RESEARCH ARTICLE

A Survey on Transfusion Status in Orthopedic Surgery at a Trauma Center

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Abstract

Background: Increased costs and mortality associated with inappropriate blood transfusions have led to investigations about blood request and blood transfusion techniques. We investigated the transfusion status in patients who underwent orthopedic surgery in Poursina Hospital (Rasht, Iran) to optimizing blood usage and determine if a scheduled transfusion program for every orthopedic surgery could improve blood transfusion management.

Method: In this descriptive-prospective study, all orthopedic surgeries in Poursina Hospital, Rasht, between April to June 2013 were reviewed. All patient information was recorded, including: demographics, type of surgery, hemoglobin level, cross-match test, duration of surgery, and blood loss, and transfusion. Based on the one-way ANOVA and independent samples test analysis, cross-match to transfusion ratio and transfusion possibility, the transfusion index, and maximal surgical blood order schedule were calculated to determine blood transfusion status.

Results: Among 872 selected orthopedic surgery candidates, 318 of them were cross-matched and among those, 114 patients received a blood transfusion. In this study, the cross-match to transfusion ratio was 6.4, transfusion possibility 36.47%, transfusion index 0.6, and maximal surgical blood order schedule 0.9.

Conclusion: We found that blood ordering was moderately higher than the standard; so it is highly recommended to focus on the knowledge of evidence based on transfusion and standard guidelines for blood transfusion to avoid over-ordering.

Keywords: Blood transfusion, Orthopedic surgery, Transfusion index, Transfusion possibility

Introduction

Increased demands for blood products and increased costs and mortality associated with blood transfusion have led to investigations about blood request and blood transfusion techniques beginning in the late 1970s (1, 2). It has been suggested that blood products are requested much more than actually needed and this creates an artificial shortage in the reserves while wasting valuable technical time (3). Furthermore, scores of blood units requested by physicians are not used and since they are reserved, it is not possible to use them for other patients. This causes problems for blood banks, while leading to the waste of blood, energy, and time (4, 5). It is suggested that blood is requested routinely with no wise calculation (2, 6, 7). Therefore, having a plan for blood request can help with blood usage in surgeries, reduce excessive requests for blood, prevent unnecessary cross-match tests and waste due to blood expiration, and lead to better management of blood banks (8). Such a plan is based on the medical center's experiences on blood transfusion. In each hospital the plan is made by coordination between the blood bank and the major blood consumers such as anesthesiologists and surgeons (9). Additionally, a number of indicators are used to determine the efficacy of the blood ordering system (1). The maximal surgical blood order schedule (MSBOS) with the cross-match/transfusion ratio (C/T ratio), transfusion index (TI), and transfusion possibility (T%) can increase the blood volume needed for each surgery (8, 9). However, in some elective surgeries, cross-match may be a waste of time

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and money. Therefore, also using MSBOS can improve the quality of blood usage (10).

This descriptive-prospective study was conducted in order to develop better blood ordering strategies in order to: 1) reduce health risks to patients involved in receiving blood transfusions, 2) reduce imposed costs of preparation and maintenance of the blood, and 3) in order to make better use of blood and its byproducts so as to avoid waste. Hence, we investigated the transfusion status in orthopedic surgery candidates in Poursina Hospital, Rasht by evaluating blood usage in each orthopedic surgery.

Materials and Method

This descriptive-prospective study was done on all qualified orthopedic surgery candidates from Poursina Hospital (in Rasht, Iran), between April to June 2013. The sample size was calculated based on the mentioned time of the research. At first, all patient information including: demographics, type of surgery, hemoglobin level and cross-match test results were recorded. Then, time of surgery, blood loss volume and replacement and serum hemoglobin levels were also recorded. If the serum hemoglobin levels were below normal, then the patient received one unit of blood containing 250 cc of whole blood, and after rechecking the serum hemoglobin level, if necessary, another blood unit was transfused.

Surgeries were divided into seven groups: hip, femur, knee, leg, shoulder, arm, and forearm fractures. Data were entered into SPSS version 18 software, and we used the one-way ANOVA and independent sample t-test to analysis the C/T ratio, T%, and TI, and then determine the MSBOS. The schedule more than 0.5 is considered as a criterion of significant blood use.

MSBOS = TI × 1.5

Cross-matched/transfused ratio (C/T ratio)=number of units crossedmatched/number of units transfused.

