Hb > 80 g/L)	Restrictive threshold (Hb ≦ 80 g/L)
Risk of transfusion	RR 0.61 [0.32, 1.15] 4 RCTs, N = 266 ⊕◯◯◯	RR 0.61 [0.32, 1.15] 4 RCTs, N = 266 ⊕◯◯◯				RR 0.39 [0.05, 3.20] 2 RCTs, N = 149 ⊕◯◯◯	**RR 0.72 [0.51, 1.00]** **2 RCTs, N = 117** **#◯◯◯**
Volume transfused (PPR)	MD 0.03 [-0.32, 0.37] 3 RCTs, N = 186 ⊕⊕◯◯	MD 0.03 [-0.32, 0.37] 3 RCTs, N = 186 ⊕⊕◯◯				MD -0.32 [-1.10, 0.47] 2 RCTs, N = 150 ⊕⊕⊕◯	MD 0.11 [-0.28, 0.50] 1 RCT, N = 36 ⊕◯◯◯
Volume transfused (PPT)	MD 0.05 [-0.64, 0.74] 2 RCTs, N = 74 ⊕⊕◯◯	MD 0.05 [-0.64, 0.74] 2 RCTs, N = 74 ⊕⊕◯◯				MD -0.01 [-0.86, 0.84] 1 RCT, N = 69 ⊕⊕⊕◯	MD 0.17 [-1.01, 1.35] 1 RCT, N = 5 ⊕◯◯◯
All-cause mortality	POR 1.19 [0.39, 3.65] 6 RCTs, N = 384 ⊕◯◯◯	POR 1.19 [0.39, 3.65] 6 RCTs, N = 384 ⊕◯◯◯				POR 1.23 [0.36, 4.16] 4 RCTs, N = 267 ⊕◯◯◯	POR 1.03 [0.06, 16.69] 2 RCTs, N = 117 ⊕◯◯◯
Blood loss	MD 106.19 [-117.45, 329.83] 3 RCTs, N = 186 ⊕⊕◯◯	MD 106.19 [-117.45, 329.83] 3 RCTs, N = 186 ⊕⊕◯◯				MD 2.48 [-330.84, 335.80] 2 RCTs, N = 150 ⊕⊕◯◯	MD 191.11 [-110.50, 492.72] 1 RCT, N = 36 ⊕⊕◯◯

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Table 17. Overview of results: Cardiovascular (vascular) *(Continued)*

Re-operation	POR 1.08 [0.07, 17.40] 2 RCTs, N = 100 ⊕◯◯◯	POR 1.08 [0.07, 17.40] 2 RCTs, N = 100 ⊕◯◯◯	POR 1.08 [0.07, 17.40] 2 RCTs, N = 100 ⊕◯◯◯	
Infection	RR 0.23 [0.03, 1.98] 2 RCTs, N = 117 ⊕◯◯◯	RR 0.23 [0.03, 1.98] 2 RCTs, N = 117 ⊕◯◯◯	RR 0.23 [0.03, 1.98] 2 RCTs, N = 117 ⊕◯◯◯	
Wound complication	RR 1.00 [0.21, 4.72] 1 RCT, N = 100 ⊕◯◯◯	RR 1.00 [0.21, 4.72] 1 RCT, N = 100 ⊕◯◯◯	RR 1.00 [0.21, 4.72] 1 RCT, N = 100 ⊕◯◯◯	
VTE/thrombosis	RD 0.00 [-0.04, 0.04] 1 RCT, N = 100 ⊕◯◯◯	RD 0.00 [-0.04, 0.04] 1 RCT, N = 100 ⊕◯◯◯	RD 0.00 [-0.04, 0.04] 1 RCT, N = 100 ⊕◯◯◯	
DVT	RD 0.00 [-0.04, 0.04] 1 RCT, N = 100 ⊕◯◯◯	RD 0.00 [-0.04, 0.04] 1 RCT, N = 100 ⊕◯◯◯	RD 0.00 [-0.04, 0.04] 1 RCT, N = 100 ⊕◯◯◯	
PE	RD 0.00 [-0.04, 0.04] 1 RCT, N = 100 ⊕◯◯◯	RD 0.00 [-0.04, 0.04] 1 RCT, N = 100 ⊕◯◯◯	RD 0.00 [-0.04, 0.04] 1 RCT, N = 100 ⊕◯◯◯	
MACE				
MI	POR 0.76 [0.17, 3.41] 3 RCTs, N = 203 ⊕◯◯◯	POR 0.76 [0.17, 3.41] 3 RCTs, N = 203 ⊕◯◯◯	POR 1.02 [0.20, 5.20] 2 RCTs, N = 167 ⊕◯◯◯	POR 0.14 [0.00, 6.82] 1 RCT, N = 36 ⊕◯◯◯
CVA/stroke	POR 0.14 [0.00, 6.82]	POR 0.14 [0.00, 6.82]	POR 0.14 [0.00, 6.82]	

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Table 17. Overview of results: Cardiovascular (vascular) *(Continued)*

	1 RCT, N = 100 ⊕○○○	1 RCT, N = 100 ⊕○○○	1 RCT, N = 100 ⊕○○○
Hospital LOS	MD -0.50 [-2.46, 1.46] 1 RCT, N = 100 ⊕⊕○○	MD -0.50 [-2.46, 1.46] 1 RCT, N = 100 ⊕⊕○○	MD -0.50 [-2.46, 1.46] 1 RCT, N = 100 ⊕⊕○○

Bolded data highlights where there was close to an intervention effect (touched the line of no effect, so not entirely clear)
"Volume" refers to mean transfusion volume; "transfusions" refers to number of people receiving an allogeneic transfusion
CI: confidence interval; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **Hb:** haemoglobin; **LOS:** hospital length of stay; **MACE:** major adverse cardiovascular events; **MD:** mean difference; **MI:** myocardial infarction; **N:** number of people analysed; **PE:** pulmonary embolism; **PJI:** prosthetic joint infection; **POR:** Peto odds ratio; **PPR:** per person randomised; **PPT:** per person transfused; **RCT:** randomised controlled trial; **RD:** risk difference; **RR**: risk ratio; **VTE:** venous thromboembolism
⊕○○○ = Very low certainty; ⊕⊕○○ = Low certainty; ⊕⊕⊕○ = Moderate certainty; ⊕⊕⊕⊕ = High certainty

Table 18. Overview of results: Cardiovascular (no bypass)

Outcome	Total [95% CI]	Subgroup: blood salvage (collection time)			Subgroup: transfusion threshold		
		Intraoperative	Postoperative	Both	No transfusion threshold	Liberal threshold (Hb > 80 g/L)	Restrictive threshold (Hb ≦ 80 g/L)
Risk of transfusion	**RR 0.82 [0.69, 0.97]** **3 RCTs, N = 169** **###○**	RR 0.83 [0.69, 1.00] * 2 RCTs, N = 110 ⊕⊕○○	RR 0.78 [0.53, 1.15] 1 RCT, N = 59 ⊕⊕○○			**RR 0.83 [0.70, 0.98]** **2 RCTs, N = 108** **###○**	RR 0.59 [0.19, 1.81] 1 RCT, N = 61 ⊕⊕○○
Volume transfused (PPR)	**MD -0.90 [-1.78, -0.01]** **5 RCTs, N = 312** **#○○○**	MD -0.69 [-1.64, 0.25] 4 RCTs, N = 270 ⊕○○○	**MD -2.30 [-4.13, -0.47]** **1 RCT, N = 42** **#○○○**		**MD -2.30 [-4.13, -0.47]** **1 RCT, N = 42** **#○○○**	MD -0.86 [-4.31, 2.59] 1 RCT, N = 49 ⊕○○○	MD -0.68 [-1.67, 0.31] 3 RCTs, N = 221 ⊕○○○
Volume transfused (PPT)	MD 0.13 [-0.80, 1.07] 2 RCTs, N = 56 ⊕⊕○○	MD 0.13 [-0.80, 1.07] 2 RCTs, N = 56 ⊕⊕○○				MD -0.55 [-4.33, 3.23] 1 RCT, N = 45 ⊕⊕○○	MD 0.18 [-0.79, 1.15] 1 RCT, N = 11 ⊕⊕○○

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Table 18. Overview of results: Cardiovascular (no bypass) *(Continued)*

All-cause mortality	POR 0.13 [0.01, 2.07] 4 RCTs, N = 209 ⊕◯◯◯	Not estimable (zero cases) 3 RCTs, N = 150 ⊕◯◯◯	POR 0.13 [0.01, 2.07] 1 RCT, N = 59 ⊕◯◯◯		POR 0.13 [0.01, 2.07] 2 RCTs, N = 108 ⊕◯◯◯	Not estimable (zero cases) 2 RCTs, N = 101 ⊕◯◯◯
Blood loss	MD -62.55 [-195.34, 70.24] 3 RCTs, N = 131 ⊕⊕◯◯	MD -23.31 [-195.59, 148.96] 2 RCTs, N = 89 ⊕⊕⊕◯	MD -120.00 [-328.45, 88.45] 1 RCT, N = 42 ⊕◯◯◯	MD -120.00 [-328.45, 88.45] 1 RCT, N = 42 ⊕◯◯◯	MD 39.00 [-411.23, 489.23] 1 RCT, N = 49 ⊕◯◯◯	MD -34.00 [-220.47, 152.47] 1 RCT, N = 40 ⊕⊕⊕◯
Re-operation	RR 0.32 [0.04, 2.92] 2 RCTs N = 108 ⊕◯◯◯	Not estimable (zero cases) 1 RCT, N = 49 ⊕◯◯◯	RR 0.32 [0.04, 2.92] 1 RCT, N = 59 ⊕◯◯◯		RR 0.32 [0.04, 2.92] 1 RCTs, N = 108 ⊕◯◯◯	
Infection	POR 2.06 [0.21, 20.61] 2 RCTs, N = 110 ⊕◯◯◯	POR 2.06 [0.21, 20.61] 2 RCTs, N = 110 ⊕◯◯◯			Not estimable (zero cases) 1 RCT, N = 49 ⊕◯◯◯	POR 2.06 [0.21, 20.61] 1 RCT, N = 61 ⊕◯◯◯
Wound complication	POR 1.00 [0.06, 15.98] 3 RCTs, N = 169 ⊕◯◯◯	POR 7.64 [0.15, 385.21] 2 RCTs, N = 110 ⊕◯◯◯	POR 0.13 [0.00, 6.59] 1 RCT, N = 59 ⊕◯◯◯		POR 0.13 [0.00, 6.59] 1 RCTs, N = 108 ⊕◯◯◯	POR 7.64 [0.15, 385.21] 1 RCT, N = 61 ⊕◯◯◯
VTE/thrombosis						
DVT						
PE						
MACE						

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Table 18. Overview of results: Cardiovascular (no bypass) *(Continued)*

MI	POR 1.98 [0.20, 19.32] 2 RCTs, N = 120 ⊕◯◯◯	POR 7.91 [0.48, 129.46] 1 RCT, N = 61 ⊕◯◯◯	POR 0.13 [0.00, 6.59] 1 RCT, N = 59 ⊕◯◯◯		POR 0.13 [0.00, 6.59] 1 RCT, n = 59 ⊕◯◯◯	POR 7.91 [0.48, 129.46] 1 RCT, N = 61 ⊕◯◯◯
CVA/stroke	POR 0.98 [0.06, 15.72] 3 RCTs, N = 160 ⊕◯◯◯	POR 7.39 [0.15, 372.38] 2 RCTs, N = 101 ⊕◯◯◯	POR 0.13 [0.00, 6.59] 1 RCT, N = 59 ⊕◯◯◯		POR 0.13 [0.00, 6.59] 1 RCT, N = 59 ⊕◯◯◯	POR 7.39 [0.15, 372.38] 2 RCTs, N = 101 ⊕◯◯◯
Hospital LOS	MD -1.34 [-3.62, 0.95] 2 RCTs, N = 160 ⊕◯◯◯	MD -1.34 [-3.62, 0.95] 2 RCTs, N = 160 ⊕◯◯◯				MD -1.34 [-3.62, 0.95] 2 RCTS, N = 160 ⊕◯◯◯

Bolded data highlights where there was a clear intervention effect.
* neared an intervention effect (touched the line of no effect)
"Volume" refers to mean transfusion volume; "transfusions" refers to number of people receiving an allogeneic transfusion
CI: confidence interval; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **Hb:** haemoglobin; **LOS:** hospital length of stay; **MACE:** major adverse cardiovascular events; **MD:** mean difference; **MI:** myocardial infarction; **N:** number of people analysed; **PE:** pulmonary embolism; **PJI:** prosthetic joint infection; **POR:** Peto odds ratio; **PPR:** per person randomised; **PPT:** per person transfused; **RCT:** randomised controlled trial; **RD:** risk difference; **RR**: risk ratio; **VTE:** venous thromboembolism
⊕◯◯◯ = Very low certainty; ⊕⊕◯◯ = Low certainty; ⊕⊕⊕◯ = Moderate certainty; ⊕⊕⊕⊕ = High certainty

Table 19. Overview of results: Cardiovascular (with bypass)

Outcome	**Total**	**Subgroup: blood salvage (collection time)**			**Subgroup: transfusion threshold**		
	[95% CI]	**Intraoperative**	**Postoperative**	**Both**	**No transfusion threshold**	**Liberal threshold (Hb > 80 g/L)**	**Restrictive threshold (Hb ≦ 80 g/L)**
Risk of transfusion	**RR 0.81 [0.73, 0.89]** **25 RCTs, N = 2676** **##◯◯**	**RR 0.78 [0.63, 0.97]** **8 RCTs, N = 1219** **#◯◯◯**	**RR 0.81 [0.72, 0.93]** **14 RCTs, N = 1145** **##◯◯**	RR 0.82 [0.63, 1.08] 4 RCTs, N = 312 ⊕◯◯◯	**RR 0.82 [0.69, 0.97]** **7 RCTs, N = 481** **##◯◯**	**RR 0.84 [0.74, 0.94]** **11 RCTS, N = 1398** **##◯◯**	**RR 0.74 [0.56, 0.98]** **7 RCTs, N = 797** **#◯◯◯**

