DOI: http://dx.doi.org/10.18203/issn.2455-4510.IntJResOrthop20185074

**Original Research Article**

# Blood loss following medial unicondylar knee replacements without a tourniquet: is there a need to group and save?

**Sayyied J. Kirmani[1]*, Mark Middleton[1], Andreas Fontalis[1], Raka Srivastava[2], Feroz Dinah[1]**

[1]Department of Trauma and Orthopaedics, [2]Department of Anaesthetic, South West London Elective Centre, Epsom, Surrey, UK

**Received:** 13 November 2018
**Accepted:** 29 November 2018

***Correspondence:**
Dr. Sayyied J. Kirmani,
E-mail: ymmij26@hotmail.com



## ABSTRACT

**Background:** There are current trends towards not using a tourniquet in total knee replacement (TKR), but there is nothing published on what the effects of not using a tourniquet on unicondylar knee replacements (UKR) may be in terms of blood loss.
**Methods:** A retrospective case series of 36 consecutive UKR from our institution were analysed. All procedures were carried out without a tourniquet and also utilised a standardised interventions protocol including withholding of anticoagulants and antiplatelet medications, administration of periarticular local anaesthetic and adrenaline injection, and both IV and topical tranexamic acid. Outcomes measured were estimated intra-operative blood loss, overall blood loss through comparison of pre and post-operative haemoglobin laboratory values, and the need for post-operative blood transfusion.
**Results:** Most patients (61.1%) experienced an estimated intra-operative blood loss of less than100 mls. There was a mean haemoglobin drop of 16.1 g/l (range 1–26, SD ±5.9), with a mean post operatively haemoglobin level of 125.1 g/l (range 107-142, SD ±8.7). No patients required a blood transfusion.
**Conclusions:** A low level of blood loss is encountered when UKR is undertaken without a tourniquet and with our standard interventions to reduce bleeding. The level of post-operative haemoglobin and absence of requirement for blood transfusion suggests that this operation can be undertaken without the need for a group and save. It is our hope that surgeons will be encouraged to perform this procedure without a tourniquet and benefit from the cost-saving opportunity of not performing a group and save.

**Keywords:** Unicondylar knee replacement, Tourniquet, Blood loss, Blood transfusion

## INTRODUCTION

Unicondylar knee replacements (UKR) have become common operations for osteoarthritis (OA), with 85,312 carried out in the UK between 2003 and 2016.[1] The vast majority of these cases were medial UKR for isolated medial compartment disease, although many surgeons also routinely consider lateral compartment UKR.

There is increasing evidence that for a standard total knee replacement (TKR), there is no added benefit in using a tourniquet, and indeed that its use may even cause harm.[2-7] The argument that tourniquet use diminishes blood loss has been challenged in recent articles.[2-9] For the most part, studies have shown that although a tourniquet reduces intra-operative blood loss, it causes a greater post-operative blood loss.[8,9] Thus, a tourniquet does not significantly reduce the overall drop in haemoglobin or the need for post-operative blood transfusion.[2-9]

To our knowledge there are no studies investigating the need for a tourniquet in UKR, or the need for blood

transfusion post-operatively. To that end we carried out a study examining the blood loss following UKR where a tourniquet was not used, and whether a transfusion was ever required. Our hypothesis was that UKR do not cause excessive bleeding, and rarely require a post-operative blood transfusion.

## METHODS

We conducted a retrospective case series study of cemented UKR carried out in our institution without a tourniquet over a 13-month period (1st June 2016- 30th June 2017). 36 consecutive cases by a single surgeon (FD) were identified and notes reviewed using our electronic database (BlueSpier). Only standard primary medial compartment unicondylar knee replacements, and any cases of patella-femoral knee replacements or lateral compartment UKR were excluded. By cross-referencing the operation notes against the anaesthetic notes, it was confirmed that a tourniquet had not been used in any of the cases. Variables recorded are presented in Table 1.

**Table 1: Recorded variables.**

| |
|---|
| **Age at surgery** |
| **Sex** |
| **Estimated blood loss** |
| **Haemoglobin levels pre-operatively** |
| **Haemoglobin levels post-operatively** |
| **Haemoglobin drop** |
| **Anaesthesia (spinal or general)** |
| **Concurrent antiplatelet or anticoagulant use (aspirin, clopidogrel or warfarin)** |
| **ASA (American Society of Anaesthesiologists) physical status** |
| **Need for transfusion** |

All UKRs in our institution undergo several standard interventions that have a bearing on blood loss during the operation:

Anti-coagulants are maintained or stopped prior to surgery as per a standard protocol. Low dose (75 mg) aspirin and corticosteroids can be continued up to and beyond the time of the operation. Dipyridamole is discontinued 48 hrs before the operation, while Factor Xa inhibitors (e.g. Rivaroxaban and Apixaban) are discontinued 3 days before surgery. Warfarin is stopped 5 days before surgery, with conversion to dalteparin if bridging anti-coagulation is required. Clopidogrel is stopped 7 days before surgery.

