



# Determination of the Average Blood Units Reserved and Consumed in Elective Shoulder Surgeries: A Single Center Study in Tehran

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## Abstract

**Background:** Orthopedic procedures on areas of the body where tourniquet application is not possible, such as the shoulder, is usually accompanied by significant bleeding in addition to a higher need for blood transfusion. Therefore, packed cell units are generally reserved prior to these kinds of procedures, however, not all of those are transfused during surgery. The waste of unused blood units takes a lot of money, time, and energy of the blood bank staff. In this study, we evaluated the average blood units reserved and consumed for elective shoulder surgeries to determine the C/T ratio (crossmatch/transfusion).

**Methods:** In this cross-sectional study, all recorded cases of elective shoulder surgeries between 2015 and 2017 were investigated through our hospital blood bank registry. The number of reserved blood units and transfused blood units (packed cell) for each surgical operation were recorded in the checklist. Finally, the average number of reserved and consumed blood units were determined using the SPSS v.16 software.

**Results:** In this work, 157 patients with a mean age of  $36 \pm 19.6$  years were studied, of which 66.9% were male. The average number of reserved blood units was  $1.5 \pm 0.586$  and the mean number of injected blood units were  $0.216 \pm 0.672$ . In addition, the average number of injected blood units in the men's group was significantly higher; this difference was statistically significant.

**Conclusions:** Considering the ratio of reserved blood units to the injected ones, this ratio, on shoulder surgeries at our hospital in Tehran, was within the normal range.

**Keywords:** Packed Cell, Shoulder Operations, Reserved, Cross Match

## 1. Background

Blood transfusion means blood or blood products transfused from the donor to the bloodstream of recipient (1). In our country, every 3 seconds, one patient needs blood transfusion, which shows the importance of this issue (2). Concentrated red blood cell (packed cell) is a red blood cell with varying amounts of leukocyte and scant plasma with a hematocrit of 65% - 80%; in addition, it is one of the most important blood products that is used in people with symptomatic anemia or those whose hemoglobin levels are less than 70 - 80 G/L (3, 4). A mild anemia prior to elective surgery should be detected and treated with packed cell injection. Furthermore, in surgeries with expected 500 cc or more blood loss, packed cell units are reserved (5). To prevent a severe immune response following a blood transfusion in the recipient's body, determination of the blood type with the ABO and Rh system, as well as cross-match, were used (6). Cross-match is a process whereby donor's

red blood cells are mixed with the recipient's serum to detect immune responses.

The number of cross-matched blood units usually exceeded transfused blood units, therefore, the cross-match/transfusion ratio (C/T) is used to overcome this problem. If the ratio is higher than 2.1 - 2.7, it indicates the probability of the blood products wastage and also imposes a financial burden on the hospital's blood bank (7).

Shoulder surgeries are considered to have a significant amount of blood loss due to the impossibility of applying the tourniquet; therefore, it is usual to reserve blood units.

So far, the C/T ratio for these surgeries has not been estimated at our center. Considering that the increase in the C/T ratio will impose heavy time and financial burdens on the hospital, this study would estimate the C/T ratio at Rasoul-e-Akram Hospital in Tehran as a referral hospital for orthopedic surgery, during 2015 - 2017. Therefore, if this ratio is increased, we would reduce the amount of unnecessary blood reservation with applying international proto-

cols. On the other hand, any drop in the ratio should cause more blood unit reservation, which prevents any resulting damage to the patients.

## 2. Methods

In this cross-sectional study, after obtaining the consent of the Ethics Committee of Iran University of Medical Sciences and respecting all the principles of medical ethics regarding the confidentiality of patient information, all filed records of elective shoulder surgeries between 2015 and 2017 at the Rasoul-e-Akram Hospital in Tehran were evaluated. The amount of blood units (packed cell) reserved and injected for each surgery, gender, age group of the patients, and the type of operation were recorded in the corresponding checklist. The average of the reserved and consumed blood units were determined and the C/T ratio was calculated. In addition, in order to examine the average number of cross-matched blood separately for each age group, the age group in this study was divided into two groups of over 30 and under 30.

The obtained data was analyzed using SPSS v.16 statistical software. P value < 0.05 was considered statistically significant.

## 3. Results

In this study, 157 patients were examined. Their mean age was  $36 \pm 19.6$  years and 66.9% were male. The average number of reserved blood units was  $1.5 \pm 0.58$  and the average number of transfused blood units were  $0.67 \pm 0.21$ . The C/T ratio in this study was 2.1. In addition, the average number of blood units reserved and consumed based on gender and age groups were investigated, which were shown in Tables 1 and 2.