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Table 19. Overview of results: Cardiovascular (with bypass) *(Continued)*

Volume transfused (PPR)	**MD -1.23 [-1.71, -0.74** **18 RCTs, N = 2110** #○○○	**MD -1.47 [-2.59, -0.36]** **7 RCTs, N = 1162** ##○○	**MD -0.78 [-1.16, -0.41]** **10 RCTs, N = 878** #○○○	**MD -2.99 [-5.11, -0.87]** **2 RCTs, N = 70** #○○○	**MD -1.15 [-1.96, -0.34]** **2 RCTs, N = 195** #○○○	**MD -1.17 [-1.90, -0.45]** **11 RCTs, N = 1403** #○○○	**MD -1.45 [-2.73, -0.17]** **5 RCTs, N = 512** #○○○
Volume transfused (PPT)	**MD -0.80 [-1.21, -0.40]** **16 RCTs, N = 1264** #○○○	MD -0.86 [-1.89, 0.18] 6 RCTs, N = 645 ⊕○○○	**MD -0.42 [-0.76, -0.09]** **9 RCTs, N = 560** #○○○	**MD -2.35 [-4.59, -0.11]** **2 RCTs, N = 59** #○○○	MD -0.63 [-1.60, 0.34] 2 RCTs, N = 161 ⊕○○○	**MD -0.81 [-1.59, -0.02]** **10 RCTs, N = 828** #○○○	MD -0.71 [-1.84, 0.43] 4 RCTS, N = 275 ⊕○○○
All-cause mortality	RR 0.86 [0.50, 1.48] 21 RCTs, N = 2491 ⊕○○○	RR 0.66 [0.32, 1.36] 8 RCTs, N = 1176 ⊕○○○	RR 1.22 [0.46, 3.21] 12 RCTs, N = 1069 ⊕○○○	RR 1.20 [0.23, 6.26] 2 RCTs, N = 246 ⊕○○○	RR 1.93 [0.51, 7.37] 5 RCTs, N = 395 ⊕○○○	RR 0.77 [0.37, 1.62] 8 RCTs, N = 1243 ⊕○○○	RR 0.64 [0.23, 1.82] 8 RCTs, N = 853 ⊕○○○
Blood loss	MD 4.72 [-49.88, 59.32] 19 RCTs, N = 2117 ⊕○○○	MD 41.01 [-16.90, 98.91] 8 RCTs, N = 1229 ⊕○○○	MD -14.33 [-137.39, 108.73] 9 RCTs, N = 790 ⊕○○○	MD -45.79 [-119.78, 28.19] 3 RCTs, N = 98 ⊕⊕○○	MD 13.64 [-67.99, 95.27] 5 RCTs, N = 308 ⊕○○○	MD -62.72 [-195.64, 70.20] 8 RCTs, N = 1215 ⊕⊕○○	MD 47.98 [-33.60, 129.56] 6 RCTs, N = 594 ⊕⊕○○
Re-operation	RR 1.37 [0.77, 2.43] 15 RCTs, N = 1274 ⊕○○○	RR 2.05 [0.58, 7.22] 5 RCTs, N = 329 ⊕○○○	RR 1.18 [0.59, 2.35] 9 RCTs, N = 732 ⊕○○○	RR 1.63 [0.28, 9.57] 1 RCT, N = 213 ⊕○○○	RR 1.37 [0.35, 5.42] 4 RCTs, N = 257 ⊕○○○	RR 2.08 [0.64, 6.75] 6 RCTs, N = 438 ⊕○○○	RR 1.16 [0.55, 2.44] 5 RCTs, N = 579 ⊕○○○
Infection	RR 1.16 [0.83, 1.61] 8 RCTs, N = 1231 ⊕⊕○○	RR 1.22 [0.87, 1.72] 5 RCTs, N = 941 ⊕⊕○○	RR 0.48 [0.12, 1.98] 3 RCTs, N = 258 ⊕○○○	Not estimable (zero cases) 1 RCT, N = 32 ⊕○○○	RR 1.07 [0.32, 3.60] 1 RCT, N = 63 ⊕○○○	RR 0.83 [0.33, 2.08] 5 RCTs, N = 1103 ⊕○○○	RR 2.92 [0.32, 26.70] 2 RCTS, N = 65 ⊕○○○
Wound complication	RR 0.96 [0.44, 2.08]	RR 1.42 [0.25, 8.12]	RR 0.52 [0.14, 1.91]	RR 1.31 [0.41, 4.15]	RR 0.36 [0.02, 8.74]	RR 0.36 [0.07, 1.81]	RR 1.43 [0.57, 3.59]

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Table 19. Overview of results: Cardiovascular (with bypass) *(Continued)*

	6 RCTs, N = 618 ⊕◯◯◯	1 RCT, N = 103 ⊕◯◯◯	4 RCTs, N = 302 ⊕◯◯◯	1 RCT, N = 213 ⊕◯◯◯	1 RCT, N = 113 ⊕◯◯◯	2 RCTS, N = 154 ⊕◯◯◯	3 RCTs, N = 351 ⊕◯◯◯
VTE/thrombosis	RD 0.00 [-0.12, 0.12] 1 RCT, N = 30 ⊕◯◯◯	RD 0.00 [-0.12, 0.12] 1 RCT, N = 30 ⊕◯◯◯					RD 0.00 [-0.12, 0.12] 1 RCT, N = 30 ⊕◯◯◯
DVT	RD 0.00 [-0.12, 0.12] 1 RCT, N = 30 ⊕◯◯◯	RD 0.00 [-0.12, 0.12] 1 RCT, N = 30 ⊕◯◯◯					RD 0.00 [-0.12, 0.12] 1 RCT, N = 30 ⊕◯◯◯
PE	RD 0.00 [-0.12, 0.12] 1 RCT, N = 30 ⊕◯◯◯	RD 0.00 [-0.12, 0.12] 1 RCT, N = 30 ⊕◯◯◯					RD 0.00 [-0.12, 0.12] 1 RCT, N = 30 ⊕◯◯◯
MACE	RD 0.00 [-0.12, 0.12] 1 RCT, N = 30 ⊕◯◯◯	RD 0.00 [-0.12, 0.12] 1 RCT, N = 30 ⊕◯◯◯					RD 0.00 [-0.12, 0.12] 1 RCT, N = 30 ⊕◯◯◯
MI	POR 0.86 [0.47, 1.58] 9 RCTs, N = 1376 ⊕◯◯◯	POR 0.61 [0.27, 1.41] 3 RCTs, N = 849 ⊕⊕◯◯	POR 1.27 [0.52, 3.13] 6 RCTs, N = 527 ⊕◯◯◯		POR 0.15 [0.00, 7.45] 1 RCT, N = 113 ⊕◯◯◯	POR 0.86 [0.40, 1.83] 4 RCTs, N = 897 ⊕◯◯◯	POR 0.98 [0.34, 2.85] 4 RCTs, N = 366 ⊕◯◯◯
CVA/stroke	RR 0.54 [0.23, 1.24] 5 RCTs, N = 1018 ⊕⊕⊕◯	RR 0.54 [0.22, 1.32] 4 RCTs, N = 820 ⊕⊕◯◯	RR 0.51 [0.05, 5.54] 1 RCT, N = 198 ⊕◯◯◯		RR 3.00 [0.13, 68.84] 1 RCT, N = 34 ⊕◯◯◯	RR 0.48 [0.18, 1.27] 1 RCT, N = 716 ⊕⊕◯◯	RR 0.44 [0.07, 2.92] 3 RCTs, N = 268 ⊕◯◯◯
Hospital LOS	MD -0.78 [-1.81, 0.25] 8 RCTs, N = 1249 ⊕⊕◯◯	MD -0.41 [-1.47, 0.66] 6 RCTs, N = 1097 ⊕⊕◯◯	**MD -2.32 [-3.83, -0.81]** **2 RCTs, N = 152**		MD 2.02 [-0.16, 4.20] 2 RCTs, N = 97	**MD -1.84 [-2.95, -0.74]** **3 RCTs, N = 868**	MD -0.72 [-1.80, 0.36] 3 RCTs, N = 284 ⊕⊕◯◯

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Table 19. Overview of results: Cardiovascular (with bypass) *(Continued)*

	##○○	⊕⊕○○	##○○

One study reporting cardiovascular (with bypass) reported data for more than one collection period, and so appears in more than one subgroup for timing: Parrot 1991 (intraoperative only, and both).
Bolded data highlights where there was a clear intervention effect.
"Volume" refers to mean transfusion volume; "transfusions" refers to number of people receiving an allogeneic transfusion
CI: confidence interval; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **Hb:** haemoglobin; **LOS:** hospital length of stay; **MACE:** major adverse cardiovascular events; **MD:** mean difference; **MI:** myocardial infarction; **N:** number of people analysed; **PE:** pulmonary embolism; **PJI:** prosthetic joint infection; **POR:** Peto odds ratio; **PPR:** per person randomised; **PPT:** per person transfused; **RCT:** randomised controlled trial; **RD:** risk difference; **RR**: risk ratio; **VTE:** venous thromboembolism
⊕○○○ = Very low certainty; ⊕⊕○○ = Low certainty; ⊕⊕⊕○ = Moderate certainty; ⊕⊕⊕⊕ = High certainty

Table 20. Overview of results: Obstetrics

Outcome	Total (95% CI)	Subgroup: blood salvage (collection time)			Subgroup: transfusion threshold		
		Intraoperative	Postoperative	Both	No transfusion threshold	Liberal threshold (Hb > 80 g/L)	Restrictive threshold (Hb ≦ 80 g/L)
Risk of transfusion	POR 0.82 [0.38, 1.76] 1 RCT, N = 1349 ⊕⊕○○	POR 0.82 [0.38, 1.76] 1 RCT, N = 1349 ⊕⊕○○			POR 0.82 [0.38, 1.76] 1 RCT, N = 1349 ⊕⊕○○		
Volume transfused (PPR)	MD -0.02 [-0.08, 0.04] 1 RCT, N = 1349 ⊕⊕⊕⊕	MD -0.02 [-0.08, 0.04] 1 RCT, N = 1349 ⊕⊕⊕⊕			MD -0.02 [-0.08, 0.04] 1 RCT, N = 1349 ⊕⊕⊕⊕		
Volume transfused (PPT)	MD -0.41 [-2.26, 1.44] 1 RCT, N = 27 ⊕⊕○○	MD -0.41 [-2.26, 1.44] 1 RCT, N = 27 ⊕⊕○○			MD -0.41 [-2.26, 1.44] 1 RCT, N = 27 ⊕⊕○○		
All-cause mortality							
Blood loss							

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Table 20. Overview of results: Obstetrics *(Continued)*

Re-operation	
Infection	
Wound complication	
VTE/thrombosis	
DVT	
PE	
MACE	
MI	
CVA/stroke	
Hospital LOS	

Bolded data highlights where there was a clear intervention effect.
"Volume" refers to mean transfusion volume; "transfusions" refers to number of people receiving an allogeneic transfusion
CI: confidence interval; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **Hb:** haemoglobin; **LOS:** hospital length of stay; **MACE:** major adverse cardiovascular events; **MD:** mean difference; **MI:** myocardial infarction; **N:** number of people analysed; **PE:** pulmonary embolism; **PJI:** prosthetic joint infection; **POR:** Peto odds ratio; **PPR:** per person randomised; **PPT:** per person transfused; **RCT:** randomised controlled trial; **RD:** risk difference; **RR**: risk ratio; **VTE:** venous thromboembolism
⊕◯◯◯ = Very low certainty; ⊕⊕◯◯ = Low certainty; ⊕⊕⊕◯ = Moderate certainty; ⊕⊕⊕⊕ = High certainty

Table 21. Overview of results: Orthopaedic (hip)

Outcome	Total [95% CI]	Subgroup: blood salvage (collection time)			Subgroup: transfusion threshold		
		Intraoperative	Postoperative	Both	No transfusion threshold	Liberal threshold (Hb > 80 g/L)	Restrictive threshold (Hb ≦ 80 g/L)
Risk of transfusion	**RR 0.52 [0.38, 0.72]** **14 RCTs, N = 1641** **#◯◯◯**	**RR 0.60 [0.40, 0.89]** **2 RCTs, N = 65** **##◯◯**	**RR 0.44 [0.26, 0.76]** **9 RCTs, N = 1168** **#◯◯◯**	RR 0.67 [0.41, 1.11] 4 RCTs, N = 408 ⊕⊕◯◯	RR 0.76 [0.37, 1.57] 4 RCTs, N = 585 ⊕◯◯◯	**RR 0.50 [0.28, 0.90]** **4 RCTs, N = 156** **#◯◯◯**	**RR 0.38 [0.28, 0.51]** **6 RCTs, N = 900** **###◯**

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Table 21. Overview of results: Orthopaedic (hip) *(Continued)*