A mixture of a long acting local anaesthetic with adrenaline is injected intra-operatively in the peri-articular tissues. This consists of 150 mls of 2 mg/ml Naropin, with 1 ml of 1 in 1000 adrenaline, and 1 ml of 30 mg/ml ketorolac, if renal function allows. This mixture is given at the start of the operation with 50 mls subcutaneously. A further 50 mls is infiltrated into the posterior joint capsule after the bony cuts have been made, and a final 50mls is infiltrated into the musculature and subcutaneous tissue during wound closure.

1 gram of IV tranexamic acid is infused on induction. A further 1 gram of topical tranexamic acid in 100mls of normal saline is applied to the wound while the cement is curing, and prior to closure.

The unit's standard VTE prophylaxis is given in the form of 5000 units of dalteparin at 6 hours post-surgery, and for 14 days thereafter.

Data was collected on estimated intra-operative blood loss, haemoglobin (Hb) drop and whether a post-operative transfusion was required.

Estimated blood loss is classified within our institution as minimal, under 100mls, under 250 mls, between 250 to 500mls, between 500 to 750 mls, and over 750mls. It is calculated from the quantity of blood accumulated in the suction catheters (minus saline irrigation used), the weight of blood soaked surgical swabs, and a view of how blood stained the surgical drapes are. It is a consensus estimation involving the surgeon, the anaesthetist and the scrub nurse and is recorded on the anaesthetic chart.

Pre and post-operative haemoglobin (Hb) levels were retrieved from the pathology results electronic database within our institution (Patient Manager). These blood samples were taken at the pre-operative assessment and 24-48 hours post-surgery respectively. By subtracting one from the other we obtained the measured Hb loss for each case, indicating the actual blood loss for the peri-operative period.

Finally reviewing the electronic notes, the number of cases where a blood transfusion was required was noted.

Data analysis was performed using the IBM SPSS Statistics Software for Windows, Version 23. All continuous variables were assessed for normality by observing the skewness, kurtosis and boxplot as well as utilising the Shapiro-Wilk and Kolmogorov-Smirnov tests. The mean and standard deviation (SD) were recorded if normal distribution was evident, whereas median and interquartile range (IQR) were utilised for not normally distributed data. Categorical variables are reported as frequencies and percentages. The difference between pre and post-operative haemoglobin levels was calculated utilising the related-samples Wilcoxon signed rank test.

## RESULTS

Baseline characteristics of the 36 patients who had undergone medial UKR are depicted in Table 2. Tourniquet was utilised for none of the operations. 14 cases (38.9%) involved female patients. The mean age at

surgery was 66.3 years (range 47-87 years, SD±9.8). Nine patients reported concurrent use of anticoagulants or antiplatelets; 7 (19.4%) reported using aspirin, 1 (2.8%) reported using clopidogrel and 1 (2.8%) warfarin. The ASA (American Society of Anaesthesiologists) physical status was also recorded with most of the patients being classified as ASA 2 (83.3%), followed by ASA 1 (8.3%). The majority of unicondylar knee replacements were performed under spinal anaesthesia, while a quarter of the patients received general anaesthetic (Table 2).

**Table 2: Baseline characteristics and categorical data.**

| Variable | Number of cases, relative frequency (%) |
|---|---|
| **Sex (female)** | 14 (38.9) |
| **Age** | 66.3 (SD ± 9.8) |
| **Medications** | |
| Aspirin | 7 (19.4) |
| Clopidogrel | 1 (2.8) |
| Warfarin | 1 (2.8) |
| **ASA** | |
| 1 | 3 (8.3) |
| 2 | 30 (83.3) |
| 3 | 2 (5.6) |
| 4 | 1 (2.8) |
| 5 | 0 (0) |
| **Anesthesia** | |
| Spinal | 27 (75) |
| General | 9 (25) |

**Table 3: Estimated blood loss.**

| Estimated blood loss (ml) | Number of cases, relative frequency (%) |
|---|---|
| **<100** | 22 (61.1) |
| **100-250** | 13 (36.1) |
| **250-500** | 1 (2.8) |

Upon comparison of the estimated blood loss among the participants, the majority (61.1%) experienced blood loss of less than 100mls, 36.1% of patients had a blood loss between 100 to 250mls, and only one patient (2.8%) was classified as having blood loss between 250–500 ml. (Table 3).

