RESEARCH ARTICLE

A Survey of Blood Request Versus Blood Utilization at a University Hospital in Iran

Arash Peivandi Yazdi, MD; Mohammad Alipour, MD; Seyyed Saeed Jahanbakhsh, MD; Mohammad Gharavifard, MD; Mehryar Taghavi Gilani, MD

Research performed at Ghaem Hospital, Mashhad, Iran

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Abstract

Background: Reservation of blood leads to blood wastage if the blood is not transfused. Therefore, in some centers only blood type and screen are evaluated. In this study, the efficacy of a blood crossmatch-to-transfusion ratio was measured and then compared with the standard levels.

Methods: This prospective study was conducted during one year in a university hospital. During this period, 398 patients for whom blood had been requested were studied. In these patients, at the first surgical type, the laboratory tests (hematocrit, hemoglobin, platelet count, and prothrombin time) and the number of preoperative crossmatched and intraoperative transfused blood units were recorded. Then the crossmatch-to-transfusion ratio, transfusion probability, transfusion index, and correlation between related factors, and the transfusion ratio were evaluated.

Results: In this cross-sectional study, blood was requested for 398 patients. According to available blood unit deficiency, from 961 blood unit requisitions, only 456 units were crossmatched and 123 units were transfused. The crossmatch-to-transfusion ratio, transfusion probability, and transfusion index were 3.71 (7.81 if all requisitions were crossmatched), 16.83%, and 0.31, respectively. The most unfavorable indexes were observed in patients who had ear, nose, and throat surgeries (0 transfused from 19 crossmatched blood units) and obstetric and gynecologic surgery (crossmatch-to-transfusion ratio was 18.6). The best indexes were related to thoracic surgery and neurosurgery (crossmatch-to-transfusion ratio was 1.53 and 1.54, respectively). There were no significant correlations between hemoglobin, hematocrit, platelet count, and prothrombin time with the number of transfused blood units (P = 0.2, 0.14, 0.26, and 0.06, respectively).

Conclusion: The data for the crossmatch-to-transfusion ratio, transfusion probability, and transfusion index were suboptimal at this center, especially for ear, nose, and throat and obstetric and gynecologic surgeries. Further multidimensional studies and determination of a new model for blood requests and to decrease blood wastage are needed.

Keywords: Blood grouping and crossmatching, Blood products, Blood transfusion

Introduction

Excessive blood requests are a common problem in elective surgeries. In many medical centers, complete compatibility tests between donors and recipients (crossmatching) are still conducted before blood transfusions are performed. This process causes the blood unit to be unavailable for others for 48 h, which implies inappropriate distribution of blood products, blood wastage, inaccessibility for emergency patients, increased costs of the blood supply, and an increased workload for blood banks (1-3).

One of the tools for the evaluation of a blood reservation system is the determination of the crossmatch-to-transfusion (C/T) ratio, which was first used by Boral Henry, and is considered an appropriate index at the threshold of 2.5:1. Mead et al. (4-6). used the probability of blood transfusion (number of crossmatched patients/number of transfused patients × 100) for assessment and considered values >30% to be desirable. Another criterion is the transfusion index, which is the ratio of the mean number of units used for the crossmatched patients (number of crossmatched patients/number

Corresponding Author: Mehryar Taghavi Gilani, Cardiac Anesthesia Research Center, Imam-Reza Hospital, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran
Email: taghavim@mums.ac.ir

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of transfused units); the values >0.5 are considered appropriate for blood quality (3-5,7).

The current limitations in blood accessibility have led to the use of the maximum surgical blood order schedule (MSBOS) to reduce blood wastage. The MSBOS comprises of a list of surgeries that require crossmatching and another list of surgeries for which only blood types and screens are needed (5,8). Based on this schedule, crossmatching is limited to only the surgeries with a high need for blood transfusion. The MSBOS is used to determine crossmatched blood units that can be formulated with a transfusion index multiplied by 1.5.

Because blood access is problematic in emergency cases, the aim was to evaluate the current blood reservation system in elective surgeries to reduce over ordering and increase the reservation of blood units in the future.

Materials and Methods

After approval by the Deputy Research of Medical Sciences, this study was conducted in a university hospital in 2013. During one year, we studied all surgical patients at the hospital for whom blood was crossmatched. Demographic data, such as age and sex, and the parameters that increased the probability of a need for blood transfusion, such as type of surgery, hemoglobin (Hb), hematocrit (Hct), platelets, and prothrombin time (PT), were assessed. Transfusion was done and recorded during surgeries while taking into consideration the blood loss of patients and the need to maintain an Hct level of 30% (maximum allowable blood loss = estimated blood volume × [initial Hct − final Hct/ average Hct]). If no transfusion was needed, the blood bank was informed so that the crossmatched blood could be removed from the waiting list. Patients with open heart surgery, massive preoperative blood loss, Hct <30%, and confirmed coagulopathy were excluded from this study.