Volume transfused (PPR)	**MD -0.61 [-1.04, -0.19]** **5 RCTs, N = 433** #OOO	**MD -1.03 [-1.61, -0.45]** **2 RCTs, N = 69** ##OO	MD -0.78 [-2.19, 0.63] 1 RCTs, N = 160 ⊕OOO	MD -0.10 [-0.23, 0.03] 1 RCT, N = 204 ⊕⊕⊕O		**MD -1.29 [-1.69, -0.90]** **3 RCTs, N = 129** ###O	MD -0.09 [-0.20, 0.02] 2 RCTs, N = 304 ⊕⊕⊕O
Volume transfused (PPT)	**MD -1.74 [-2.92, -0.55]** **4 RCTs, N = 63** #OOO	**MD -2.04 [-2.92, -1.16]** **1 RCT, N = 16** #OOO	MD -0.53 [-2.98, 1.92] 2 RCTs, N = 34 ⊕OOO	Not estimable (SD 0 in both groups) 1 RCT, N = 13 ⊕OOO		**MD -1.74 [-2.92, -0.55]** **2 RCTs, N = 44** ##OO	Not estimable (SD zero in both groups) 2 RCTs, N = 19 ⊕OOO
All-cause mortality	POR 0.46 [0.06, 3.33] 4 RCTs, N = 651 ⊕OOO		POR 0.19 [0.01, 3.20] 2 RCTs, N = 317 ⊕OOO	POR 1.07 [0.07, 17.17] 2 RCTs, N = 334 ⊕OOO	POR 0.19 [0.01, 3.20] 2 RCTs, N = 317 ⊕OOO	POR 0.14 [0.00, 7.08] 1 RCT, N = 216 ⊕OOO	POR 8.22 [0.16, 416.61] 1 RCT, N = 118 ⊕OOO
Blood loss	MD -78.13 [-162.74, 6.48] 10 RCTs, N = 1085 ⊕OOO	MD -260.64 [-1209.11, 687.83] 2 RCTs, N = 65 ⊕OOO	MD -12.52 [-27.17, 2.13] 4 RCTs, N = 451 ⊕⊕OO	MD -111.32 [-238.53, 15.89] 4 RCTs, N = 569 ⊕⊕⊕O	MD 3.00 [-86.67, 92.67] 1 RCT, N = 91 ⊕⊕OO	MD -86.79 [-354.95, 181.36] 5 RCTs, N = 372 ⊕OOO	MD -115.60 [-240.14, 8.95] 4 RCTs, N = 622 ⊕⊕OO
Re-operation	RD 0.00 [-0.03, 0.03] 1 RCT, N = 153 ⊕OOO		RD 0.00 [-0.03, 0.03] 1 RCT, N = 153 ⊕OOO		RD 0.00 [-0.03, 0.03] 1 RCT, N = 153 ⊕OOO		
Infection	POR 0.72 [0.17, 2.98] 4 RCTs, N = 549 ⊕OOO		POR 0.55 [0.12, 2.52] 4 RCTs, N = 494 ⊕OOO	POR 4.81 [0.08, 283.10] 1 RCT, N = 55 ⊕OOO	POR 0.72 [0.17, 2.98] 3 RCTs, N = 429 ⊕OOO		Not estimable (zero cases) 1 RCT, N = 120 ⊕OOO

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Table 21. Overview of results: Orthopaedic (hip) *(Continued)*

Wound complication	POR 0.94 [0.36, 2.45] 4 RCTs, N = 609 ⊕◯◯◯		POR 1.18 [0.38, 3.65] 3 RCTs, N = 338 ⊕◯◯◯	POR 0.54 [0.09, 3.22] 2 RCTs, N = 271 ⊕◯◯◯	POR 1.94 [0.30, 12.58] 1 RCT, N = 115 ⊕◯◯◯	POR 0.53 [0.05, 5.15] 1 RCT, N = 216 ⊕◯◯◯	POR 0.80 [0.22, 2.89] 2 RCTs, N = 278 ⊕◯◯◯
PJI	POR 0.31 [0.05, 1.78] 5 RCTs, N = 806 ⊕◯◯◯		Not estimable (zero cases) 2 RCTs, N = 213 ⊕◯◯◯	POR 0.31 [0.05, 1.78] 4 RCTs, N = 593 ⊕◯◯◯	Not estimable (zero cases) 2 RCTs, N = 268 ⊕◯◯◯	POR 0.14 [0.00, 7.08] 1 RCT, N = 216 ⊕◯◯◯	POR 0.37 [0.05, 2.68] 2 RCTs, N = 322 ⊕◯◯◯
VTE/thrombosis	POR 1.45 [0.24, 8.72] 2 RCTs, N = 196 ⊕◯◯◯		POR 1.45 [0.24, 8.72] 2 RCTs, N = 196 ⊕◯◯◯		POR 1.45 [0.24, 8.72] 1 RCT, N = 96 ⊕◯◯◯		Not estimable (zero cases) 1 RCT, N = 100 ⊕◯◯◯
DVT	POR 1.05 [0.20, 5.60] 3 RCTs, N = 343 ⊕◯◯◯	POR 1.66 [0.26, 10.58] 1 RCT, N = 39 ⊕◯◯◯	Not estimable (zero cases) 1 RCT, N = 100 ⊕⊕◯◯	POR 0.14 [0.00, 6.82] 1 RCT, N = 204 ⊕◯◯◯		POR 1.66 [0.26, 10.58] 1 RCT, n = 39 ⊕◯◯◯	POR 0.14 [0.00, 6.82] 2 RCTs, N = 304 ⊕◯◯◯
PE	POR 0.14 [0.00, 7.08] 2 RCTs, N = 316 ⊕◯◯◯		Not estimable (zero cases) 1 RCT, N = 100 ⊕⊕◯◯	POR 0.14 [0.00, 7.08] 1 RCT, N = 216 ⊕◯◯◯		POR 0.14 [0.00, 7.08] 1 RCT, N = 216 ⊕◯◯◯	Not estimable (zero cases) 1 RCT, N = 100 ⊕◯◯◯
MACE							
MI							
CVA/stroke	RR 3.00 [0.13, 68.26] 1 RCT, N = 30 ⊕◯◯◯	RR 3.00 [0.13, 68.26] 1 RCT, N = 30 ⊕◯◯◯				RR 3.00 [0.13, 68.26] 1 RCT, N = 30 ⊕◯◯◯	

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Table 21. Overview of results: Orthopaedic (hip) *(Continued)*

Hospital LOS	MD 0.07 [-0.37, 0.52] 4 RCTs, N = 542 ⊕◯◯◯	MD 0.19 [-0.79, 1.17] 2 RCTs, N = 220 ⊕◯◯◯	MD -0.01 [-0.50, 0.47] 2 RCTs, N = 322 ⊕⊕◯◯	MD 0.07 [-0.37, 0.52] 4 RCTs, N = 542 ⊕◯◯◯

One study reporting orthopaedic (hip) reported data for more than one collection period, and so appears in more than one subgroup for timing: Rollo 1995 (postoperative only and both).
Bolded data highlights where there was a clear intervention effect.
"Volume" refers to mean transfusion volume; "transfusions" refers to number of people receiving an allogeneic transfusion
CI: confidence interval; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **Hb:** haemoglobin; **LOS:** hospital length of stay; **MACE:** major adverse cardiovascular events; **MD:** mean difference; **MI:** myocardial infarction; **N:** number of people analysed; **PE:** pulmonary embolism; **PJI:** prosthetic joint infection; **POR:** Peto odds ratio; **PPR:** per person randomised; **PPT:** per person transfused; **RCT:** randomised controlled trial; **RD:** risk difference; **RR**: risk ratio; **VTE:** venous thromboembolism
⊕◯◯◯ = Very low certainty; ⊕⊕◯◯ = Low certainty; ⊕⊕⊕◯ = Moderate certainty; ⊕⊕⊕⊕ = High certainty

Table 22. Overview of results: Orthopaedic (knee)

Outcome	Total [95% CI]	Subgroup: blood salvage (collection time)			Subgroup: transfusion threshold		
		Intraoperative	Postoperative	Both	No transfusion threshold	Liberal threshold (Hb > 80 g/L)	Restrictive threshold (Hb ≦ 80 g/L)
Risk of transfusion	**RR 0.49 [0.37, 0.66]** **21 RCTs, N = 2214** **#◯◯◯**		**RR 0.45 [0.32, 0.63]** **20 RCTs, N = 1939** **#◯◯◯**	RR 0.82 [0.67, 1.01] * 2 RCTs, N = 275 ⊕⊕◯◯	RR 0.16 [0.02, 1.32] 3 RCTs, N = 238 ⊕◯◯◯	**RR 0.44 [0.29, 0.64]** **12 RCTs, N = 1142** **#◯◯◯**	RR 0.81 [0.65, 1.01] * 6 RCTS, N = 834 ⊕⊕◯◯
Volume transfused (PPR)	**MD -0.87 [-1.09, -0.64]** **5 RCTs, N = 563** **##◯◯**		**MD -0.84 [-1.13, -0.55]** **5 RCTs, N = 428** **##◯◯**	**MD -0.93 [-1.29, -0.57]** **1 RCTs, N = 135** **##◯◯**		**MD -0.87 [-1.09, -0.64]** **5 RCTS, N = 563** **##◯◯**	
Volume transfused (PPT)	**MD -0.54 [-0.90, -0.19]** **3 RCTs, N = 221** **#◯◯◯**		MD -0.37 [-0.81, 0.07] RCTs, N = 130 ⊕◯◯◯	**MD -0.89 [-1.16, -0.62]** **1 RCT, N = 91**		**MD -0.54 [-0.90, -0.19]** **3 RCTs, N = 221** **#◯◯◯**	

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Table 22. Overview of results: Orthopaedic (knee) *(Continued)*

			##○○			
All-cause mortality						
Blood loss	MD -79.01 [-170.27, 12.24] 9 RCTs, N = 629 ⊕⊕○○	MD -79.01 [-170.27, 12.24] 9 RCTs, N = 629 ⊕⊕○○		MD 5.00 [-219.16, 229.16] 1 RCT, N = 70 ⊕○○○	MD -56.24 [-175.85, 63.37] 6 RCTs, N = 344 ⊕⊕⊕○	**MD -200.89 [-384.06, -17.72]** **2 RCTs, N = 215** **###○**
Re-operation	RD 0.00 [-0.02, 0.02] 1 RCT, N = 178 ⊕○○○	RD 0.00 [-0.02, 0.02] 1 RCT, N = 178 ⊕○○○				RD 0.00 [-0.02, 0.02] 1 RCT, N = 178 ⊕○○○
Infection	POR 0.74 [0.28, 1.94] 5 RCTS, N = 730 ⊕○○○	POR 0.86 [0.29, 2.52] 5 RCTS, N = 595 ⊕○○○	POR 0.43 [0.05, 3.57] 1 RCT, N = 135 ⊕○○○	POR 0.35 [0.05, 2.61] 1 RCT, N = 70 ⊕○○○	POR 0.70 [0.17, 2.77] 2RCTs, N = 360 ⊕○○○	POR 1.52 [0.25, 9.08] 2 RCTs, N = 300 ⊕○○○
Wound complication	POR 1.42 [0.61, 3.31] 6 RCTs, N = 734 ⊕○○○	POR 1.42 [0.61, 3.31] 6 RCTs, N = 734 ⊕○○○			POR 1.15 [0.41, 3.19] 4 RCTs, N = 356 ⊕○○○	POR 2.27 [0.50, 10.24] 2 RCTs, N = 378 ⊕○○○
PJI	RD 0.00 [-0.01, 0.01] 4 RCTs, N = 663 ⊕○○○	RD 0.00 [-0.01, 0.01] 4 RCTs, N = 528 ⊕○○○	RD 0.00 [-0.03, 0.03] 1 RCT, N = 135 ⊕○○○		RD 0.00 [-0.03, 0.03] 1 RCT, N = 248 ⊕○○○	RD 0.00 [-0.02, 0.02] 3 RCTs, N = 415 ⊕○○○
VTE/thrombosis						
DVT	POR 1.29 [0.56, 2.95] 9 RCTs, N = 793	POR 1.29 [0.56, 2.95] 9 RCTs, N = 793		Not estimable (zero cases)	POR 1.50 [0.62, 3.65] 6 RCTs, N = 462	POR 0.48 [0.05, 4.64]

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Table 22. Overview of results: Orthopaedic (knee) *(Continued)*

	⊕◯◯◯	⊕◯◯◯	1 RCT, N = 70 ⊕⊕◯◯	⊕◯◯◯	2 RCTs, N = 293 ⊕◯◯◯
PE	POR 0.51 [0.10, 2.52] 6 RCTs, N = 574 ⊕◯◯◯	POR 0.51 [0.10, 2.52] 6 RCTs, N = 574 ⊕◯◯◯		POR 0.30 [0.05, 1.73] 5 RCTs, N = 459 ⊕◯◯◯	POR 7.02 [0.14, 354.40] 1 RCT, N = 115 ⊕◯◯◯
MACE	RD 0.00 [-0.03, 0.03] 1 RCT, N = 112 ⊕⊕◯◯	RD 0.00 [-0.03, 0.03] 1 RCT, N = 112 ⊕⊕◯◯		RD 0.00 [-0.03, 0.03] 1 RCT, N = 112 ⊕⊕◯◯	
MI	POR 7.02 [0.14, 354.40] 1 RCT, N = 115 ⊕◯◯◯	POR 7.02 [0.14, 354.40] 1 RCT, N = 115 ⊕◯◯◯			POR 7.02 [0.14, 354.40] 1 RCT, N = 115 ⊕◯◯◯
CVA/stroke	RD 0.00 [-0.06, 0.06] 1 RCT, N = 60 ⊕⊕◯◯	RD 0.00 [-0.06, 0.06] 1 RCT, N = 60 ⊕⊕◯◯		RD 0.00 [-0.06, 0.06] 1 RCT, N = 60 ⊕⊕◯◯	
Hospital LOS	MD -0.79 [-2.30, 0.72] 4 RCTs, N = 255 ⊕◯◯◯	MD -0.79 [-2.30, 0.72] 4 RCTs, N = 255 ⊕◯◯◯	**MD -2.60 [-4.76, -0.44]** **1 RCT, N = 70** **##◯◯**	MD -0.28 [-1.59, 1.03] 3 RCTs, N = 185 ⊕⊕◯◯	

