

J Med Sci
Volume 43, No. 2, June 2011: 105-111

A comparison study on the blood transfusion reaction between the elective and the emergency operation's patients

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ABSTRACT

Blood transfusion is principally a process of transferring blood or blood components from one individual (the donor) to another individual (the recipient). Blood transfusion can be either a life saving condition or a life threatening situation due to the complications happened. Therefore, blood transfusion should be conducted with clear and accurate indication in order to obtain a condition in which the advantages outweighs the disadvantages. The aim of this study was to evaluate the differences of the blood transfusion reactions between the patients underwent the emergency surgery with the elective surgery. This was a cross sectional study using data from the medical records from January to December 2009 and from the observation on blood transfusion patients from January to May 2010. Data were analyzed using independent t-test, Chi-square test or the logistic regression, with 95% confidence interval ($p < 0.05$). Two hundred and sixty eight data from medical records and directly observation on blood transfusion patients were obtained during the study. The were significant differences of patient reactions after blood transfusion on both types of operation and blood components transferred ($p < 0.05$). The transfusion reactions were more frequent in emergency surgery (54.9%) compared with elective surgery (30.5%). Based on types of blood component transferred, the transfusion reaction was more frequent after Whole Blood/WB transfusion (84.9%) compared with Packed Red Cell/PRC transfusion (25.1%) and Fresh Frozen Plasma/FFP transfusion (25%). The types of operation and blood products had been proven to be the risk factors in blood transfusion. Moreover the blood products contributed more in the transfusion reactions compared with the types of operation ($p < 0.05$). Amount of transfused blood based on haemoglobin correction formula on both the emergency or elective operations was not significantly different ($p > 0.05$). In conclusion, blood transfusion reactions happened more frequently in emergency surgery than elective surgery. The WB also generated transfusion reaction more frequently than the PRC. The amount of blood required based on hemoglobin correction formula for most patients was similar to the blood transfused.

Key words: blood transfusion-type of operation-transfusion reaction - whole blood-haemoglobin correction formula

ABSTRAK

Transfusi darah pada hakekatnya adalah proses pemberian darah atau komponen darah dari satu individu (donor) ke individu lainnya (resipien). Transfusi dapat menjadi penyelamat nyawa atau sebaliknya dapat pula berbahaya akibat komplikasi yang ditimbulkan. Oleh karena itu transfusi darah harus dilakukan dengan indikasi yang jelas dan akurat untuk memperoleh manfaat yang lebih besar daripada kerugiannya. Tujuan penelitian ini adalah untuk mengkaji perbedaan reaksi yang timbul akibat transfusi darah pada pasien yang mengalami operasi emergensi dan operasi elektif. Penelitian ini merupakan penelitian potong lintang menggunakan data rekam medik antara Januari-Desember 2009 dan data hasil observasi pada pasien transfusi darah antara Januari-Mei 2010. Data yang diperoleh dianalisis menggunakan uji t independen, Chi-square atau regresi logistik dengan tingkat kepercayaan 95% ($p < 0,05$). Sebanyak 268 data dari hasil rekam medis dan pengamatan langsung pada pasien yang menjalani transfusi diperoleh selama penelitian. Terdapat perbedaan bermakna terhadap reaksi pasien setelah transfusi darah baik berdasarkan jenis operasi maupun jenis komponen darah yang ditransfer ($p < 0,05$). Reaksi transfusi lebih sering terjadi pada operasi emergensi (54,9%) dibandingkan dengan operasi elektif (30,5%). Berdasarkan komponen darah yang ditransfer, reaksi transfusi lebih sering pada transfusi WB (84,9%) dibandingkan dengan transfusi PRC (25,1%) dan transfusi FFP (25%). Jenis operasi dan jenis darah merupakan faktor risiko terjadinya reaksi transfusi namun jenis darah lebih sering menimbulkan reaksi transfusi ($p < 0,05$). Jumlah darah yang ditransfer berdasarkan rumus formula hemoglobin pada kedua jenis operasi berbeda namun perbedaan ini tidak bermakna ($p > 0,05$). Dapat disimpulkan bahwa reaksi transfusi darah lebih sering terjadi pada operasi emergensi dibandingkan operasi elektif. Reaksi transfusi lebih sering ditimbulkan oleh transfusi WB dibandingkan PRC. Jumlah darah yang diperlukan berdasarkan rumus koreksi hemoglobin pada hampir sebagian besar pasien sama dengan darah yang ditransfusikan.