A ratio lower than 2.5 should be explaining as blood usage efficiency. A C/T ratio of > 2.5 means that less than 40% of cross-matches are transfused.

Transfusion possibility (T%)=number of patients transfused/number of patients cross-matched×100.

A value of greater than 30 was considered indicative of significant blood usage.

Transfusion index (TI)=number of units transfused/number of units cross-matched.

A value of 0.5 or more is considered as significant blood utilization.

Results

In this study, within 6 months, 872 patients were candidates for elective orthopedic surgery and 318 of them were cross-matched and from those, 116 patients received a blood transfusion. Of the 318 patients that were cross-matched, 208 cases (65.4%) were male. The mean age of patients was 45±22 years and the most common age groups of cross-matched patients were between 20 to 40 and 60 to 80 years old [in each group 86 cases (27%)].

Patients with femur fracture with 166 cases (52.2%) had the maximum request for cross-match, followed by leg, hip, and arm fractures with 50, 36, and 24 numbers of cases, respectively.

Average time of surgery was 2.66± 0.64 hours: the shortest operation lasted for 1 hour and the longest for 4.83 hours. Average serum hemoglobin level pre- and postoperatively was 11.69 ±1.78 gr/dl and 10.48±1.77 gr/dl, respectively.

In Table 1, the hemoglobin level before and after surgery according to type of fracture and the number of received blood unit can be seen.

In Table 2, the C/T ratio, T%, TI, and MSBOS according to type of fracture can be seen.

The highest possibility of blood transfusion based on type of fracture with 49.39% was in the femur fracture. The one-way ANOVA test showed a significant relationship between type of fracture and TI (P= 0.0001); the mean C/T ratio number was also significant.

Regarding Table 3, it is understood that the highest possibility of transfusion was in the age group 20-40-years-old (51.16%) and the least possibility of transfusion was in the age group: more than 80-years-old (18.18%). Based on the one-way ANOVA test, the

Table 1. Comparison of the hemoglobin level before and after surgery, intraoperative bleeding, and blood being cross-matched and transfused based on type of fracture

Type of fracture	Mean Hb level before surgery (g/dl)	Mean Hb level after surgery (g/dl)	Intraoperative mean bleeding volume (ml)	Crass-matched		Transfusion				
				Number of patients	Number of units	Number of patients	Number of units	Before surgery	Intraoperative	After surgery
Shoulder	11.51	11.21	162.50	16	64	4	6	0	6	0
Arm	12	10.59	275.00	24	96	6	6	0	6	0
Forearm	11.71	11.63	190.00	12	44	2	6	0	6	0
Hip	11.01	9.93	491.66	36	110	12	18	6	12	0
Femur	11.63	10.59	404.21	166	644	82	140	30	70	40
Knee	11.10	10.54	285.71	14	48	2	4	0	4	0
Leg	12.10	11.58	228.80	50	188	6	12	4	8	0
Total	11.69	10.84	343.63	318	1194	114	192	40	112	40

Table 2. Transfusion indicators in all types of fractures

Type of fracture	Transfusion index (TI)	C/T	Transfusion possibility (T %)	MSBOS
Shoulder	0.09	10.66	25.00%	0.55
Arm	0.06	16	25.00%	0.37
Forearm	0.13	7.33	16.66%	0.75
Hip	0.16	6.11	46.15%	1.03
Femur	0.21	4.6	49.39%	0.26
Knee	0.08	12	14.28%	0.42
Leg	0.06	15.66	12.00%	0.36
Total	0.16	6.40	36.47%	0.9

C/T ratio was significant in age groups: the least amount related to patients younger than 20-years-old, and the most was related to patients older than 80-years-old (P=0.0001). Transfusion index in age groups was significant, and the highest amount was related to patients younger than 20-years-old and the least was related to patients older than 80-years-old (P=0.0001).

Independent samples test showed that the difference between the two sexes in the transfusion possibility was not significant (P=0.835). According to the definition of transfusion possibility, in which the proper value is 30% and beyond, transfusion possibility was appropriate in both sexes. Transfusion index based on the independent samples test in genders was not significant at all (P=0.738). Also, the C/T ratio based on the independent samples test in sexes was not significant at all (P= 0.078).

