

ORIGINAL ARTICLE

Evaluation of Cross Match to Transfusion Ratio as a Tool of Quality Working In Tertiary Care Transfusion Services

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ABSTRACT

Objective: To evaluate the cross match to transfusion (CT) ratio, transfusion probability (%TP), and transfusion index (Ti) of packed red cells as a tool of quality working in the blood bank.

Study Design: Descriptive observational study

Place and Duration of Study: This study was carried out from all indoor patient departments and blood bank over a 06 month period, from April 2024 to October 2024 at Shifa International Hospital

Materials and Methods: After receiving Institutional Review Board approval, the sample size was calculated using the WHO Calculator 2.0, data was collected through blood bank (HMIS) and department wise CT ratio, TP% and TI were calculated, entered and analysed using SPSS version 26.

Results: 527 packed red cell products (RCC) were prepared after cross-matching, 198 (38%) were transfused, leaving 329(62%) unused with an overall cross CT of 2.6. These results showed that overall CT of blood bank was very close to target CT ratio . Departmental variations were observed, with surgery having a CT ratio of 2.1 indicating significant blood usage while Gynecology/Obstetrics and Liver transplant having 6.6, indicating over-requesting of blood products.

Conclusion: The study found that blood usage is generally acceptable, with a CT ratio of 2.6. However, significant variation was seen across departments: the surgical department had an efficient CT ratio of 2.1, while Gynecology/Obstetrics and Liver Transplant showed higher ratios (6.6), pointing to possible over-ordering and wastage. The results emphasize the need for targeted approaches, including department-specific protocols and regular audits, to optimize blood utilization.

Key Words: *Blood Typing, Cross Matching, Red Cells.*

Introduction

Transfusions of blood is a very useful therapeutic technique in hospitals. Obtaining whole blood from healthy donors, properly screening and making its components is included in blood transfusion services .The first blood transfusion was documented by James Bundell (obstetrician and physician) in December 22, 1818.¹

The most important service of the blood bank is therapeutic rather than diagnostic. "Vein to vein" process incorporates all the stages starting from blood donation to patient transfusion.² A cross match test between a patient and a donor's blood is

essential before any blood transfusion. As per the standard operating procedure, when blood centres receive requests for a specific number of blood units, the required units are reserved for the designated department after the routine cross-match is completed. Once cross-matching is done, the units are unavailable for other patients, ensuring that the blood products are allocated to the intended recipient. Furthermore blood units that are cross-matched several times but not issued may ultimately be discarded when they expire.⁸

A crucial indicator for evaluating the effectiveness of blood use and assisting in the prediction of excessive blood demand is CT ratio. It was introduced by Boral Henry in 1975, since then the C/T ratio has since been widely utilized by various researchers to analyse and evaluate blood transfusion practices. This ratio provides a valuable measure for ensuring that blood products are ordered and utilized in a manner that aligns with clinical needs, helping to improve resource management and reduce unnecessary transfusions.^{3,4}

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By analysing this ratio, healthcare facilities can optimize their blood management practices and improve overall resource allocation.⁵

Over-ordering of blood units is commonly observed among patients that are scheduled for elective surgery. These pre-operative requisitions are often based on assumptions of worst-case scenarios or an overestimation of intra-operative or post-operative blood loss, leading to excessive demands for red cell concentrates (PRBCs).⁴

Utilizing and managing blood products requires a multidisciplinary approach in order to minimize waste and reduce complexity. The amount of blood products collected by transfusion services worldwide reflects the ongoing rise in hospital blood product demand.⁶ Before requesting different blood components, clinicians should carefully consider whether the indications are appropriate. This will help to avoid blood wastage, unnecessary patient exposure to various transfusion-transmitted illnesses, and the formation of antibodies.¹ The Hospital Transfusion Committee (HTC) should conduct a thorough evaluation and audit of the procedures for ordering and using blood. In order to improve blood transfusion services and put policies in place that can improve the blood center's offerings, the gathered data can be used for discussions at HTC meetings, which should involve all relevant clinical and administrative departments.¹

This study was conducted with the objective to evaluate the CT ratio of various departments in a hospital setting to assess the patterns of blood component demand and its utilisation. By evaluating our data, our study can help to reduce unnecessary transfusions and guide necessary improvements in the use of red cell concentrates within the hospital.

Materials and Methods

Descriptive observational study carried out at Shifa International Hospital (blood transfusion services). This study was conducted after obtaining approval from Institutional Review Board (IRB#398-23). The span of study was 06 months from March 2024 till September 2024. This study was done by collecting information through blood bank information system after obtaining informed consent from all in-patient departments.

527 recipients and their donors who needed red cell concentrates from in-patient departments (Surgery,

Medicine, Paeds, Gyne/obs, Surgical ICU, Medical ICU, Paediatric ICU, Neurology, Oncology, Orthopaedic, Liver transplant, Kidney transplant, Gastroenterology, Emergency) were enrolled in the study.

Blood products that were provided by a blood transfusion services other than the blood transfusion services of Shifa International Hospital (SIH) were excluded from the study although according to policy of our blood bank these blood bank can be used on demand.