Kata kunci: transfusi darah - jenis operasi - reaksi transfusi - darah lengkap - rumus koreksi hemoglobin

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INTRODUCTION

Blood transfusion is the process of transferring either blood or blood components from a donor to a recipient. Blood transfusion plays an essential role in the modern health service. An appropriate transfusion shall save patient's life and may increase the quality of health. The blood transfusions are mostly performed to augment the blood capacity in delivering oxygen, to repair the body's blood volume and to restore the congeal blood.^{1,2}

World Health Organization (WHO) reported that 80% of population in the developed countries, which just covered 20% of world population, used of safe blood donors. On the contrary, only 20% of population in developing countries, which covered 80% of world population, used safe blood donors.^{1,2}

The indication of blood transfusion are based on the clinical symptoms and laboratory examination of a patient. Based on its indication, the blood transfusion can be differentiated into whole blood transfusion (WB), packed red cell transfusion (PRC) and fresh frozen plasma transfusion (FFP).^{1,4} Whatever the indication of blood transfusion decided, the transfused-blood must be safe, accessible, affordable, and the quantity can meet the demand. However, the blood transfusion reaction can be observed, even after an appropriate transfusion has been performed. The risks of blood transfusion that have been reported are acute hemolytic or delayed hemolytic reaction, viral infection, and massive transfusion risk.⁵

The objectives of this study were to evaluate the differences of blood transfusion reaction in patients who undergo emergency surgery with the ones who undergo elective surgery and to asses the implementation of the hemoglobine correction formula in the Dr. Sardjito General Hospital, Yogyakarta.

MATERIALS AND METHODS

This was cross-sectional study which involved all the patients of both sexes who underwent either elective or emergency operations in Dr. Sardjito General Hospital, Yogyakarta during January 2009 to May 2010. Data were collected from two resources. The first one, it were taken from the medical record of operation patients for the period of January to December 2009 and the second one,

it were taken from patients who underwent blood transfusion both in the emergency unit and in the patient ward of Dr. Sardjito General Hospital, Yogyakarta for the period January to May 2010.

The independent variables of study were age, sex, types of operation, types of blood transfused, the amount of blood unit given while the dependent variables were the blood transfusion reactions i.e. fever, rashes, pruritus, tachycardia, nausea and hypercalemia. The inclusion criteria of the subjects were patients aged between 2 months to 77 years old of both sexes while the exclusion criteria were the patients who underwent the elective or emergency operation but were not treated by blood transfusion. Number of patients was unlimited, all the patients who were eligible in the inclusion criteria were involved in this study. Depend on type of data, statistical analysis of the data used independent t-test, Chi-square test or multivariate logistic regression, with 95% confidence interval ($p < 0.05$).⁶

The study has been approved by the Health Research Ethics Committee of Faculty of Medicine, Gadjah Mada University, Yogyakarta.

RESULTS

Two hundred and sixty eight data from medical records and directly observation of patients who underwent blood transfusion were obtained during the study. The subjects characteristics, number of blood unit tranfused, blood transfusion and operation types of the patients who were admitted to the emergency unit or patient wards in Dr. Sardjito General Hospital, Yogyakarta for the period January 2009 to May 2010 are presented in TABLE 1.