Discussion

In this study, that was performed on 318 orthopedic surgery candidates in Poursina Hospital, in Rasht over six months, the T% in all patients was 36.47%. Accordingly, the standard value of 30% and beyond expresses the appropriate use of blood. The TI was recorded at 0.16 in our study, so that in comparison with the defined TI of 0.5 and more, indicates the appropriate use of blood in all types of operations. It was also observed that the TI in age groups is in the proper range. However, the C/T ratio in the age groups and all type of operations remained high, which specifically requires a revision of blood ordering methods by surgeons. The most prevalent condition leading to blood ordering was hip fracture, but the greatest possibility of transfusion was related to femoral fracture. On the other hand, our result showed an increasing rate of MSBOS hip fracture; whereas the accurate finding in which the highest transfusion possibility existed was in the femoral fracture group. The greatest number of patients in the femoral fracture group makes the interpretation of higher blood transfusion in this group easier than the hip fracture. This finding in our study was similar to Khoshrang et al.'s study (2013) in which they studied on demand and consumption patterns of blood in urologic surgeries. Their study showed that there was a significant correlation between the hemoglobin level before surgery and the blood requested and consumed afterward. The C/T ratio was 14.16, TI was 0.11 and T% was 8.85%. Eventually they concluded that the amount of blood requested and cross-matched for elective urologic surgery was much more than the amount required (11).

In the study of Subramanian et al. they found that the C/T ratio in all types of fractures was higher than normal (normal amount≤2.5). It was recorded at 6.4, indicating the inappropriate use of blood (12). In Ayanyunde et al.' study in 2008, C/T ratio was 4 to 1, and the consumption and loss rate were 65.5% and 6.3%, respectively. This study led to a reduction in MSBOS for esophagectomy to 2 units (13). Based on the Waqas's study, it was shown that the implementation of the protocol could reduce incurred costs for the patients (2).

Blood transfusion carries risks and is not without costs, and so safe blood supply problems, maintaining blood against different contaminations accompanied by increasing costs of preparing blood products are the major issues of blood transfusion (3, 5, 14). So the

Table 3. Transfusion indicators in age groups

Age group	Number of patients being crossed-matched	Number of units being crossed-matched	Number of patients being transfused	Number of units being transfused	T%	C/T	TI
<20	56	224	20	50	35.71%	4.48	0.22
20-40	86	320	44	52	51.16%	6.51	0.16
40-60	68	262	14	28	20.58%	9.35	0.41
60-80	86	340	34	56	39.53%	6.07	0.10
>80	22	84	4	6	18.18%	14.6	0.07

physician must have a high understanding of indications, effectiveness, and complications of blood therapy (2, 9, 15). Results of investigating the amount of unnecessary blood transfusions in various studies indicate that the transfusion rate is 18-25% of cases (16, 17). The blood bank strategy is to maintain the C/T ratio of less than 2.5. Maximal surgical blood order schedule is arranged by a list of surgical procedures and the maximal number of units of blood that the blood bank will cross-match for each procedure; hence, based on the experience of the surgeon or anesthesiologist, this MSBOS can be modified leading to the reduction of unwanted type and screening examinations. However, we must bear in mind that young healthy patients with normal cardiopulmonary function can easily tolerate anesthesia with the least changes in their hemodynamic system, whereas older patients (generally >80-years-old) with cardiac disease may experience serious problems with surgery and anesthesia. This is an important issue in blood ordering based on type of surgery, patient age and the level of Hb, as these major variables could affect the surgeon or anesthesiologist's decision to order blood. Hence, the use of appropriate guidelines can improve MSBOS in every hospital (18, 19).

According to the results for improving transfusion status in patients with elective orthopedic surgery and approaching the index transfusion to the standard range in the center, a greater coordination between the department of orthopedics, anesthesiology, and the blood bank is recommended. It would be helpful to educate physicians, nurses, relevant staff of the blood bank, and other associated groups in order to achieve better outcomes. In addition, if we consider the suitable design for blood usage and ordering, staff workload, and overall costs will be reduced (14).

Furthermore, with advances in surgical techniques and procedures that can decrease bleeding during surgery, the C/T ratio can be corrected. Of the positive points of this study was the evaluation of the intraoperative bleeding volume and duration of surgery. Finally, in our opinion every hospital center especially in academic research centers must establish and implement the above mentioned strategy to improve the transfusion index. In this regard, co-operation between the anesthesiologist and surgeon is an important factor to improve unwanted blood usage and ordering (15).

The amount of blood requests to the blood center was more than actually required, so by identifying the type of surgery and patient's condition, the actual need for blood transfusion would be determined.

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