The C/T ratio, transfusion probability (number of crossmatched patients/number of transfused patients × 100), and transfusion index (number of crossmatched patients/number of transfused units) were measured in total and based on the type of surgery.

Data were analyzed using the SPSS version 16 software (IBM, Armonk, NY). The C/T ratio, transfusion probability, and transfusion index were measured for various surgeries. Multiple linear regression was used to assess the relationship between independent parameters (Hb, Hct, platelets, and PT) and the C/T ratio.

Table 1. Demographic and preoperative related parameters; mean±sd

Parameters	Results
Age (year)	43.7±18.1
Sex (F/M%)	58.3/41.7%
Hematocrite (%)	41.3±0.8
Platelet (n/micL)	$128.2\pm18.5\times10^3$
PT (second)	13.5±0.5

Results

This cross-sectional prospective study was performed over a period of one year with surgical patients aged 43.7±18.1 years. During this period, 398 patients for whom blood had been requested were studied (58.3% female and 41.7% male). Preoperative Hct, platelets, and PT were 41.3 ± 0.8%, 128.2 ± 18.5 × 10^3, and 13.5 ± 0.5 s, respectively [Table 1].

For all the studied patients, a total of 961 blood units was requested by the surgery department, and only 456 units were crossmatched by the blood bank staff (based on blood deficiency and without special guidelines). A total of 123 blood units were transfused to the study patients. The C/T ratio, transfusion probability, and transfusion index obtained were 3.71, 16.83%, and 0.31, respectively. If all 961 blood units had been crossmatched, the C/T ratio would have been 7.81.

After separating the surgical groups, we found that the highest numbers of blood units requested were for orthopedic, gynecological, and general surgeries, respectively. The highest numbers of crossmatched units were in orthopedic and gynecological surgeries

Table 2. Crossmatch to transfusion ratio, transfusion probability, and index at different surgical wards.

Surgical type	Cross matched patients (N)	Transfused patients (N)	Cross matched units (N)	Transfused units (N)	C/T Ratio	Transfusion probability	Transfusion index
ENT surgery	19	0	19	0	∞	0	0
Gynecological and obstetric	89	3	93	5	18.6	3.37	0.06
General surgery	86	5	90	9	10	5.81	0.10
Urology	36	5	39	9	4.33	13.89	0.25
Orthopedic	94	18	110	32	3.44	19.15	0.34
Neurosurgery	57	27	82	53	1.54	47.37	0.93
Thoracic surgery	17	9	23	15	1.53	52.94	0.88
Total	398	67	456	123	3.71	16.83	0.31

Table 3. Correlation between preoperative Hb, Hct, platelet and Pt with blood transfusion; mean (standard deviation)

Transfused blood units	0	1	2	3	*P*-value	R
Hb (mg/dl)	13.6 (0.9)	138. (0.6)	13.9 (0.8)	13.8 (0.4)	0.20	0.10
Hct (%)	41.1 (3.1)	42 (2.1)	42.1 (2.5)	42.4 (0.5)	0.14	0.11
Plt count (n/micl)(*1000)	128.3 (19.7)	131.9 (8.7)	124.9 (7.9)	139.8 (28.4)	0.26	-0.01
PT (second)	13.4 (0.5)	13.5 (0.5)	13.6 (0.5)	13.2 (0.4)	0.06	0.08

(110 and 93 blood units, respectively). The C/T ratio, transfusion probability, and transfusion index data for the different surgery types are shown in Table 2. The best C/T ratios were in thoracic and neurological surgeries, at 1.53 and 1.54, respectively, and the worst C/T ratios were in ear, nose, and throat surgeries (lack of transfusion of 19 crossmatched units) and obstetric and gynecological surgeries (18.6). No relationship was observed between preoperative factors (Hb, Hct, platelets, and PT) and transfusion need (P = 0.2, 0.14, 0.26, and 0.06, respectively) [Table 3].

The MSBOS needed to precisely separate the type of surgery; however it was not performed in this study. But according to the surgery groups, the MSBOS was from 0 blood units for ear, nose, and throat surgeries to 1.4 units for neurosurgery.