TABLE 1. Subject characteristics, blood transfusion and operation types (n = 268)

Characteristics	Number (%)
Age (years \pm SD)	44.47 \pm 21.93
• Yongest	• 2
• Oldest	• 77
Sex	
• Male	• 138 (51.5)
• Female	• 130 (48.5)
Number of blood unit transfused (unit \pm SD)	2.09 \pm 0.77
• Minimum number	• 1
• Maximum number	• 4

Characteristics	Number (%)
Blood products*	
• WB	• 53 (19.8)
• PRC	• 211 (78.7)
• FFP	• 4 (1.5)
Operation types	
• Emergency	• 71 (26.5)
• Elective	• 197 (73.5)

* WB: whole blood, PRC: packed red cell, FFP: fresh frozen plasma

The age range of the patients was between 2 months – 77 years old with the mean of patient age was 44.47 ± 21.93 years. From the total number of the subjects, the male subjects were 138 (51.5%) and the female were 130 (48.5%). The mean of blood unit transfused was 2.09 ± 0.77 unit with the

minimum number of one unit and the maximum number of four unit. The blood products that were transfused were WB for 53 patients (19.8%), PRC for 211 patients (78.7%) and FFP for four patients (1.5%). Based on the operation types, most of patients (197 patients or 73.5%) underwent emergency operation whereas 71 or 26.5% patients underwent elective operation.

TABLE 2 showed the characteristics of subjects, the number of blood transfused and the blood products based on the operation types. Statistical analysis showed that the patients' age ($p=0.001$), the number of blood unit transfused ($p=0.006$) and the blood products ($p=0.001$) were significantly different. However, the sex variable did not show significant difference between both groups ($p=0.074$).

TABLE 2. Subject characteristics, number of blood unit transfused and blood products based (n or %) on operation types

Variables	Emergency operation (n= 71)	Elective operation (n= 197)	p
Ager (year \pm SD)	31.26 ± 25.35	49.38 ± 18.59	0.001
Sex (n or /%)			
• Male	43 (60.6)	95 (48.2)	0.074
• Female	28 (39.4)	102 (51.8)	
Number of blood unit transfused (n or %)			
• 1 time	11 (15.5)	42 (21.4)	0.006
• 2 time	53 (74.6)	102 (51.9)	
• 3 time	5 (7.0)	39 (19.8)	
• 4 time	2 (2.8)	14 (7.1)	
Blood products (n or %)			
• WB	30 (42.3)	23 (11.7)	0.001
• PRC	41 (57.7)	170 (86.3)	
• FFP	0 (0)	4 (2.8)	

* WB: whole blood, PRC: packed red cell, FFP: fresh frozen plasma

The occurrence of the transfusion reaction of patients after underwent blood transfusion in both the operation types is presented in TABLE 3. The occurrence of the transfusion reaction on the

emergency operation patients was higher (54.9% of 71 patients) significantly than on the elective operation patients (30.5% of 197 patients) ($p=0.001$).

TABLE 3. Transfusion reaction based on the operation types

Transfusion reaction	Emergency operation (n= 71)	Elective operation (n= 197)	p
Occur (n or %)	39 (54.9)	60 (30.5)	0.001
Not occur (n or %)	32 (45.1)	137 (69.5)	
Total	71 (100)	197 (100)	

The occurrence of the blood transfusion reactions based on blood products is presented in TABLE 4. The blood transfusion reactions were proven to be affected by the type of blood products.

The WB caused more blood transfusion reactions (84.9%) compared with PRC (25.1%) and FFP (25.1%).

TABLE 4. The occurrence of blood transfusion reaction base on blood product

Blood product	Transfusion reaction n (%)		p
	Occur	Not occur	
Whole blood (WB)	45 (84.9)	8 (15.1)	0.001
Packed red cell (PRC)	53 (25.1)	158 (74.9)	
Fresh frozen plasma (FFP)	1 (25)	3 (75)	

TABLE 5 showed the transfusion reaction based on post-transfusion Hb rate. There was no significant difference in transfusion reaction between the Hb rate of >10 g/dL and of ≤ 10 g/dL. However, the

transfusion reaction on post-transfusion Hb rate of >10 g/dL (29.9%) tended to be higher than on Hb rate of ≤ 10 g/dL (7.1%).