The median haemoglobin level (g/l) prior to the operation was 143 (range 116–153 g/l, IQR 14.25), while the mean respective level post operatively was 125.1 (range 107-142 g/l, SD±8.7). This in turn demonstrated a mean haemoglobin drop of 16.1 (range 1–26 g/l, SD±5.9). By employing the related-samples Wilcoxon signed rank test it was noted that the difference in pre and post-operative Hb levels reached statistical significance, $p<0.001$. However, despite the drop in haemoglobin, none of the 36 patients required a blood transfusion. This means that although the drop in haemoglobin was statistically significant, it was not clinically significant (Table 4).

**Table 4: Measured haemoglobin.**

| | Mean±SD or Median (IQR) | P value |
|---|---|---|
| **Haemoglobin, pre-operative levels (g/L)** | 143 (14.25) | < 0.001 |
| **Haemoglobin, post-operative levels (g/L)** | 125.1±8.7 | |
| **Haemoglobin drop (g/L)** | 16.1±5.9 | |

## DISCUSSION

Our results show UKR surgery without the use of a tourniquet produced an estimated blood loss of under 100mls in the majority of cases. It also revealed a mean blood loss of 16.1 g/l when comparing pre and post-operative Hb levels. Although this proved to be statistically significant, the drop in Hb did not reach clinical significance in any of the cases as not one required a blood transfusion. Our mean post-operative Hb level of 125.1 g/l is still well within a normal range, and is far removed from a Hb level below 70g/l which is commonly considered as a relative indicator for a blood transfusion.[10]

Swab et al in 2014 carried out a study comparing blood loss of UKR to TKR where tourniquets were used.[11] They showed that UKR had less of a Hb loss when compared to TKR, and none of them required a post-operative blood transfusion. They even went further in saying that patients with pre-operative anaemia can undergo UKR without the risk of blood transfusions. The average blood loss for UKR in their study was 8 g/l, with a mean post-operative Hb level of 129 g/l at 48 hrs. In comparison to our study, they have less blood loss, which is to be expected as a tourniquet was used in their study. However, interestingly the post-operative Hb levels were similar to ours.

Some aspects of UKR are conducive to minimal blood loss. Although UKR is a technically demanding operation, it requires a smaller incision, less soft tissue release, and less bony cuts compared to a TKR. This in turn means UKR have lower complication rates and less blood loss when compared to TKR.[11-13] We also employ intra-operative strategies to reduce blood loss during surgery, which are well supported in the literature. The pro-thrombotic agent tranexamic acid is given intravenously immediately before the operation, and topically during the operation.[14-16] Local anaesthetic agents mixed with adrenaline are given at various stages of the operation.[17,18] Careful haemostasis with diathermy use is employed throughout the operation. From the anaesthetic point of view a permissive hypotension is promoted via a more limited fluid provision and concise control of the blood pressure during surgery.[19,20]

Furthermore, patients undergoing UKR are typically younger than for example, those undergoing TKR. In our

sample, the mean age was 66 years, compared to 70 years for TKR.[21] Such younger patients could tolerate minor degrees of post-operative anaemia, and therefore rarely require a post-operative blood transfusion.

The low level of blood loss and absence of transfusion in our series calls into question the need to perform a group and save prior to undergoing UKR. Similar claims have been made for enhanced recovery hip and knee replacements, and elective and emergency laparoscopic general surgery.[22-24] With the cost of carrying out a group and save estimated at approximately £20, cost savings in our institution would be modest.[23] However, extrapolating this onto a national scale would have greater financial implications.

## CONCLUSION

To our knowledge, this is the first reported single-surgeon case series to demonstrate that UKR undertaken without a tourniquet and with a series of standardised haemostatic interventions does not result in clinically significant blood loss. The level of post-operative haemoglobin remained within the acceptable range and no patient needed a blood transfusion. This suggests that this operation can be undertaken without the need for a group and save. It is our hope that surgeons will be encouraged to perform this procedure without a tourniquet and benefit from the cost-saving opportunity of not performing a group and save.

*Funding: No funding sources*
*Conflict of interest: None declared*
*Ethical approval: Not required*