Discussion

Nowadays, excessive blood wastage is a common problem in hospitals. To reduce and prevent problems, various methods, such as the MSBOS, surgical blood order equation (SBOE), and simply typing and screening, are used in different medical centers. In our centers, there are no determined and unique models for blood requests, blood storage, crossmatching, or even typing and screening. This issue has led to blood wastage and sometimes canceled surgeries. In this study of 398 patients, 961 blood units were requested by the surgery department, but because of a blood bank deficiency, only 456 blood units were crossmatched and just 123 units were transfused.

Several studies have been conducted in different centers and countries to assess and determine blood bank quality. Hall et al. conducted a 6-month study of 541 surgical patients (9). In their study, 507 units were crossmatched and 238 units were transfused for 507 major surgery patients, and the C/T ratio was 2.1. In Kozarzoska et al.'s research the general C/T ratio was 9, with a breakdown of 6.61 in the high-risk, 13.7 in the medium-risk, and 35.5, in the low-risk groups (10). In these three groups, transfusion probabilities were 18.8%, 8.69%, and 2.94% respectively, indicating a need for reassessment of the blood preparation policy.

In developing countries, various C/T ratios have been described. In Nigeria, Ethiopia, India, and Egypt transfusion probabilities of 26.9%, 47%, 59%, and 8.74%, respectively, have been observed (1, 7, 11, 12). Several studies have been conducted in Iran as well, where C/T ratios ranging from 1.33 to 7 have been reported (13-15).

To reduce blood wastage and decrease costs and working time in different centers, various methods are being followed for preparing blood before surgeries. One of the simplest methods is the use of typing and screening, and one of the most conventional methods is the MSBOS. The MSBOS was first used by Friedman and first formulated using the Mead criterion (5, 6). Using the Mead criterion, the transfusion index is multiplied by 1.5 to calculate the number of blood units needed for each surgery. In this method, different surgeries, along with their bleeding and transfusion information, are assessed, and typing and screening are applied for the surgeries with a lesser blood need. On the basis of surgery type, the level of need for crossmatched units is determined. In a study conducted in 2013 in Serbia, a typing-and-screening procedure led to modification of the transfusion probability from 44.96% to 61.28% and a change in the transfusion index from 0.36 to 0.60 (16).

The SBOE is a more advanced method than the MSBOS. In the SBOE, various surgery-related factors such as preoperative and postoperative Hb and perioperative bleeding are assessed, and the number of units needed for crossmatching in different surgeries is evaluated accordingly. This criterion decreases blood wastage compared with the conventional method. In Kajja's study the C/T ratio decreased from 2.3 to 1.5 when this method was used (17). Furthermore, in Mahadevan's study use of the SBOE rather than the MSBOS reduced the C/T ratios in hip surgery from 3.24 to 2.18 and in knee surgery from 7.95 to 1.2 (18). In addition, in other studies, SBOE has been more effective than the MSBOS in improving blood maintenance quality and reducing blood wastage (19-21).

A number of other factors are involved in the need for blood transfusion. In a study by Goundan on cesarean section the factors that seemed to be involved in the need for blood transfusion included placenta previa, anemia, placental disruption, atonic uterus, general anesthesia, and insufficient care during child delivery (22). In Bameshki's investigation on burn graft surgeries transfusion need was directly and inversely related to burn level and preoperative Hb, respectively (23).

In the present study, the C/T ratio, transfusion probability, and transfusion index were 3.71, 16.83%, and 0.31, respectively, which was not desirable compared

with the standard value. In various surgeries, this ratio varied from 1.53 in thoracic surgery to 18.6 in obstetric and gynecologic surgery. In ear, nose, and throat surgeries, none of the 19 crossmatched blood units were transfused. With regard to the selection of patients without coagulopathy or correction of preoperative anemia, we did not observe a significant correlation of PT, platelet, Hb, and Hct with transfusion rate.

In conclusion, because the C/T ratio in our study was 3.71 (without blood bank limitation, the C/T ratio was 7.81) and above the standard, we recommend that a multicenter study with different surgery types be performed to obtain an appropriate model and guideline for correction of blood transfusion quality and to decrease blood wastage and costs.