One study reporting for orthopaedic (knee) reported data for more than one collection period, and so appears in more than one subgroup for timing: Blatsoukas 2010 (postoperative only, and both).
Bolded data highlights where there was a clear intervention effect.
* neared an intervention effect (touched the line of no effect)
"Volume" refers to mean transfusion volume; "transfusions" refers to number of people receiving an allogeneic transfusion
CI: confidence interval; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **Hb:** haemoglobin; **LOS:** hospital length of stay; **MACE:** major adverse cardiovascular events; **MD:** mean difference; **MI:** myocardial infarction; **N:** number of people analysed; **PE:** pulmonary embolism; **PJI:** prosthetic joint infection; **POR:** Peto odds ratio; **PPR:** per person randomised; **PPT:** per person transfused; **RCT:** randomised controlled trial; **RD:** risk difference; **RR**: risk ratio; **VTE:** venous thromboembolism
⊕◯◯◯ = Very low certainty; ⊕⊕◯◯ = Low certainty; ⊕⊕⊕◯ = Moderate certainty; ⊕⊕⊕⊕ = High certainty

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Table 23. Overview of results: Orthopaedic (spinal)

Outcome	Total [95% CI]	Subgroup: blood salvage (collection time)			Subgroup: transfusion threshold		
		Intraoperative	Postoperative	Both	No transfusion threshold	Liberal threshold (Hb > 80 g/L)	Restrictive threshold (Hb ≦ 80 g/L)
Risk of transfusion	**RR 0.44 [0.31, 0.63]** **3 RCTs, N = 194** **###○**	**RR 0.43 [0.26, 0.71]** **2 RCTs, N = 144** **###○**	RR 0.50 [0.05, 5.17] 1 RCT, N = 50 ⊕○○○		**RR 0.32 [0.18, 0.58]** **1 RCT, N = 49** **##○○**	RR 0.50 [0.05, 5.17] 1 RCT, N = 50 ⊕○○○	**RR 0.54 [0.34, 0.86]** **1 RCT, N = 95** **###○**
Volume transfused (PPR)	MD -0.99 [-2.49, 0.50] 3 RCTs, N = 208 ⊕○○○	MD -1.39 [-3.48, 0.71] 2 RCTs, N = 145 ⊕○○○	MD -0.21 [-0.63, 0.21] 1 RCT, N = 63 ⊕⊕○○				MD -0.99 [-2.49, 0.50] 3 RCTs, N = 208 ⊕○○○
Volume transfused (PPT)	MD 0.59 [-0.09, 1.27] 1 RCT, N = 45 ⊕○○○	MD 0.59 [-0.09, 1.27] 1 RCT, N = 45 ⊕○○○					MD 0.59 [-0.09, 1.27] 1 RCT, N = 45 ⊕○○○
All-cause mortality							
Blood loss	MD -121.37 [-245.90, 3.15] 3 RCTs, N = 208 ⊕⊕⊕○	MD -111.92 [-238.45, 14.60] 2 RCTs, N = 145 ⊕⊕⊕○	MD -413.00 [-1115.93, 289.93] 1 RCT, N = 63 ⊕⊕⊕○				MD -121.37 [-245.90, 3.15] 3 RCTs, N = 208 ⊕⊕⊕○
Re-operation							
Infection	RD 0.00 [-0.06, 0.06] 1 RCT, N = 63 ⊕⊕○○		RD 0.00 [-0.06, 0.06] 1 RCT, N = 63 ⊕⊕○○				RD 0.00 [-0.06, 0.06] 1 RCT, N = 63 ⊕⊕○○

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Table 23. Overview of results: Orthopaedic (spinal) *(Continued)*

Wound complication	RR 4.44 [0.22, 88.04] 1 RCT, N = 49 ⊕◯◯◯	RR 4.44 [0.22, 88.04] 1 RCT, N = 49 ⊕◯◯◯	RR 4.44 [0.22, 88.04] 1 RCT, N = 49 ⊕◯◯◯
PJI			
VTE/thrombosis			
DVT			
PE	POR 8.17 [0.16, 413.39] 1 RCT, N = 63 ⊕◯◯◯	POR 8.17 [0.16, 413.39] 1 RCT, N = 63 ⊕◯◯◯	POR 8.17 [0.16, 413.39] 1 RCT, N = 63 ⊕◯◯◯
MACE			
MI			
CVA/stroke			
Hospital LOS			

Bolded data highlights where there was a clear intervention effect.
"Volume" refers to mean transfusion volume; "transfusions" refers to number of people receiving an allogeneic transfusion
CI: confidence interval; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **Hb:** haemoglobin; **LOS:** hospital length of stay; **MACE:** major adverse cardiovascular events; **MD:** mean difference; **MI:** myocardial infarction; **N:** number of people analysed; **PE:** pulmonary embolism; **PJI:** prosthetic joint infection; **POR:** Peto odds ratio; **PPR:** per person randomised; **PPT:** per person transfused; **RCT:** randomised controlled trial; **RD:** risk difference; **RR**: risk ratio; **VTE:** venous thromboembolism
⊕◯◯◯ = Very low certainty; ⊕⊕◯◯ = Low certainty; ⊕⊕⊕◯ = Moderate certainty; ⊕⊕⊕⊕ = High certainty

Table 24. Overview of results: Orthopaedic (mixed)

Outcome	**Total**	**Subgroup: blood salvage (collection time)**			**Subgroup: transfusion threshold**		
	[95% CI]	**Intraoperative**	**Postoperative**	**Both**	**No transfusion threshold**	**Liberal threshold (Hb > 80 g/L)**	**Restrictive threshold (Hb ≦ 80 g/L)**

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Table 24. Overview of results: Orthopaedic (mixed) *(Continued)*

Risk of transfusion	**RR 0.64 [0.45, 0.90]** **11 RCTs, N = 4011** **#○○○**	RR 0.63 [0.38, 1.02] * 1 RCT, N = 40 ⊕○○○	**RR 0.60 [0.40, 0.90]** **7 RCTs, N = 1349** **#○○○**	RR 0.74 [0.34, 1.59] 3 RCTs, N = 2622 ⊕○○○	**RR 0.61 [0.43, 0.86]** **4 RCTS, N = 390** **##○○**	**RR 0.34 [0.23, 0.51]** **3 RCTs, N = 458** **##○○**	RR 0.93 [0.63, 1.38] 4 RCTS, N = 3163 ⊕○○○
Volume transfused (PPR)	MD -0.38 [-0.85, 0.08] 5 RCTs, N = 2687 ⊕○○○	**MD -0.68 [-0.98, -0.38]** **1 RCT, N = 40** **#○○○**	MD -0.28 [-1.27, 0.71] 2 RCTs, N = 146 ⊕○○○	MD -0.32 [-1.16, 0.52] 2 RCTs, N = 2501 ⊕○○○	**MD -0.68 [-0.98, -0.38]** **1 RCT, N = 40** **#○○○**	**MD -0.80 [-1.38, -0.22]** **1 RCT, N4 = 59** **##○○**	MD -0.15 [-0.68, 0.39] 3 RCTS, N = 2588 ⊕○○○
Volume transfused (PPT)	MD -0.24 [-0.73, 0.24] 5 RCTs, N = 395 ⊕○○○	**MD -0.58 [-0.72, -0.44]** **1 RCT, N = 26** **##○○**	MD -0.02 [-1.00, 0.97] 2 RCTs, N = 65 ⊕○○○	MD -0.23 [-1.03, 0.58] 2 RCTs, N = 304 ⊕○○○	**MD -0.58 [-0.72, -0.44]** **1 RCT, N = 26** **#○○○**	MD -0.80 [-1.92, 0.32] 1 RCT, N = 18 ⊕○○○	MD 0.04 [-0.50, 0.57] 3 RCTS, N = 351 ⊕⊕○○
All-cause mortality	RD 0.00 [-0.07, 0.07] 1 RCT, N = 69 ⊕○○○		RD 0.00 [-0.07, 0.07] 1 RCT, N = 69 ⊕○○○				RD 0.00 [-0.07, 0.07] 1 RCT, N = 69 ⊕○○○
Blood loss	MD -28.78 [-97.43, 39.88] 2 RCTs, N = 99 ⊕⊕○○	MD -30.30 [-100.75, 40.15] 1 RCT, N = 40 ⊕○○○		MD 0.00 [-306.24, 306.24] 1 RCT, N = 59 ⊕○○○	MD -30.30 [-100.75, 40.15] 1 RCT, N = 40 ⊕○○○	MD 0.00 [-306.24, 306.24] 1 RCT, N = 59 ⊕○○○	
Re-operation							
Infection	RD 0.00 [-0.02, 0.02] 1 RCT, N = 239 ⊕○○○		RD 0.00 [-0.02, 0.02] 1 RCT, N = 239 ⊕○○○			RD 0.00 [-0.02, 0.02] 1 RCT, N = 239 ⊕○○○	

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Table 24. Overview of results: Orthopaedic (mixed) *(Continued)*

Wound complication	RR 1.75 [0.53, 5.75] 1 RCT, N = 160 ⊕◯◯◯	RR 1.75 [0.53, 5.75] 1 RCT, N = 160 ⊕◯◯◯			RR 1.75 [0.53, 5.75] 1 RCT, N = 160 ⊕◯◯◯	
PJI	POR 1.25 [0.44, 3.51] 3 RCTs, N = 826 ⊕◯◯◯	POR 1.25 [0.44, 3.51] 3 RCTs, N = 826 ⊕◯◯◯		POR 5.27 [0.50, 55.38] 1 RCT, N = 91 ⊕◯◯◯	POR 1.00 [0.06, 16.13] 1 RCT, N = 160 ⊕◯◯◯	POR 0.86 [0.24, 3.05] 1 RCT, N = 575 ⊕◯◯◯
VTE/thrombosis	RD 0.00 [-0.02, 0.02] 2 RCTs, N = 278 ⊕⊕◯◯	RD 0.00 [-0.02, 0.02] 2 RCTs, N = 278 ⊕⊕◯◯		RD 0.00 [-0.04, 0.04] 1 RCT, N = 118 ⊕◯◯◯	RD0.00 [-0.02, 0.02] 1 RCT, N = 160 ⊕◯◯◯	
DVT	POR 0.41 [0.09, 1.92] 4 RCTs, N = 3295 ⊕⊕◯◯	POR 0.99 [0.09, 10.99] 3 RCTs, N = 853 ⊕◯◯◯	POR 0.22 [0.03, 1.67] 1 RCT, N = 2442 ⊕⊕◯◯	Not estimable (zero cases) 1 RCT, N = 118 ⊕◯◯◯	Not estimable (zero cases) 1 RCT, N = 160 ⊕◯◯◯	POR 0.41 [0.09, 1.92] 2 RCTS, N = 3017 ⊕⊕◯◯
PE	POR 1.86 [0.48, 7.27] 4 RCTs, N = 3295 ⊕◯◯◯	POR 1.44 [0.18, 11.64] 3 RCTs, N = 853 ⊕◯◯◯	POR 2.25 [0.37, 13.57] 1 RCT, N = 2442 ⊕◯◯◯	Not estimable (zero cases) 1 RCT, N = 118 ⊕◯◯◯	Not estimable (zero cases) 1 RCT, N = 160 ⊕◯◯◯	POR 1.86 [0.48, 7.27] 2 RCTs, N = 3017 ⊕◯◯◯
MACE						
MI	POR 0.62 [0.17, 2.22] 2 RCTs, N = 3017 ⊕◯◯◯	POR 0.05 [0.00, 3.13] 1 RCT, N = 575 ⊕◯◯◯	POR 0.81 [0.21, 3.08] 1 RCT, N = 2442 ⊕◯◯◯			POR 0.62 [0.17, 2.22] 2 RCTs, N = 3017 ⊕◯◯◯

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Table 24. Overview of results: Orthopaedic (mixed) *(Continued)*

CVA/stroke				
Hospital LOS	MD -0.02 [-1.94, 1.90] 2 RCTs, N = 160 ⊕◯◯◯	MD -0.02 [-1.94, 1.90] 2 RCTs, N = 160 ⊕◯◯◯	MD 0.83 [0.30, 1.36] 1 RCT, N = 91 ⊕◯◯◯	MD -1.15 [-2.70, 0.40] 1 RCT, N = 69 ⊕◯◯◯

Bolded data highlights where there was a clear intervention effect.
* neared an intervention effect (touched the line of no effect)
"Volume" refers to mean transfusion volume; "transfusions" refers to number of people receiving an allogeneic transfusion
CI: confidence interval; **CVA:** cerebrovascular accident; **DVT:** deep vein thrombosis; **Hb:** haemoglobin; **LOS:** hospital length of stay; **MACE:** major adverse cardiovascular events; **MD:** mean difference; **MI:** myocardial infarction; **N:** number of people analysed; **PE:** pulmonary embolism; **PJI:** prosthetic joint infection; **POR:** Peto odds ratio; **PPR:** per person randomised; **PPT:** per person transfused; **RCT:** randomised controlled trial; **RD:** risk difference; **RR**: risk ratio; **VTE:** venous thromboembolism
⊕◯◯◯ = Very low certainty; ⊕⊕◯◯ = Low certainty; ⊕⊕⊕◯ = Moderate certainty; ⊕⊕⊕⊕ = High certainty

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APPENDICES

Appendix 1. Search strategy (2010)

MEDLINE search strategy

1. cell$ sav$.mp.
2. cell$ salvage.mp.
3. blood transfusion, autologous/
4. autotransfusion$.mp.
5. auto-transfusion$.mp.
6. blood salvage.mp.
7. autovac.mp.
8. solcotrans system.mp.
9. constavac.mp.
10. solcotrans.mp.
11. hemovac.mp.
12. BRAT.mp.
13. fresenius.mp.
14. consta vac.mp.
15. cell saver.mp.
16. dideco.mp.
17. electromedic.mp.
18. electromedics.mp.
19. gish biomedical.mp.
20. haemonetics.mp.
21. orth-evac.mp.
22. pleur-evac.mp.
23. sorenson.mp.
24. reinfusion system.mp.
25. sorin biomedical.mp.
26. or/1-25
27. exp blood transfusion/
28. exp hemorrhage/
29. exp anesthesia/
30. transfusion$.mp.
31. bleed$.mp.
32. blood loss$.mp.
33. hemorrhag$.mp.
34. haemorrhag$.mp.
35. or/27-34
36. 26 and 35
37. randomized controlled trial.pt.
38. controlled clinical trial.pt.
39. randomized controlled trials.sh.
40. random allocation.sh.
41. double blind method.sh.
42. single blind method.sh.
43. or/37-42
44. clinical trial.pt.
45. exp Clinical trials/
46. (clin$ adj25 trial$).ti,ab.
47. ((singl$ or doubl$ or trebl$ or tripl$) adj25 (blind$ or mask$)).ti,ab.
48. placebos.sh.
49. placebo$.ti,ab.
50. random$.ti,ab.
51. research design.sh.
52. or/44-51
53. comparative study.sh.
54. exp Evaluation studies/
55. follow up studies.sh.