TABLE 5. Transfusion reaction based on post-transfusion Hb rate

Hb Rate variable	Transfusion Reaction n (%)		p
	Occur	Not occur	
Post-transfusion			0.863
> 10 g/dl	80 (29.9)	138 (51.5)	
≤ 10 g/dl	19 (7.1)	31 (11.6)	

TABLE 6 demonstrated kinds of blood transfusion reactions that occurred in both operation types. Tachycardia, fever, nausea, rash, hypercalcemia and pruritus with mild to moderate severe occurred in the patients either who underwent the emergency on the elective operation. The incidence

of tachycardia, hypercalcemia and pruritus on the patients underwent the emergency operation was higher than the patients underwent the elective operations (p=0.003). Conversely, the incidence of fever, nausea and rash on the patients underwent the elective was higher.

TABLE 6. Kinds of the blood transfusion reactions (n or %) based on the operation types

Kinds reaction	Emergency operation (n= 71)	Elective operation (n= 197)	p
Tachycardia	8 (20.6)	1 (1.7)	0.003
Fever	13 (32.8)	33 (55.0)	
Nausea	2 (5.2)	6 (10.0)	
Rash	4 (10.4)	11 (18.3)	
Hypercalemia	6 (15.5)	2 (3.3)	
Pruritus	6 (15.5)	7 (11.7)	
Total number	39 (100)	60 (100)	

In this study, the quantity of blood tansfusion varied from 1-4 Kolf. Hb correction formula was used to evaluate the amount of blood transfused with blood required. Hb correction formula applied in Dr. Sardjito General Hospital, Yogyakarta is DHb x BB x 72/12 (Hb_x - Hb patient x BB x 6) for WB

and DHb x BB x 80/22 (Hb_x - Hb patient x BB x 3,6) for PRC.⁷ The number of patients based on the difference in amount of the blood transfused with blood required (in mL) according to the Hb correction formula in each operation types and blood products is shown in TABLE 7.

TABLE 7. The number of patients (n or %) based on the difference in amount of the blood transfused with blood required

Range of blood volume (mL)	Emergency operation		Elective operation	
	PRC* (n=41)	WB** (n=29)	PRC (n=170)	WB (n=23)
- 50 to -30	0 (0)	1 (3)	6 (4)	4 (17)
- 30 to -10	2 (5)	2 (7)	23 (14)	3 (13)
- 10 to 10	21 (51)	9 (30)	64 (38)	10 (43)
10 to 30	15 (37)	2 (7)	61 (36)	3 (13)
30 to 50	2 (5)	12 (40)	13 (8)	2 (9)
50 to 70	1 (2)	3 (10)	1 (1)	1 (4)
70 to 90	0 (0)	1 (3)	2 (1)	0 (0)

*PRC: packed red cell; ** WB: whole blood

The difference between the amount of the blood transfused with the amount of blood required based on the Hb correction formula of most of the patients was observed in the range of blood volume – 10 to 10 mL on emergency operation using PRC transfusion (21 patients or 51%) and on elective operation using PRC (64 patients or 38%) and WB transfusion (10 patients or 43%). However, on emergency operation using WB transfusion, the difference of most the patients was observed in the range 30 to 50 mL. The highest difference (70 to 90 mL) was found only on three patients, one patient on emergency operation using WB transfusion and

two patient on elective operation using PRC transfusion.

Statistical analysis of the effect of the operation and the blood products on transfusion reaction using multivariate logistic regression analysis is presented on TABLE 8. The blood products can be a risk factor of the occurrence of transfusion reaction with Odds Ratio of 14.759 (p=0.0010). Moreover, the operations types can be also risk factor of the occurrence of transfusion reaction (Odds Ratio of 1.478) although statistically it was not significant (p=0.252).