Arash Peivandi Yazdi MD
Mohammad Alipour MD
Seyyed Saeed Jahanbakhsh MD
Mohammad Gharavifard MD
Mehryar Taghavi Gilani MD
Cardiac Anesthesia Research Center, Imam-Reza Hospital, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran

References

1. Bhutia SG, Srinivasan K, Ananthakrishnan N, Jayanthi S, Ravishankar M. Blood utilization in elective surgery--requirements, ordering and transfusion practices. Natl Med J India. 1997; 10(4):164-8.
2. Chawla T, Kakepoto GN, Khan MA. An audit of blood cross-match ordering practices at the Aga Khan University Hospital: first step towards a Maximum Surgical Blood Ordering Schedule. J Pak Med Assoc. 2001; 51(7):251-4.
3. Vibhute M, Kamath SK, Shetty A. Blood utilisation in elective general surgery cases: requirements, ordering and transfusion practices. J Postgrad Med. 2000; 46(1):13-7.
4. Boral LI, Henry JB. The type and screen: a safe alternative and supplement in selected surgical procedures. Transfusion. 1977; 17(2):163-8.
5. Friedman BA, Oberman HA, Chadwick AR, Kingdon KI. The maximum surgical blood order schedule and surgical blood use in the United States. Transfusion. 1976; 16(4):380-7.
6. Mead JH, Anthony CD, Sattler M. Hemotherapy in elective surgery: an incidence report, review of the literature, and alternatives for guideline appraisal. Am J Clin Pathol. 1980; 74(2):223-7.
7. Olawumi HO, Bolaji BO. Blood utilization in elective surgical procedures in Ilorin. Trop J Health Sci. 2006; 13(1):15–7.
8. Friedman BA. An analysis of surgical blood use in United States hospitals with application to the maximum surgical blood order schedule. Transfusion. 1979; 19(3):268-78.
9. Hall TC, Pattenden C, Hollobone C, Pollard C, Dennison AR. Blood transfusion policies in elective general surgery: how to optimise cross-match-to-transfusion ratios. Transfus Med Hemother. 2013; 40(1):27-31.
10. Kozarzewska M, Mackowiak M, Steler J, Krefta M, Hasak L, Kardel-Reszkiewicz E. The analysis of surgical blood order protocol. Anestezjol Intens Ter. 2011; 43(2):71-3.
11. Belayneh T, Messele G, Abdissa Z, Tegene B. Blood requisition and utilization practice in surgical patients at university of Gondar hospital, Northwest Ethiopia. J Blood Transfus. 2013; 2013(10):1-5.
12. Ibrahim SZ, Mamdouh HM , Ramadan AM. Blood utilization for elective surgeries at main university hospital in Alexandria, Egypt. J Am Sci. 2011; 7(6):683–9.
13. Nikpoor AR, Daneshvar H, Sanei ME, Askari M. Assessment of requisition and consumption indices of blood in educational hospitals in Kerman city. Sci J Iran Blood Transfus Organ. 2013; 10(1):12-9.
14. Bameshki A, Karimi SA. Comparisonal evaluation of reserved blood to transfuse blood for different surgical procedures and definition of maximal surgical blood order schedule. Med J Mashhad Univ Med Sci. 2002; 45(77):21-4.
15. Gharah BA, Hatami H, Emami H, Bardeh M, Karimi G. Evaluation of blood utilization in Rasht. Sci J Iran Blood Transfus Org. 2010; 7(2):101-8.
16. Tesic I, Velisavljev D, Martinov D. The type and screen method of blood requisition in General Hospital Zrenjanin. Med Pregl. 2013; 66(1-2):58-63.
17. Kajja I, Bimenya GS, Eindhoven GB, ten Duis HJ, Sibinga CT. Surgical blood order equation in femoral fracture surgery. Transfusion Med. 2011; 21(1):7-12.
18. Mahadevan D, Challand C, Clarke A, Keenan J. Maximum surgical blood ordering schedules for revision lower limb arthroplasty. Arch Orthop Trauma Surg. 2011; 131(5):663-7.
19. Nuttall GA, Santrach PJ, Oliver WC Jr, Ereth MH, Horlocker TT, Cabanela ME, et al. Possible guidelines for autologous red blood cell donations before total

hip arthroplasty based on the surgical blood order equation. Mayo Clin Proc. 2000; 75(1):10-7.
20. Nuttall GA, Horlocker TT, Santrach PJ, Oliver WC Jr, Dekutoski MB, Bryant S. Use of the surgical blood order equation in spinal instrumentation and fusion surgery. Spine. 2000; 25(5):602-5.
21. Sakurai Y, Okada C. Comparison by simulation of the efficiency of surgical blood order equation (SBOE) with that of maximum surgical blood order schedule (MSBOS). Masui. 2001; 50(1):69-75.
22. Goundan A, Kalra JK, Raveendran A, Bagga R, Aggarwal N. Descriptive study of blood transfusion practices in women undergoing cesarean delivery. J Obstet Gynaecol Res. 2011; 37(10):1277-82.
23. Bameshki A, Taghavi GM, Tolou HH, Chitgar RF. Necessary blood volume requirement during debridement and skin graft in burn patients. Sci J Iran Blood Trans Org. 2009; 6(2):125-30.