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56. prospective studies.sh.
57. (control$ or prospectiv$ or volunteer$).ti,ab.
58. or/53-57
59. 43 or 52 or 58
60. 36 and 59
61. animal/ not human/
62. 60 not 61

Appendix 2. Search strategies (2023)

MEDLINE

1. Operative Blood Salvage/ or *Blood Transfusion, Autologous/

2. Blood Transfusion, Autologous/

3. limit 2 to yr="2009 - 2011"

4. (((cell* or blood) adj2 salvag*) or cell saver* or cellsaver* or blood saver* or bloodsaver* or cell saving or autologous hemotherapy or autologous haemotherapy or blood collection system).tw,kf.

5. ((blood or autologous or perioperative* or postoperative* or intraoperative* or operative*) adj1 (salvag* or retransfus* or re-transfus*)).tw,kf.

6. (((wash* or unwashed or collection) adj1 (red cells or red blood cells or RBCs)) or red cell recovery or red cell collection or red blood cell recovery or red blood cell collection or RBC recovery or RBC collection).tw,kf.

7. ((whole blood or pump blood or red cell* or red blood cell* or RBC* or shed blood or mediastinal blood) adj5 (salvag* or re-transfus* or retransfus* or reinfus* or re-infus*)).tw,kf.

8. (drain* adj5 (blood or autologous or wound* or surgical* or post-operat* or postoperat* or intraoperat* or intra-operat* or operat* or peri-operat* or perioperat*) adj5 (transfus* or retransfus* or re-transfus* or infus* or reinfus* or re-infus* or reperfus* or re-perfus*)).tw,kf.

9. (wound drain* and (autologous adj5 (transfus* or retransfus* or re-transfus*))).mp.

10. (autotransfus* or auto-transfus* or autoblood* or autohemotransfus* or auto-hemotransfus* or autohaemotransfus* or auto-haemotransfus*).tw,kf.

11. (Constavac or ConstavacTM or Orth-Evac or Orth-EvacTM or OrthoPat or OrthoPatTM or Solcotrans or SolcotransTM or Hemovac or HemovacTM or Cobe BRAT or "BRAT 2" or "Fresenius continuous" or "consta vac" or dideco or electromedic* or Gish biomedical or haemonetic* or Sorenson ATS or Sorenson Receptal Device or sorin biomedical).tw,kf.

12. (ABTrans or Atrium 2050 or Atrium 2550 or Autovac or AutovacTM or Bard cardiotomy reservoir* or Bellovac ABT or Beijing PerMed or PerMed Biomedical or Bentley Catr or BIODREN or CATR 3500 or Cell Trans or CellTrans or CellTransTM or Cobe Bayler or Flow-Gard* or Gish Orthofuser or Medtronic Autolog or Ortho-Evac or Ortho-EvacTM or Pleur-Evac or Pleur-EvacTM or Redivac or RedivacTM or Redon Drain* or Sangvia or SangviaTM or Shiley hardshell or Terumo TE-171).tw,kf.

13. 1 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12

14. Meta-Analysis/ or Network Meta-Analysis/

15. Systematic Review.pt.

16. "Systematic Reviews as Topic"/ or "Meta-Analysis as Topic"/

17. ((meta analy* or metaanaly*) and (trials or studies)).ab.

18. (meta analy* or metaanaly* or evidence-based).ti.

19. ((systematic* or evidence-based) adj2 (review* or overview*)).tw,kf.

20. (evidence synthes* or cochrane or medline or pubmed or embase or cinahl or cinhal or lilacs or "web of science" or science citation index or scopus or search terms or literature search or electronic search* or comprehensive search* or systematic search* or published articles or search strateg* or reference list* or bibliograph* or handsearch* or hand search* or manual* search*).ab.

21. Cochrane Database of systematic reviews.jn.

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22. ((additional adj (papers or articles or sources)) or (relevant adj (journals or articles))).ab.

23. ((electronic* or online) adj (sources or resources or databases)).ab.

24. network meta-analys*.tw,kf.

25. or/14-24

26. Review.pt.

27. Randomized Controlled Trials as Topic/

28. selection criteria.ab. or critical appraisal.ti.

29. (data adj (abstraction or extraction or analys*)).ab.

30. exp Randomized Controlled Trial/

31. or/27-30

32. 26 and 31

33. 25 or 32

34. (Controlled Clinical Trial or Clinical Trial Protocol).pt.

35. exp Randomized Controlled Trial/

36. (randomi* or randomly or placebo).tw,kf.

37. trial.ti,kf.

38. Clinical Trials as Topic/

39. Clinical Trial, Phase III/ or ("phase 3" or "phase3" or "phase III" or P3 or "PIII").tw,kf.

40. or/34-39

41. 33 or 40

42. (exp Animals/ or exp Animal Experimentation/ or exp Models, Animal/) not Humans/

43. Editorial.pt.

44. 42 or 43

45. 41 not 44

46. 13 and 45

47. limit 46 to yr="2009 -Current"

Embase

1. Blood Salvage/ or *Blood Autotransfusion/

2. (((cell* or blood) adj2 salvag*) or cell saver* or cellsaver* or blood saver* or bloodsaver* or cell saving or autologous hemotherapy or autologous haemotherapy or blood collection system).tw,kw.

3. ((blood or autologous or perioperative* or postoperative* or intraoperative* or operative*) adj1 (salvag* or retransfus* or re-transfus*)).tw,kw.

4. (((wash* or unwashed or collection) adj1 (red cells or red blood cells or RBCs)) or red cell recovery or red cell collection or red blood cell recovery or red blood cell collection or RBC recovery or RBC collection).tw,kw.

5. ((whole blood or pump blood or red cell* or red blood cell* or RBC* or shed blood or mediastinal blood) adj5 (salvag* or re-transfus* or retransfus* or reinfus* or re-infus*)).tw,kw.

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6. (drain* adj5 (blood or autologous or wound* or surgical* or post-operat* or postoperat* or intraoperat* or intra-operat* or operat* or peri-operat* or perioperat*) adj5 (transfus* or retransfus* or re-transfus* or infus* or reinfus* or re-infus* or reperfus* or re-perfus*)).tw,kw.

7. (wound drain* and (autologous adj5 (transfus* or retransfus* or re-transfus*))).mp.

8. (autotransfus* or auto-transfus* or autoblood* or autohemotransfus* or auto-hemotransfus* or autohaemotransfus* or auto-haemotransfus*).tw,kw.

9. (Constavac or ConstavacTM or Orth-Evac or Orth-EvacTM or OrthoPat or OrthoPatTM or Solcotrans or SolcotransTM or Hemovac or HemovacTM or Cobe BRAT or "BRAT 2" or "Fresenius continuous" or "consta vac" or dideco or electromedic* or Gish biomedical or haemonetic* or Sorenson ATS or Sorenson Receptal Device or sorin biomedical).tw,kw.

10. (ABTrans or Atrium 2050 or Atrium 2550 or Autovac or AutovacTM or Bard cardiotomy reservoir* or Bellovac ABT or Beijing PerMed or PerMed Biomedical or Bentley Catr or BIODREN or CATR 3500 or Cell Trans or CellTrans or CellTransTM or Cobe Bayler or Flow-Gard* or Gish Orthofuser or Medtronic Autolog or Ortho-Evac or Ortho-EvacTM or Pleur-Evac or Pleur-EvacTM or Redivac or RedivacTM or Redon Drain* or Sangvia or SangviaTM or Shiley hardshell or Terumo TE-171).tw,kw.

11. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10

12. Meta Analysis/

13. (meta analy* or metaanaly*).ti,kw.

14. ((meta analy* or metaanaly*) and (trials or studies)).ab.

15. Systematic Review/

16. ((systematic* or evidence-based) adj2 (review* or overview*)).tw,kw.

17. (evidence synthes* or cochrane or medline or pubmed or embase or cinahl or cinhal or lilacs or "web of science" or google scholar or google database or science citation index or scopus or search terms or literature search or electronic search* or comprehensive search* or systematic search* or published articles or search strateg* or reference list* or bibliograph* or handsearch* or hand search* or manual* search*).ab.

18. ((electronic* or online) adj (sources or resources or databases)).ab.

19. ((additional adj (papers or articles or sources)) or (relevant adj (journals or articles))).ab.

20. exp "Controlled Clinical Trial (Topic)"/

21. or/12-20

22. Review.pt.

23. (data extraction or selection criteria).ab.

24. 22 and 23

25. 21 or 24

26. Editorial.pt.

27. 25 not 26

28. crossover-procedure/ or double-blind procedure/ or randomized controlled trial/ or single-blind procedure/

29. (random* or factorial* or crossover* or cross over* or cross-over* or placebo* or doubl* blind* or singl* blind* or assign* or allocat* or volunteer*).mp.

30. 27 or 28 or 29

31. (exp animal/ or nonhuman/) not exp human/

32. 30 not 31

33. 11 and 32

34. limit 33 to yr="2009 -Current"

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CENTRAL

#1 MeSH descriptor: [Operative Blood Salvage] this term only
#2 MeSH descriptor: [Blood Transfusion, Autologous] this term only

#3 ("cell salvage" or "cell saver" or cellsaver* or "cell savers" or "blood salvage" or "salvaged blood" or "blood saver" or "blood savers" or bloodsaver* or "cell saving" or "autologous hemotherapy" or "autologous haemotherapy" or "blood collection system" or "blood collection systems" or retransfusion system* or re-transfusion system* or reinfusion system* or re-infusion system*):ti,ab

#4 ((blood or autologous or perioperative* or postoperative* or intraoperative* or operative*) near/1 (salvag* or retransfus* or re-transfus*)):ti,ab

#5 (((wash* or unwashed or collection) near/1 ("red cells" or "red blood cells" or RBCs)) or "red cell recovery" or "red cell collection" or "red blood cell recovery" or "red blood cell collection" or "RBC recovery" or "RBC collection"):ti,ab

#6 (("whole blood" or "pump blood" or "red cell" or "red cells" or "red blood cell" or "red blood cells" or RBC* or "shed blood" or "mediastinal blood") near/5 (salvag* or re-transfus* or retransfus* or reinfus* or re-infus*)):ti,ab

#7 (drain* near/5 (blood or autologous or wound* or surgical* or post-operat* or postoperat* or intraoperat* or intra-operat* or operat* or peri-operat* or perioperat*) near/5 (transfus* or retransfus* or re-transfus* or infus* or reinfus* or re-infus* or reperfus* or re-perfus*)):ti,ab

#8 ("wound drain" or "wound drains" or "wound drainage") and (autologous near/5 (transfus* or retransfus* or re-transfus*))

#9 (autotransfus* or auto-transfus* or autoblood* or autohemotransfus* or auto-hemotransfus* or autohaemotransfus* or auto-haemotransfus*):ti,ab

#10 (Constavac or ConstavacTM or Orth-Evac or Orth-EvacTM or OrthoPat or OrthoPatTM or Solcotrans or SolcotransTM or Hemovac or HemovacTM or "Cobe BRAT" or "BRAT 2" or "Fresenius continuous" or "consta vac" or dideco or electromedic* or "Gish biomedical" or haemonetic* or "Sorenson ATS" or "Sorenson Receptal Device" or "sorin biomedical"):ti,ab

#11 (ABTrans or "Atrium 2050" or "Atrium 2550" or Autovac or AutovacTM or "Bard cardiotomy reservoir" or "Bellovac ABT" or "Beijing PerMed" or "PerMed Biomedical" or "Bentley Catr" or BIODREN or "CATR 3500" or "Cell Trans" or CellTrans or CellTransTM or "Cobe Bayler" or Flow-Gard* or "Gish Orthofuser" or "Medtronic Autolog" or Ortho-Evac or Ortho-EvacTM or Pleur-Evac or Pleur-EvacTM or Redivac or RedivacTM or "Redon Drain" or Sangvia or SangviaTM or "Shiley hardshell" or "Terumo TE-171"):ti,ab