## REFERENCES

1. NJR 14th Annual Report 2017. Available at http://www.njrreports.org.uk/Portals/0/PDFdownloads/NJR%2014th%20Annual%20Report%202017.pdf. Accessed 23 April 2018.
2. Alcelik I, Pollock RD, Sukeik M, Bettany-Saltikov J, Armstrong PM, Fismer P. A comparison of outcomes with and without a tourniquet in total knee arthroplasty: a systematic review and meta-analysis of randomized controlled trials. J Arthroplasty. 2012;27:331–40.
3. Shixiong Yi, Jixiang Tan, Cheng Chen, Hong Chen, Wei Huang. The use of pneumatic tourniquet in total knee arthroplasty: a meta-analysis. Arch Orthop Trauma Surg. 2014;134:1469–76.
4. Zhang W, Ning L, Chen S, Tan Y, Al-Aidaros M, Chen L. The effects of a tourniquet used in total knee arthroplasty: a meta-analysis. J Orthop Surg Res. 2014;9:13
5. Tai TW, Lin CJ, Jou IM, Chang CW, Lai KA, Yang CY. Tourniquet use in total knee arthroplasty: a meta-analysis. Knee Surg Sports Traumatol Arthrosc. 2011;19:1121–30.
6. Wang K, Ni S, Li Z, Zhong Q, Li R, Li H, et al. The effects of tourniquet use in total knee arthroplasty: a randomized controlled trial. Knee Surg Sports Traumatol Arthrosc. 2017;25:2849–57.
7. Smith TO, Hing CB. Is a tourniquet beneficial in total knee replacement surgery? A meta-analysis and systematic review. Knee. 2010;17:141–7.
8. Li B, Wen Y, Wu H, Qian Q, Lin X, Zhao H. The effect of tourniquet use on hidden blood loss in total knee arthroplasty. Int Orthop. 2009;33:1263–8.
9. Tai TW, Chang CW, Lai KA, Lin CJ, Yang CY. Effects of tourniquet use on blood loss and soft-tissue damage in total knee arthroplasty: a randomized controlled trial. J Bone Joint Surg Am. 2012;94:2209–15.
10. Blood Transfusion, NICE guideline, Published: 18 November 2015. Available at: https://www.nice.org.uk/guidance/ng24/resources/algorithm-pdf-2178655021. Accessed on 25 May 2018
11. Schwab PE, Lavand'homme P, Yombi JC, Thienpont E. Lower blood loss after uni-compartmental than total knee arthroplasty. Knee Surg Sports Traumatol Arthrosc. 2015;23(12):3494-500.
12. Brown NM, Sheth NP, Davis K, Berend ME, Lombardi AV, Berend KR, Della Valle CJ. Total knee arthroplasty has higher postoperative morbidity than unicompartmental knee arthroplasty: a multicenter analysis. J Arthroplasty. 2012;27(8):86-90.
13. Amin AK, Patton JT, Cook RE. Unicompartmental or total knee arthroplasty?:results from a matched study. Clin Orthop Relat Res. 2006;451:101–6.
14. Zhang XQ, Ni J, Ge WH. Combined use of intravenous and topical versus intravenous tranexamic acid in primary total joint arthroplasty:A meta-analysis of randomized controlled trials. Int J Surg. 2017;38:15-20.
15. Wu Q, Zhang HA, Liu SL, Meng T, Zhou X, Wang P. Is tranexamic acid clinically effective and safe to prevent blood loss in total knee arthroplasty? A meta-analysis of 34 randomized controlled trials. Eur. J. Orthop. Surg. Traumatol. 2015;25:525-41.
16. Tan J, Chen H, Liu Q, Chen C, Huang W. A meta-analysis of the effectiveness and safety of using tranexamic acid in primary unilateral total knee arthroplasty. J Surg Res. 2013;184:880.
17. Anderson LA, Engel GM, Bruckner JD, Stoddard GJ, Peters CL. Reduced blood loss after total knee arthroplasty with local injection of bupivacaine and epinephrine. J Knee Surg. 2009;22:130–6.
18. Gasparini G, Papaleo P, Pola P, Cerciello S, Pola E, Fabbriciani C. Int Orthop. 2006;30(4):253-6.
19. Juelsgaard P, Larsen UT, Sørensen JV, Madsen F, Søballe K. Hypotensive Epidural Anesthesia in Total Knee Replacement Without Tourniquet: Reduced Blood Loss and Transfusion. Regional Anesthesia Pain Med. 2001;26:2.

20. Russo R, Dasa V, Duarte R, Beakley B, Mishra M, Thompson H. Post-Operative Hypertension after Total Knee Arthroplasty and the Effects on Transfusion Rates. PLoS ONE. 2012;7(12):e50967.
21. Ewan B. Goudie, Cal Robinson, Phil Walmsley, Ivan Brenke. Changing trends in total knee replacement. Eur J Orthop Surg Traumatol. 2017;27:539–44
22. Metcalfe CW, Jayatilaka ML, Cope MR. Is a preoperative group and save necessary for enhanced recovery joint replacement patients? Br J Hosp Med (Lond). 2014;75(12):708-10.
23. Thomson PM, Ross J, Mukherjee S, Mohammadi B. Are Routine Blood Group and Save Samples Needed for Laparoscopic Day Case Surgery? World J Surg. 2016;40(6):1295-8.
24. Barrett-Lee J, Vatish J, Vazirian-Zadeh M, Waterland P. Routine blood group and antibody screening prior to emergency laparoscopy Ann R Coll Surg Engl. 2018;100(4):322-5.

**Cite this article as:** Kirmani SJ, Middleton M, Fontalis A, Srivastava R, Dinah F. Blood loss following medial unicondylar knee replacements without a tourniquet: is there a need to group and save?. Int J Res Orthop 2019;5:65-9.