## 4. Discussion

Many orthopedic surgeries are associated with significant bleeding due to the impossibility of tourniquet application in some areas of the human body. Therefore, in

**Table 2.** Reserved and Injected Packed Cell According to Age Groups

Age	No. (%)	Reserved Packed Cell, Mean $\pm$ SD	Injected Packed Cell, Mean $\pm$ SD
$\leq 30$	74 (48)	$1.52 \pm 0.72$	$0.88 \pm 0.33$
$> 30$	83 (52)	$1.41 \pm 0.45$	$0.38 \pm 0.10$
P value		0.2	0.01

Abbreviation: SD: standard deviation.

these surgeries, in order to ensure the patient's well-being during surgery, a cross-matched packed cell is reserved for immediate transfusion beforehand. Blood reservation is a costly, time-taking, and energy-consuming procedure. Besides, the probability of the shortage of blood products, which are vital and sometimes lifesaving, is possible. Thus, the C/T ratio is used to compare the amount of blood loss in different hospitals. According to international standards, the C/T ratio is between 2.1 - 2.7 (7). Therefore, higher amounts reflect a much higher reservation of blood than international indicators.

In this study, which was conducted on patients who had undergone shoulder surgeries at Rasoul-e-Akram Hospital in Tehran during 2015 - 2017, the C/T ratio was found 2.1, which was within normal international range. In a study conducted by Zaman et al. (8), on all patients who had undergone elective surgeries in Rasoul-e-Akram Hospital in Tehran in 2006, the C/T ratio was found 3.12, indicating the wrong estimation of blood loss by the surgeon. Since our study has been conducted about 12 years after the Zaman et al. (8), study, it can be concluded that there has been a significant improvement in the C/T ratio during this period, possibly due to increased knowledge and changes in the transfusion policy leading to reduction of blood reservation. In contrast with our study, Zaman et al. (8), included all elective surgeries, which explains the difference in C/T ratio with our results. This finding could describe a possibility that bleeding in shoulder surgeries is more predictable than surgeries on other anatomical sites.

Similar studies have been carried out in other hospitals around the country, in some of these studies, the C/T ratio is within the normal range, and in others, this ratio is very high. In a study conducted by Nadri et al. (9), in 2012, the C/T ratio was calculated 1.1, and out of 648 patients having blood reservation who underwent various surgical procedures, blood transfusions were performed in 256 patients.

In another study, the amount of blood required and consumed during surgical operations in the central operating room of Imam Reza Hospital (Mashhad) in 2003 was determined by Bameshki and Karimi (10). It was found that among 20 procedures who necessitate blood reservation, about five did not need a transfusion while the minimum,

**Table 1.** Reserved and Injected Packed Cell According to Gender

Gender	No. (%)	Reserved Packed Cell, Mean $\pm$ SD	Injected Packed Cell, Mean $\pm$ SD
Male	105 (66.9)	$1.55 \pm 0.65$	$0.79 \pm 0.29$
Female	52 (33.1)	$1.32 \pm 0.44$	$0.23 \pm 0.05$
P value		0.25	0.006

Abbreviation: SD: standard deviation.

and in other surgeries, the minimum and maximum blood transfusion rate, were in nephrectomy and mastectomy, respectively with C/T ratio of 18 and 2.75, respectively. A mastectomy was the only type of surgery with the C/T ratio in the normal range.

In addition, in a study conducted by Beyzaii et al. (11), in 2011, in 22-Bahman Hospital (Mashhad); the amount of reserved blood (in cross-matched and non-cross matched form) before the elective surgery from 2002 to 2010 was collected and the efficacy of the New York guideline was examined. It was discovered that 1557 blood units were requested for 772 patients, of which 1305 units were requested in cross-matched form, and only 126 units were injected, leading to a C/T ratio of 35 in this study. It means that 91.9% of the non-cross matched blood units and 90.35% of the cross-matched ones were not used, respectively.

Another study conducted in 2008 by Ayantunde et al. (12), in the United States, to predict the amount of blood transfusion in patients undergoing elective esophagectomy due to cancer, revealed that out of 1241 cross-matched blood units, 316 blood units were transfused to 71 patients, consisting about 49% of cases. In this study, the C/T ratio of 5.1 was reported.

In our study, we evaluated the average of reserved packed cell units in two groups of gender and age (under 30 and over 30 years), which were not statistically significant. This suggests that the packed blood units reservation is done regardless of the gender and age of patients, which needs more attention. In addition, according to Tables 1 and 2, the average of injected packed cell was higher in patients less than 30 years of age and in men. These differences were statistically significant. Regarding these results, it appears that more bleeding in men and patients under the age of 30 is expected in elective shoulder surgeries. In addition, it is advisable that the average reservation for these groups should be different from that of women and patients over the age of 30.

#### 4.1. Conclusion

The ratio of the number of cross-matched units to the number of injected blood units in elective shoulder surgeries is within the normal range. The average blood reservation in different age and sex groups should be different, although further multicenter studies and larger samples are necessary.

#### Footnote

**Authors' Contribution:** Study concept and design: Amir Sobhani Eraghi, Mohsen Motalebi; analysis and interpretation of data: Siavash Sarreshtehdari, Mohsen Motalebi; drafting of the manuscript: Amir Sobhani Eraghi, Mohsen Motalebi; critical revision of the manuscript for important intellectual content: Mohsen Motalebi, Siavash Sarreshtehdari; statistical analysis: Mohsen Motalebi.

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