#12 #1 or #2 or #3 or #4 or #5 or #6 or #8 or #9 or #10 or #11 with Publication Year from 2009 to 2023, in Trials

Epistemonikos

title:("cell salvage" OR "cell saver" OR "cell saving" OR "autologous blood" OR "blood salvage" OR "blood saver" OR "blood saving" OR retransfus* OR re-transfus*) OR abstract:("cell salvage" OR "cell saver" OR "cell saving" OR "autologous blood" OR "blood salvage" OR "blood saver" OR "blood saving" OR retransfus* OR re-transfus*) NOT title: platelet-rich (2009-2023)

PubMed

#1 ("cell salvage"[TIAB] OR "cell saver"[TIAB] OR "cell savers"[TIAB] OR "blood salvage" OR "salvaged blood"[TIAB] OR "blood saver"[TIAB] OR "blood savers"[TIAB] OR "cell saving"[TIAB] OR "autologous hemotherapy"[TIAB] OR "autologous haemotherapy"[TIAB] OR "blood collection systems"[TIAB] OR "retransfusion system"[TIAB] OR "retransfusion systems"[TIAB] OR "re-transfusion system" [TIAB] OR "re-transfusion systems"[TIAB] OR "reinfusion system"[TIAB] OR "reinfusion systems"[TIAB] OR "re-infusion system"[TIAB] OR "re-infusion systems"[TIAB])

#2 ((blood[TIAB] OR autologous[TIAB] OR perioperative*[TIAB] OR postoperative*[TIAB] OR intraoperative*[TIAB] OR operative*[TIAB]) AND (salvag*[TIAB] OR retransfus*[TIAB] OR re-transfus*[TIAB]))

#3 ("washed red cells"[TIAB] OR "washing red cells"[TIAB] OR "unwashed red cells"[TIAB] OR "washed red blood cells"[TIAB] OR "washing red blood cells"[TIAB] OR "unwashed red blood cells"[TIAB] OR "washed RBCs"[TIAB] OR "washing RBCs"[TIAB] OR "unwashed RBCs"[TIAB] OR "red cell recovery"[TIAB] OR "red blood cell recovery"[TIAB] OR "RBC recovery"[TIAB])

#4 (("whole blood"[TIAB] OR "pump blood"[TIAB] OR "red cell"[TIAB] OR "red cells"[TIAB] OR "red blood cell"[TIAB] OR "red blood cells"[TIAB] OR RBC*[TIAB] OR "shed blood"[TIAB] OR "mediastinal blood"[TIAB]) AND (salvag*[TIAB] OR re-transfus*[TIAB] OR retransfus*[TIAB] OR reinfus*[TIAB] OR re-infus*[TIAB]))

#5 (drain*[TIAB] AND (blood[TIAB] OR autologous[TIAB] OR wound*[TIAB] OR surgical*[TIAB] OR post-operat*[TIAB] OR postoperat*[TIAB] OR intraoperat*[TIAB] OR intra-operat*[TIAB] OR operat*[TIAB] OR peri-operat*[TIAB] OR perioperat*[TIAB]) AND (transfus*[TIAB] OR retransfus*[TIAB] OR re-transfus*[TIAB] OR infus*[TIAB] OR reinfus*[TIAB] OR re-infus*[TIAB] OR reperfus*[TIAB] OR re-perfus*[TIAB]))

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#6 (autotransfus*[TIAB] OR auto-transfus*[TIAB] OR autoblood*[TIAB] OR autohemotransfus*[TIAB] OR auto-hemotransfus*[TIAB] OR autohaemotransfus*[TIAB] OR auto-haemotransfus*[TIAB])

#7 (Constavac[TIAB] OR ConstavacTM[TIAB] OR Orth-Evac[TIAB] OR Orth-EvacTM[TIAB] OR OrthoPat[TIAB] OR OrthoPatTM[TIAB] OR Solcotrans[TIAB] OR SolcotransTM[TIAB] OR Hemovac[TIAB] OR HemovacTM[TIAB] OR "Cobe BRAT"[TIAB] OR "BRAT 2"[TIAB] OR "Fresenius continuous"[TIAB] OR "consta vac"[TIAB] OR dideco[TIAB] OR electromedic*[TIAB] OR "Gish biomedical"[TIAB] OR haemonetic*[TIAB] OR "Sorenson ATS"[TIAB] OR "Sorenson Receptal Device"[TIAB] OR "sorin biomedical"[TIAB])

#8 (ABTrans[TIAB] OR "Atrium 2050"[TIAB] OR "Atrium 2550"[TIAB] OR Autovac[TIAB] OR AutovacTM[TIAB] OR "Bard cardiotomy reservoir"[TIAB] OR "Bellovac ABT"[TIAB] OR "Beijing PerMed"[TIAB] OR "PerMed Biomedical"[TIAB] OR "Bentley Catr"[TIAB] OR BIODREN[TIAB] OR "CATR 3500"[TIAB] OR "Cell Trans"[TIAB] OR CellTrans[TIAB] OR CellTransTM[TIAB] OR "Cobe Bayler"[TIAB] OR Flow-Gard*[TIAB] OR "Gish Orthofuser"[TIAB] OR "Medtronic Autolog"[TIAB] OR Ortho-Evac[TIAB] OR Ortho-EvacTM[TIAB] OR Pleur-Evac[TIAB] OR Pleur-EvacTM[TIAB] OR Redivac[TIAB] OR RedivacTM[TIAB] OR "Redon Drain"[TIAB] OR Sangvia[TIAB] OR SangviaTM[TIAB] OR "Shiley hardshell"[TIAB] OR "Terumo TE-171"[TIAB])

#9 #1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8

#10 (random*[TIAB] OR blind*[TIAB] OR "control group"[TIAB] OR placebo*[TIAB] OR "controlled trial"[TIAB] OR "controlled trials"[TIAB] OR "controlled clinical trial"[TIAB] OR "controlled study"[TIAB] OR "controlled studies"[TIAB] OR trial*[TI] OR "systematic review"[TIAB] OR "systematic overview" [TIAB] OR "meta-analysis" OR metaanalysis[TIAB] OR "evidence synthesis"[TIAB] OR "literature search"[TIAB] OR medline[TIAB] OR pubmed[TIAB] OR cochrane[TIAB] OR embase[TIAB]) NOT medline[sb]

#11 #9 AND #10 [2009-present]

Tranfusion Evidence Library

Subject Area: Alternatives to Transfusion / Autologous Transfusion and Cell Salvage

Date: 2009-2023

International HTA database (INAHTA)

("Blood Transfusion, Autologous")[mh] OR ("cell salvage" OR "cell saver" OR "cell saving" OR "autologous blood" OR "blood salvage" OR "blood saver" OR "blood saving" OR retransfus* OR re-transfus*)[Title] OR ("cell salvage" OR "cell saver" OR "cell saving" OR "autologous blood" OR "blood salvage" OR "blood saver" OR "blood saving" OR retransfus* OR re-transfus*)[abs] OR ("cell salvage" OR "cell saver" OR "cell saving" OR "autologous blood" OR "blood salvage" OR "blood saver" OR "blood saving" OR retransfus* OR re-transfus*)[Keywords] FROM 2009 TO 2023

Web of Science

#1 TS=("cell salvage" OR "cell saver" OR "cell savers" OR "blood saver" OR "blood savers" OR "cell saving" OR "autologous hemotherapy" OR "autologous haemotherapy" OR "blood collection systems" OR "retransfusion system" OR "retransfusion systems" OR "re-transfusion system" OR "re-transfusion systems" OR "reinfusion system" OR "reinfusion systems" OR "re-infusion system" OR "re-infusion systems")

#2 TS= ((blood or autologous or perioperative* or postoperative* or intraoperative* or operative*) near/1 (salvag* or retransfus* or re-transfus*))

#3 TS= (((wash* or unwashed or collection) near/1 ("red cells" or "red blood cells" or RBCs)) or "red cell recovery" or "red cell collection" or "red blood cell recovery" or "red blood cell collection" or "RBC recovery" or "RBC collection")

#4 TS= (("whole blood" or "pump blood" or "red cell" or "red cells" or "red blood cell" or "red blood cells" or RBC* or "shed blood" or "mediastinal blood") near/6 (salvag* or re-transfus* or retransfus* or reinfus* or re-infus*))

#5 TS= (drain* near/5 (blood or autologous or wound* or surgical* or post-operat* or postoperat* or intraoperat* or intra-operat* or operat* or peri-operat* or perioperat*) near/5 (transfus* or retransfus* or re-transfus* or infus* or reinfus* or re-infus* or reperfus* or re-perfus*))

#6 TS= (autotransfus* or auto-transfus* or autoblood* or autohemotransfus* or auto-hemotransfus* or autohaemotransfus* or auto-haemotransfus*)

#7 TS=(Constavac OR ConstavacTM OR Orth-Evac OR Orth-EvacTM OR OrthoPat OR OrthoPatTM OR Solcotrans OR SolcotransTM OR Hemovac OR HemovacTM OR "Cobe BRAT" OR "BRAT 2" OR "Fresenius continuous" OR "consta vac" OR dideco OR electromedic* OR "Gish biomedical" OR haemonetic* OR "Sorenson ATS" OR "Sorenson Receptal Device" OR "sorin biomedical")

#8 TS=(ABTrans OR "Atrium 2050" OR "Atrium 2550" OR Autovac OR AutovacTM OR "Bard cardiotomy reservoir" OR "Bellovac ABT" OR "Beijing PerMed" OR "PerMed Biomedical" OR "Bentley Catr" OR BIODREN OR "CATR 3500" OR "Cell Trans" OR CellTrans OR CellTransTM OR "Cobe Bayler" OR Flow-Gard* OR "Gish Orthofuser" OR "Medtronic Autolog" OR Ortho-Evac OR Ortho-EvacTM OR Pleur-Evac OR Pleur-EvacTM OR Redivac OR RedivacTM OR "Redon Drain" OR Sangvia OR SangviaTM OR "Shiley hardshell" OR "Terumo TE-171")

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#9 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8

#10 TS=(randomi* OR blind* OR "control group" OR placebo* OR controlled OR trial OR "systematic review" OR "meta-analysis" OR metaanalysis OR "evidence synthesis")

#11 #9 and #10

#12 Refined by: PUBLICATION YEARS: (2023 OR 2022 OR 2021 OR 2020 OR 2019 OR 2018 OR 2017 OR 2016 OR 2015 OR 2014 OR 2013 OR 2012 OR 2011 OR 2010 OR 2009)

ClinicalTrials.gov

Other Terms: "cell salvage" OR "cell saver" OR cellsaver OR "blood salvage" OR autotransfusion OR retransfusion OR re-transfusion OR "surgical drain" OR "red cell recovery" OR "red blood cell recovery" OR "washed RBCs" OR "washed red blood cells"

OR

Other Terms: "blood collection system" OR "reinfusion system" OR "re-infusion system" OR constavac OR orth-evac OR solcotrans OR hemovac OR "Cobe BRAT" OR "BRAT 2" OR "Fresenius continuous" OR "consta vac" OR dideco OR electromedic OR haemonetic

OR

Other Terms: ABTrans OR "Atrium 2050" OR "Atrium 2550" OR Autovac OR "Bard cardiotomy reservoir" OR "Bellovac ABT" OR "Beijing PerMed" OR "PerMed Biomedical" OR "Bentley CATR" OR BIODREN OR "CATR 3500" OR "Cell Trans" OR CellTrans OR "Cobe Bayler" OR Flow-Gard

OR

Other Terms: "Sorenson ATS" OR "Gish Biomedical" OR "Gish Orthofuser" OR "Medtronic Autolog" OR Ortho-Evac OR Orthopat OR Pleur-Evac OR Redivac OR "Redon Drain" OR Sangvia OR "Shiley hardshell" OR "Sorenson ATS" OR "Sorenson Receptal" OR "Terumo TE-171"

WHO ICTRP

Title OR Intervention: cell salvage OR cell saver OR cellsaver OR blood salvage OR autotransfusion OR retransfusion OR re-transfusion OR surgical drain OR red cell recovery OR red blood cell recovery OR washed RBCs OR washed red blood cells

OR

Title OR Intervention: constavac OR orth-evac OR solcotrans OR hemovac OR Cobe BRAT OR BRAT 2 OR Fresenius continuous OR consta vac OR dideco OR electromedic OR haemonetic OR reinfusion system OR blood collection system OR reinfusion system OR re-infusion system

OR

Title OR Intervention: ABTrans OR Atrium 2050 OR Atrium 2550 OR Autovac OR Bard cardiotomy reservoir OR Bellovac ABT OR Beijing PerMed OR PerMed Biomedical OR Bentley CATR OR BIODREN OR CATR 3500 OR Cell Trans OR CellTrans OR Cobe Bayler OR Flow-Gard

OR

Title OR Intervention: Gish Biomedical OR Gish Orthofuser OR Medtronic Autolog OR Ortho-Evac OR Orthopat OR Pleur-Evac OR Redivac OR Redon Drain OR Sangvia OR Shiley hardshell OR Sorenson ATS OR Sorenson Receptal OR Terumo TE-171

Appendix 3. Volume of transfusion data: conversion from mean per person transfused (PPT) to mean per person randomised (PPR)

In the table below, the first column '**R/T reported**' indicates whether studies reported mean and calculated the standard deviation (SD) using the number of people randomised (R) (i.e. including zero units where no transfusion was given), or only number of people who received a transfusion (T). We have then used these data to recalculate data from all studies onto the same scale: units transfused **per person randomised (PPR)** and units transfused **per person transfused (PPT).** Where studies reported volume, but not the number of people who received a transfusion, we assumed their data included all people randomised, but were not able to calculate relevant data for PPT.