TABLE 8. Statistical analysis of the effect of the operation types and the blood products toward the transfusion reaction

Variables	Odds Ratio	95% Confidence Interval	p
Operation types	1.478	0.757 – 2.886	0.252
Blood products	14.759	6.398 – 34.047	0.001

DISCUSSION

Blood transfusion in patients who undergo operation is often needed due to blood loss that occurs during operation. Although generally, a normal young adult can still handle the functional disorder that caused by the 10% of blood loss, 20 % of oxygen load capacity or 40% of losing the coagulation factor. The loss of twice amount of the above quantity will not inflict any medical emergency although the symptoms are quite hard to handle.⁸⁻¹⁰

Blood transfusion can generate transfusion reaction. Some factors involve on the occurrence of the transfusion reaction during or after blood transfusion. In this study types of operation (emergency or elective operations), types of blood transfused (WB, PRC or FFP) and the amount of blood unit given (post transfusion Hb rate) were proven to be factors that involved on the occurrence of the transfusion reaction.

It was found in this study that the emergency operations tended to generate the transfusion reaction compared to the electives ones (TABLE 2). Emergency operation is operation that is conducted in certain conditions with some reasons and mostly in critical or emergency conditions.¹¹ While, elective operation is planned operation and not-emergency operations that is conducted based on clear and optimal medical indications.¹² Emergency operation is normally conducted without adequate planning therefore the transfusion reactions is more likely to occur in emergency operations than in elective operations.

It was also found that WB transfusion showed more transfusion reactions than PRC (TABLE 3). The WB transfusion should consider patient's condition, the signs and symptoms of hypoxia, blood loss, anaemia risk caused by the illness suffered and of the transfusion reaction.¹³ However, WB transfusion are often conducted on the cases of mild or moderate blood loss. Although, the blood loss itself normally will not increase the morbidity and

perioperative mortality. Many PRC are available for blood transfusion on the case of mild or moderate blood loss in order to avoid transfusion reaction using WB. In fact, it was reported that the absence of transfusion on the mild or moderate blood loss will not cause the outcome of perioperative treatment becomes worse.¹⁴⁻¹⁶

The transfusion reaction on post-transfusion Hb rate of >10 g/dL tended to be higher than on Hb rate of ≤ 10 g/dL, although it was not significantly different (TABLE 5). A study conducted by Carson *et al.*¹⁷ that involved 8.787 patients who underwent the operation for thigh fracture with the Hb rate of ≥ 8 g/dl also showed that the perioperative transfusion did not influence the number of mortality within the range of 30 to 90 days after the treatment. In addition, the postoperative transfusion with the formulation of Hb rate of <8 g/dL on up to 90.5% of patients did not affect the mortality rate within the range of 30 up to 90 days by considering the cardiovascular complication and other risk factors that may be involved. Other study on 84 thigh fracture patients who underwent blood transfusion with Hb rate of <8 g/dL compared with the blood transfusion to maintain the Hb rate > 10 g/dL showed that there was no progress on the rehabilitation process, morbidity or mortality.¹⁸

The incidence of blood transfusion reactions in both emergency and elective operations was significant in different (TABLE 6). It makes sense since the nature of emergency operation was often conducted in critical and emergency conditions,^{11,19} while the elective ones was more well-planned and considered for a non-emergency conditions which was conducted mostly under the clear medical indications and it was optimally performed.¹²

CONCLUSION

This study concluded that :

1. The transfusion reaction was more likely to happen on the patients who underwent the

emergency operation than the ones treated with the elective surgery.

2. The blood product of the WB generated more transfusion reaction compared to the PRC.
3. The amount of blood required based on hemoglobin correction formula for most patients was similar to the blood transfused.

ACKNOWLEDGEMENT

Author would like to thank Head of Department of Surgery, Faculty of Medicine, UGM/Dr. Sardjito General Hospital, Yogyakarta for his permission to perform this study. Author would also like to thank Head of Medical Record Installation of Dr. Sardjito General Hospital, Yogyakarta for the medical record of the patients whom involved in this study.

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