The (n-1) calculations (see second table below) assume that the authors calculated SD correctly; these calculations will give a little too much weight to trials which calculated it incorrectly, and the smaller the trial, the larger this bias will be. The (n) calculations assume that the authors calculated SD incorrectly; they will give a little less weight to trials which calculated it correctly, and the smaller the trial, the larger this bias will be.

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The choice of which of these to use is not clear-cut (unless the authors state their method). The (n-1) sheets will underestimate the pooled variance if any trials used the wrong formula for SD. (n) will overestimate it if any calculated it correctly. On these grounds alone we should prefer (n) because we shouldn't make assumptions that exaggerate the strength of evidence; conservative assumptions are generally considered more appropriate. However, using (n-1) will more appropriately reflect the data from trialists. **We have therefore used the calculated data using (n-1) in our formal analyses.**

The calculator and all input and output data are available here.

The other difficult question is whether to report PPT or PPR. In many cases, PPR contains too many zero units for the theory underlying the statistics to apply, and the problem will be worse for smaller trials, and we would therefore prefer PPT. The lower the percentage transfused, the larger the sample size needs to be to obtain an accurate estimate of the SD. The use of PPT is also more helpful clinically, to know the average transfusion volume when someone requires a transfusion.

However, there are good clinical and practical reasons to want to report PPR. PPR gives a more direct measure of the amount of blood needed. Additionally, a surprisingly large proportion of trials report units transfused but not the number of people transfused. This means we are likely to have a lot more data for PPR than PPT, and it is probably best to report as much data as we can. **We have therefore reported both PPR and PPT in our formal analyses**.

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Calculated using (n)

	R/T reported	Cell salvage (intervention) (PPR)			No cell salvage (control) (PPR)			Cell salvage (intervention)(PPT)			No cell salvage (control) (PPT)		
		Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD	N
Adalberth 1998	T	0.75	1.12	24	0.88	1.29	25	2.25	0.48	8	2.20	1.09	10
Altinel 2007	R	1.00	1.16	16	2.29	1.26	16						
Atay 2010	R	0.40	0.84	37	1.17	1.31	40	1.49	1.00	10	2.04	1.09	23
Axford 1994	R	2.00	2.07	16	3.30	2.48	16	3.20	1.69	10	3.77	2.27	14
Blatsoukas 2010 ALL	R	0.85	0.92	163	1.74	1.04	85	1.41	0.78	99	2.21	0.56	67
Blatsoukas 2010 SUBGROUP both	R	0.81	0.88	92	1.74	1.04	43	1.31	0.78	57	2.20	0.58	34
Blatsoukas 2010 SUBGROUP post-op only	R	0.91	0.97	71	1.74	1.04	42	1.54	0.78	42	2.21	0.56	33
Clagett 1999	R	2.10	2.12	50	2.30	2.12	50	3.18	1.83	33	3.19	1.83	36
Dalrymple-Hay 1999	R	0.99	1.23	56	1.69	1.23	56	1.98	1.03	28	2.06	1.04	46
Davies 1987	R	4.00	3.47	25	5.50	5.92	25						
Djurasovic 2018	R	0.79	1.31	48	1.10	1.21	47	2.37	1.19	16	1.78	1.08	29
Ekback 1995	R	1.90	1.60	15	2.70	1.20	15						
Elawad 1991	T	0.22	0.60	19	1.37	1.54	20	0.69	0.92	6	2.73	0.93	10
Eng 1990	T	1.20	0.85	20	1.70	1.05	20	1.41	0.73	17	2.00	0.81	17
Gäbel 2013a	R	1.30	1.97	15	0.10	0.41	15	3.25	1.80	6	0.75	1.19	2
Goel 2007	R	1.54	6.01	24	2.40	6.58	25	1.85	6.56	20	2.40	6.58	25

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(Continued)

Heddle 1992	R	0.40	0.81	39	1.20	1.01	40	1.56	0.87	10	1.78	0.69	27
Horstmann 2012	T	0.08	0.40	50	0.16	0.55	50	2.00	0.00	2	2.00	0.00	4
Horstmann 2013	T	0.08	0.39	102	0.18	0.57	102	2.00	0.00	4	2.00	0.00	9
Kelley-Patteson 1993	T	0.28	0.69	18	0.17	0.54	18	1.67	0.82	3	1.50	1.00	2
Khan 2017 (SALVO)	T	0.05	0.50	665	0.07	0.62	684	2.92	2.43	12	3.33	2.62	15
Kirkos 2006	R	0.54	0.87	78	1.63	1.51	77						
Koopman-van Gemert 1993a	R	4.90	3.50	17	6.20	6.16	20	5.55	3.19	15	6.20	6.16	20
Koopman-Van Gemert 1993b	R	0.30	0.81	29	1.10	1.42	30	1.74	1.23	5	2.54	0.97	13
Lepore 1989	R	2.70	2.82	67	3.30	2.72	68	3.62	2.71	50	3.62	2.64	62
Martin 2000	T	0.99	0.94	98	1.61	1.01	100	1.80	0.36	54	2.20	0.26	73
Murphy 2005	T	0.23	0.63	30	0.35	0.86	31	1.75	0.54	4	1.57	1.22	7
Nemani 2019	R	0.57	0.91	30	0.78	0.83	33						
Niranjan 2006 - all	R	0.53	0.66	40	1.38	1.33	40						
Niranjan 2006 - SUBGROUP on CPB	R	0.60	0.73	20	1.98	1.50	20						
Niranjan 2006 - SUBGROUP off CPB	R	0.47	0.63	20	0.77	0.82	20						
Page 1989	R	3.15	2.07	48	3.83	2.61	51	3.60	1.81	42	4.34	2.33	45
Parrot 1991 - ALL	T	1.30	1.05	44	4.50	0.89	22	1.79	0.81	32	4.50	0.89	22
Parrot 1991 SUBGROUP intra-op only	T	1.88	0.98	22	4.50	0.91	11	2.18	0.68	19	4.50	0.91	11
Parrot 1991	T	0.82	0.90	22	4.50	0.91	11	1.38	0.76	13	4.50	0.91	11

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(Continued)

SUBGROUP both

Savvidou 2009	R	0.58	0.69	25	3.03	0.83	25						
Schaff 1978	R	2.40	2.40	63	4.80	4.32	51						
Schönberger 1993	R	0.10	1.37	20	0.60	1.37	20	2.00	0.00	1	3.00	1.54	4
Shen 2016	R	2.11	2.69	53	5.40	3.52	50	5.08	1.42	22	6.92	2.26	39
Shirvani 1991	R	4.11	2.84	21	4.06	1.56	21	4.32	2.74	20	4.06	1.56	21
So-Osman 2006	T	1.10	1.34	47	0.86	1.08	22	2.36	0.94	22	1.90	0.74	10
So-Osman 2014	R	0.34	1.37	1481	0.28	1.04	961	2.72	2.98	183	2.65	1.96	103
Tripkovic 2008	R	0.22	1.00	30	1.74	1.17	30	1.65	2.54	4	2.18	0.86	24
Unsworth 1996	T	2.49	1.79	71	2.74	1.52	34	2.81	1.66	63	3.00	1.31	31
Vermeijden 2015	R	2.00	3.50	364	2.30	3.00	352	4.21	4.07	173	3.91	3.01	207
Xie 2015	R	2.01	2.77	72	5.39	3.30	69	5.36	1.52	27	7.15	1.31	52
Zhang 2008	T	0.36	0.38	20	1.04	0.57	20	0.72	0.14	10	1.30	0.23	16
Zhao 1996	R	3.60	2.46	22	5.90	3.57	20						
Zhao 2003	T	0.76	0.63	30	2.22	0.41	30	1.20	0.27	19	2.22	0.41	30
Zhao 2017	R	2.47	0.80	60	4.07	0.98	60						

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Calculated using (n-1)

	R/T reported	Cell salvage (intervention) (PPR)			No cell salvage (control) (PPR)			Cell salvage (intervention) (PPT)			No cell salvage (control) (PPT)		
		Mean'	SD'	N	Mean'	SD'	N	Mean'	SD'	N	Mean'	SD'	N
Adalberth 1998	T	0.75	1.11	24	0.88	1.27	25	2.25	0.46	8	2.20	1.03	10
Altinel 2007	R	1.00	1.12	16	2.29	1.22	16						
Atay 2010	R	0.40	0.83	37	1.17	1.29	40	1.49	0.97	10	2.04	1.06	23
Axford 1994	R	2.00	2.00	16	3.30	2.40	16	3.20	1.55	10	3.77	2.18	14
Blatsoukas 2010 ALL	R	0.85	0.91	163	1.74	1.03	85	1.41	0.77	99	2.21	0.55	67
Blatsoukas 2010 SUBGROUP both	R	0.81	0.88	92	1.74	1.03	43	1.31	0.77	57	2.20	0.55	34
Blatsoukas 2010 SUBGROUP post-op only	R	0.91	0.96	71	1.74	1.03	42	1.54	0.76	42	2.21	0.52	33
Clagett 1999	R	2.10	2.10	50	2.30	2.10	50	3.18	1.79	33	3.19	1.80	36
Dalrymple-Hay 1999	R	0.99	1.22	56	1.69	1.22	56	1.98	1.00	28	2.06	1.02	46
Davies 1987	R	4.00	3.40	25	5.50	5.80	25						
Djurasovic 2018	R	0.79	1.30	48	1.10	1.20	47	2.37	1.14	16	1.78	1.05	29
Ekback 1995	R	1.90	1.55	15	2.70	1.16	15						
Elawad 1991	T	0.22	0.56	19	1.37	1.53	20	0.69	0.87	6	2.73	0.88	10
Eng 1990	T	1.20	0.83	20	1.70	1.03	20	1.41	0.71	17	2.00	0.79	17
Gäbel 2013a	R	1.30	1.90	15	0.10	0.40	15	3.25	1.58	6	0.75	1.12	2
Goel 2007	R	1.54	5.88	24	2.40	6.45	25	1.85	6.42	20	2.40	6.45	25

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(Continued)

Heddle 1992	R	0.40	0.80	39	1.20	1.00	40	1.56	0.83	10	1.78	0.66	27
Horstmann 2012	T	0.08	0.40	50	0.16	0.55	50	2.00	0.00	2	2.00	0.00	4
Horstmann 2013	T	0.08	0.39	102	0.18	0.57	102	2.00	0.00	4	2.00	0.00	9
Kelley-Patteson 1993	T	0.28	0.67	18	0.17	0.51	18	1.67	0.58	3	1.50	0.71	2
Khan 2017 (SALVO)	T	0.05	0.49	665	0.07	0.61	684	2.92	2.35	12	3.33	2.53	15
Kirkos 2006	R	0.54	0.86	78	1.63	1.50	77						
Koopman-van Gemert 1993a	R	4.90	3.40	17	6.20	6.00	20	5.55	3.05	15	6.20	6.00	20
Koopman-van Gemert 1993b	R	0.30	0.80	29	1.10	1.40	30	1.74	1.16	5	2.54	0.88	13
Lepore 1989	R	2.70	2.80	67	3.30	2.70	68	3.62	2.68	50	3.62	2.61	62
Martin 2000	T	0.99	0.94	98	1.61	1.01	100	1.80	0.36	54	2.20	0.26	73
Murphy 2005	T	0.23	0.63	30	0.35	0.84	31	1.75	0.50	4	1.57	1.13	7
Nemani 2019	R	0.57	0.89	30	0.78	0.82	33						
Niranjan 2006 - all	R	0.53	0.65	40	1.38	1.31	40						
Niranjan 2006 - SUBGROUP on CPB	R	0.60	0.71	20	1.98	1.46	20						
Niranjan 2006 - SUBGROUP off CPB	R	0.47	0.61	20	0.77	0.80	20						
Page 1989	R	3.15	2.05	48	3.83	2.58	51	3.60	1.78	42	4.34	2.30	45
Parrot 1991 - ALL	T	1.30	1.05	44	4.50	0.87	22	1.79	0.79	32	4.50	0.87	22
Parrot 1991 SUBGROUP intra-op only	T	1.88	0.97	22	4.50	0.87	11	2.18	0.65	19	4.50	0.87	11
Parrot 1991	T	0.82	0.88	22	4.50	0.87	11	1.38	0.72	13	4.50	0.87	11

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(Continued)

SUBGROUP both

Savvidou 2009	R	0.58	0.67	25	3.03	0.81	25						
Schaff 1978a	R	2.40	2.38	63	4.80	4.28	51						
Schönberger 1993	R	0.10	1.34	20	0.60	1.34	20	2.00	0.00	1	3.00	1.33	4
Shen 2016	R	2.11	2.66	53	5.40	3.48	50	5.08	1.30	22	6.92	2.19	39
Shirvani 1991	R	4.11	2.77	21	4.06	1.52	21	4.32	2.67	20	4.06	1.52	21
So-Osman 2006	T	1.10	1.33	47	0.86	1.07	22	2.36	0.89	22	1.90	0.70	10
So-Osman 2014	R	0.34	1.37	1481	0.28	1.04	961	2.72	2.97	183	2.65	1.95	103
Tripkovic 2008	R	0.22	0.98	30	1.74	1.15	30	1.65	2.48	4	2.18	0.82	24
Unsworth 1996	T	2.49	1.78	71	2.74	1.50	34	2.81	1.63	63	3.00	1.29	31
Vermeijden 2015	R	2.00	3.50	364	2.30	3.00	352	4.21	4.06	173	3.91	3.00	207
Xie 2015	R	2.01	2.75	72	5.39	3.28	69	5.36	1.42	27	7.15	1.22	52
Zhang 2008	T	0.36	0.38	20	1.04	0.57	20	0.72	0.14	10	1.30	0.22	16
Zhao 1996	R	3.60	2.40	22	5.90	3.48	20						
Zhao 2003	T	0.76	0.63	30	2.22	0.40	30	1.20	0.27	19	2.22	0.40	30
Zhao 2017	R	2.47	0.79	60	4.07	0.97	60						

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Appendix 4. Types of cell salvage devices used in included studies

The included studies used various types of cell salvage (autotransfusion) systems, as follows.

- ABTrans autologous re-transfusion system
- Atrium 2050
- Atrium 2550 in-line autotransfusion drainage system
- Autovac postoperative orthopaedic autotransfusion canister
- Bard cardiotomy reservoir
- Bellovac ABT autotransfusion system
- Beijing PerMed Biomedical Engineering Company
- Bentley Catr hard shell cardiotomy reservoir
- BIODREN autotransfusion system
- BRAT-2 Cell Saver
- CATR 3500 cardiotomy reservoir
- Cell Trans system (Summit Medical)
- ConstaVac CBC system
- ConstaVac CBCII system
- COBE Bayler rapid autotransfusion system
- Dideco Compact
- Dideco Electra system
- Dideco 742 cardiotomy reservoir
- Dideco Autotrans BT 795
- Dideco 797 reinfusion system (Sorin Biomedical)
- DONOR system (Van Straten Medical)
- Electromedics Autotrans AT-100
- Electromedics BT-795
- Flow-Gard 6200 (Baxter)
- Fresenius continuous autotransfusion system (C.A.T.S)
- Gish Orthofuser Biomedical autotransfusion system
- Haemonetics Cell Saver
- Haemonetics Cell Saver 3
- Haemonetics Cell Saver 3 Plus
- Haemonetics Cell Saver 4
- Haemonetics Cell Saver 5
- Haemonetics Cell Saver 5 Plus
- Haemonetics Haemolite cell washer
- Haemonetics Haemolite-2
- Haemonetics OrthoPAT
- HandyVAC ATS Unomedical Retransfusion set
- Medtronic Autolog system
- Medtronic EL402 cardiotomy reservoir
- Ortho-Evac system
- Pleur-evac autotransfusion system
- Sangvia® Blood Salvage System
- Shiley hardshell cardiotomy reservoir
- Solcotrans Cell Saver
- Solcotrans Orthopedic Plus system
- Solcotrans Orthopedic system
- Sorenson ATS (autotransfusion system)
- Sorin Biomedica Cardiotomy reservoir
- Terumo TE-171 system (Terumo)
- Transolog Autotransfusion set

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Appendix 5. Additional information provided by trialists

For Tachias 2022:

Question: Please can you clarify how the control group were managed? Did they receive blood from the Extracorporeal Circuit on completion of bypass or was this discarded?

Answer from trialists: yes, the control group received blood from the circuit after by-pass.

Question: Can I also ask whether the blood from the circuit was processed by the cell saver prior to return to patients in the control group?

Answer: No, in the control group cell saver was not used at all and the remaining blood was not processed.

So in summary and to confirm, the groups were treated in the following ways:

- CS group: bypass blood returned **with** processing + cell salvage
- Control: bypass blood returned **no** processing + no cell salvage

WHAT'S NEW

Date	Event	Description
8 September 2023	New search has been performed	We re-assessed all studies that were listed as included and excluded in the previous review. We excluded 15 that had been included, and included 7 that had been excluded (therefore including 67 studies from the 2010 publication). Searches were updated in January 2023, adding 39 new studies to the analysis (see Results of the search for more detail).
8 September 2023	New citation required and conclusions have changed	The revised included study list, with additional studies and new analyses, has resulted in a change in conclusions. The previous conclusions were based only on data for orthopaedic surgery or cardiovascular (CV) surgery (of any type). We have added data for cancer surgery and for obstetrics. We have separated CV surgery into: vascular surgeries, CV with bypass, and CV without bypass.

HISTORY

Protocol first published: Issue 1, 2000
Review first published: Issue 4, 2003

Date	Event	Description
19 December 2011	Amended	We shortened the Plain Language Summary title to comply with new guidelines.
10 February 2010	New citation required and conclusions have changed	The review has been updated with the results of 24 additional trials.
1 June 2006	New search has been performed	May 2006 The searches were updated in January 2004 as part of a Health Technology Assessment (HTA) project. Two new studies have been included (Naumenko 2003; Zhao 2003), with the results of the review amended accordingly.

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CONTRIBUTIONS OF AUTHORS

The author contributions for the 2023 update are listed below. All authors have contributed to the review, and have read and checked the manuscript prior to submission.

Tom D Lloyd (TDL): screening and full-text assessment, retrieved full-text publications, arranged translation for non-English language publications, data extraction (including checking and amending data from previous versions of the review), risk of bias assessment, contacted study authors for additional information, contributed to GRADE assessments, interpreted the results, wrote the manuscript.

Louise J Geneen (LJG): screening and full-text assessment, retrieved full-text publications, data extraction (including checking and amending data from previous versions of the review), risk of bias assessment, entered data into RevMan, performed all analyses including subgroup/sensitivity analyses and GRADE assessments, interpreted the results, wrote the manuscript.

Keeley Bernhardt (KB): screening and full-text assessment, data extraction (including checking and amending data from previous versions of the review), risk of bias assessment, interpreted the results, contributed to the development of the manuscript.

William McClune (WM): screening and full-text assessment, data extraction (including checking and amending data from previous versions of the review), risk of bias assessment, interpreted the results, contributed to the development of the manuscript.

Scott J Fernquest (SJF): screening and full-text assessment, data extraction, risk of bias assessment, contributed to the development of the manuscript.

Tamara Brown (TB): screening and full-text assessment, contributed to the development of the manuscript.

Carolyn Dorée (CD): developed and performed all search strategies and de-duplication, retrieved full-text publications, contributed to the development of the manuscript.

Susan J Brunskill (SJB): interpreted the results, contributed to the development of the manuscript.

Michael F Murphy (MFM): interpreted the results, contributed to the development of the manuscript.

Antony JR Palmer (AJRP): interpreted the results, contributed to the development of the manuscript.

DECLARATIONS OF INTEREST

Tom D Lloyd (TDL): none known

Louise J Geneen (LJG): none known

Keeley Bernhardt (KB): none known

William McClune (WM): none known

Scott J Fernquest (SJF): none known

Tamara Brown (TB): none known

Carolyn Dorée (CD): none known

Susan J Brunskill (SJB): none. SJB is a Cochrane editor (with Cochrane Haematology) and was not involved with the editorial process for this review.

Michael F Murphy (MFM): MFM is in receipt of consulting fees as a Member of the Scientific Advisory Council from Haemonetics Corporation. However, MFM was not involved in the extraction, assessment of bias, or analysis of this review.

Antony JR Palmer (AJRP): none known

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Internal sources

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  Provides support for the Cochrane Injuries Group

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- NIHR research capability funding (RCF) with NHSBT, UK

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- NIHR Blood and Transplant Research Unit in Data Driven Transfusion Practice, UK

  Part-funded salary of one author (AJRP)
- NIHR/NHSBT Academic Clinical Fellowship, UK

  Part-funded salary of one author (TL)

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

In this update, we made some changes to the previously published protocol and full systematic review, in accordance with updates in Cochrane methodological guidance, as follows.

Database searching

We revised and expanded the search strategies and the databases searched to include five additional sources: Epistemonikos Systematic Review Database (Epistemonikos Foundation, Chile); PubMed (NLM, for e-publications ahead of print); International HTA Database (INAHTA, 1996 onward); Transfusion Evidence Library (Evidentia Publishing, 1950 onward); and Web of Science Conference Proceedings Index (CPCI-S) (Clarivate, 1990 onward).

Risk of bias assessment

The risk of bias (ROB) assessment in the previously published version of the review pre-dated the use of ROB1, and only assessed selection bias, allocation concealment, and general blinding. We expanded ROB assessment to the full Cochrane ROB1 (Boutron 2022; Higgins 2011), and have re-assessed all previously included studies to reflect this.

Outcomes

Change to focus on allogeneic blood transfusion only

The aim of cell salvage is to reduce patient exposure to allogeneic blood by re-transfusing their own blood if required, which has been salvaged from the operative field. Whereas the published review assessed the effect of cell salvage on the number of patients exposed to allogeneic or autologous blood, or both, in the current review we assessed the effect of cell salvage on the number of patients exposed to allogeneic blood (and volume of allogeneic blood transfusion) only.

Clarification of volume of blood transfused

We specified that we planned to analyse mean number of units transfused, per person transfused (PPT), not just per person randomised (PPR). We have also calculated both PPR and PPT from whichever form it was reported in.

Myocardial infarction (MI)

Previously referred to as 'non-fatal myocardial infarction', we updated this to 'any MI' (to include fatal and non-fatal) as non-fatal MI was not truly a safety outcome: if one group only had non-fatal MIs, and the other group had MIs that resulted in death, it would appear that the group that resulted in death fared better as they had fewer non-fatal MIs, which would be an incorrect inference.

Wound complication definition

Wound complication is defined as an all-encompassing outcome that may include infection, but also excessive bruising (haematoma), dehiscence, breakdown of the wound, and non-infective events related to the surgical site. Wound complication requires additional input from clinicians, and may require further treatment.

Endpoints assessed

The protocol (2003) and the previous publication (2010) did not specify an endpoint for any of the outcomes, though it was assumed to be shortly after the surgery, as information noted in the 'Characteristics of included studies' tables (2010) largely noted two, five, and 10 days post-surgery. We specified a 90-day follow-up for: mortality, thromboembolic events, wound complications, any infection, and major adverse cardiovascular events; and up to one year for prosthetic joint infections.

We did not specify a time period for blood loss, transfusions, or re-operation for bleeding, but instead specified that these outcomes were assessed during the in-hospital period.

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Sensitivity analyses

Conversion of data for blood volume

The original protocol (2003) mentioned a planned sensitivity analysis to examine the impact of converting data reported as millilitres transfused to units (using 300 mL per unit for the conversion). No other sensitivity analyses were planned. Instead of assessing the impact of conversion by analysing data in millilitres and also by units, we converted any data reported as blood transfused in millilitres to blood transfused in units prior to data analysis. Therefore, we did not perform this sensitivity analysis. Earlier conversion to units, and no sensitivity analysis, was also standard in the previous version of this review (2010).

Prospective registration

Since 2005 it has been standard to register medicinal trials prior to randomisation, and therefore the lack of registration may suggest a trial that may be more open to bias. However, as cell salvage is not classed as a medicine under the EU Directive (EU Clinical Trial Directive 2001; EU Regulations 2014), many trials will not have registered as they are not required to. However, due to the issues surrounding false data in unregistered/retrospectively registered trials (Broughton 2021; Carlisle 2021; Roberts 2015), we have introduced a sensitivity analysis of data from all relevant trials compared to data excluding trials that were not prospectively registered (when published after 2010). This sensitivity analysis still includes all relevant data published before 2010.

Study conduct (risk of bias)

The previous review (2010) planned a subgroup analysis based on trial methodological quality (though it was not performed or reported). However, we have performed this as a sensitivity analysis: assessing the impact of including only those trials with low risk of bias for both random sequence generation and blinding (performance bias and detection bias) for the primary outcome (transfusions).

Subgroup analyses

The original protocol (2003) listed possible subgroups as: age, sex of participant, type of surgery, use of transfusion protocols, and the quality of study methods. The previous publication (2010) listed subgrouping for two primary outcomes (exposure to red cell transfusion; volume of red cells transfused) using:

- type of surgery;
- use of a transfusion protocol;
- type of salvaged blood re-transfused (washed or unwashed);
- timing of cell salvage (intra- or postoperative, or both);
- trial methodological quality.

We took the decision to only subgroup by:

- timing of cell salvage (intra- or postoperative, or both);
- actual threshold used for the transfusion protocol, instead of just whether a transfusion protocol was used.

We could do this as we assessed the impact of study conduct (risk of bias) in a sensitivity analysis, and separated all analyses by type of surgery. We deemed it unnecessary to subgroup by washing as autotransfusion of blood intraoperatively is usually washed, and autotransfusion of blood postoperatively is usually unwashed. So the timing subgroup analysis would cover this: washing and re-suspension of red blood cells is performed for the majority of current cell salvage practice. Unwashed techniques are frequently used when blood is salvaged from surgical drains; however, drains are now less often used due to their association with adverse events.

Analyses by population (type of surgery)

We analysed the data as a complete set (all studies) for our primary outcome of risk of allogeneic transfusion (number of people who required a transfusion of donated blood), as described in the original protocol (2003) and previous publication (2010). However, we then conducted all analyses, and reported the evidence, as separate analyses based on the type of surgery:

- cancer;
- cardiovascular (vascular);
- cardiovascular (no bypass);
- cardiovascular (with bypass);
- obstetric surgery (elective Caesarean sections and other surgeries);
- orthopaedic (hip, knee, spinal, mixed populations);
- other elective surgeries.

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GRADE (Summary of findings)

We suspect, and suggest, that future updates of this review will be split into separate reviews using these populations due to the large variation (clinical heterogeneity) between these groups.

INDEX TERMS

Medical Subject Headings (MeSH)

Blood Specimen Collection [methods]; *Blood Transfusion, Autologous; Elective Surgical Procedures; *Erythrocyte Transfusion; Randomized Controlled Trials as Topic

MeSH check words

Adult; Humans

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