The sample size was determined with the help of WHO calculator 2.0. Data was entered & analysed with the help of SPSS (Version-26). Categorical variables were depicted as frequencies & percentages. CT ratio, Transfusion probability and transfusion index were calculated by using these formulas: Cross-match to transfusion ratio (C/T ratio) = number of units cross-matched/number of units transfused. A ratio of 2.5 and below is considered indicative of significant blood usage.⁶

Transfusion probability (%T) = number of patients transfused/number of patients cross-matched × 100. A value of 30% and above was considered indicative of significant blood usage.⁶

Transfusion index (TI) = number of units transfused/number of patients cross-matched. A value of 0.5 or more was considered indicative of significant blood utilization.⁶

Results

In six-month study, over all 527 packed red cell products (RCC) were prepared after cross-matching, 198 (38%) were transfused, leaving 329(62%) unused with an overall cross CT of 2.6. These results showed that overall CT of blood bank was very close to target CT. The data retrieved from various units of the hospital with significant and effective blood utilization included the Emergency Unit, with CT ratio of (2.1) . Surgery Unit showed CT ratio of (2.5). Medical Unit yielded CT ratio (2.1). Gastroenterology unit had CT ratio (2). Oncology presented with a CT ratio (1.27). Paediatric ICU had CT ratio of 1.

The data recovered from various units of the hospital with insignificant and ineffective blood consumption comprised the Gynaecology/Obstetrics Department that showed CT ratio of (6.6). The Liver Transplant Department had CT ratio of (4.28). Surgical ICU had CT ratio of (2.8). Medical ICU, gave CT ratio of (4.1).

Neurology Department had CT ratio (5). Nephrology Department generated CT ratio of (2.7). Orthopaedic Department had CT ratio (3.2). Kidney Transplant Department generated CT ratio of (1). Paediatric Department had CT ratio of (4). In order to achieve

more significant or efficient blood product usage by lowering CT ratio, it is very important to evaluate the indication for cross match generated from various department.

Table I: Overall Cross match to transfusion ratio, transfusion probability and transfusion Index

Total number of cross matches	Total no of bag used	Total no of bags unused	Cross match to transfusion ratio	Transfusion probability	Transfusion index
527	198	329	2.66	38	0.38

Table II: Department wise C: T ratio, transfusion probability and transfusion index

Departments	No of Cross Match	No of Bags Issued	No of Bags Cross Matched but not Issued (Wastage)	Cross Match to Transfusion Ratio(C:T Ratio)	Transfusion Probability (TP)	Transfusion Index (TI)
Emergency	24	11	13	2.1	45	0.45
Medicine	30	14	16	2.1	47	0.47
Surgery	113	45	68	2.5	40	0.40
Liver transplant	30	07	23	4.28	23.2	0.23
Medical ICU	33	08	25	4.1	24	0.24
Surgical ICU	14	05	09	2.8	36	0.36
Neurology	10	02	08	5.0	20	0.20
Gastroenterology	39	19	20	2.0	49	0.49
Pediatrics	04	01	03	4.0	25	0.25
Pediatric ICU	03	03	00	1.0	100	1.0
Nephrology	25	09	16	2.7	36	0.36
Oncology	55	43	12	1.27	78	0.78
Gyne/Obs	111	17	94	6.6	15	0.15
Orthopedic	32	10	22	3.2	31	0.31
Kidney transplant	04	04	00	1.0	100	1.0

(n=527)

Cross match to transfusion ratio, Transfusion index, Transfusion probability

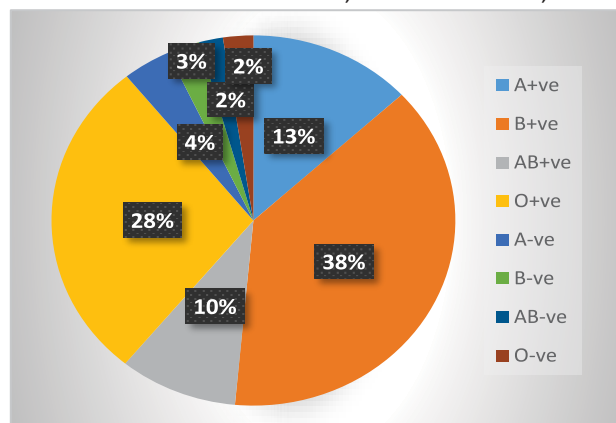


Figure-1: Frequency of blood groups among Donors (n=527)

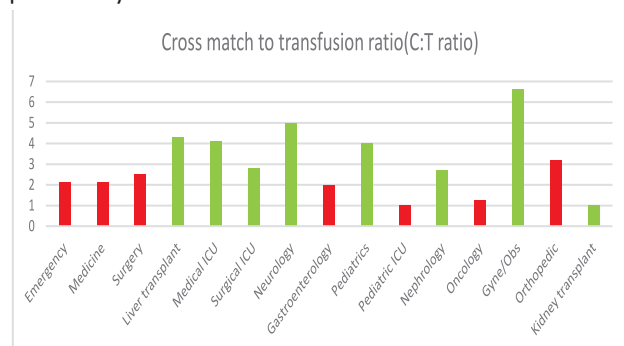


Figure 2: Cross match to transfusion ratio of various departments (n=527)

■ Significant CT ratio <2.6
■ Insignificant CT ratio >2.6

Discussion

Blood transfusions are often based on the subjective expectation of blood loss rather than estimations of evidence based blood loss during certain surgeries. CT ratio below 2.5 is considered indicative of significant blood usage that means at least 30% of the cross-matched blood should have been needed for transfusion.¹ The cross match process for packed red blood cells is a significant test done at our blood center, in addition to blood type and serum screening for the corresponding patient. Testing using the gel card method for patient serum incompatibility with donor cells is done. Cells from the patient undergo the typing process, after which they are examined for ABO and Rd (D) using the appropriate anti-serum.¹

A study done by Yasmeen et al in North India showed overall CT was 1:1, (TP %) was 68% and Transfusion index was 1. These three blood utilization indices indicated that blood products were efficiently utilized in their hospital that was relatable to our study that also showed overall CT ratio (2.6), TP (38%) & TI (0.38).¹⁰

A study conducted in Nepal by Amar et al showed CT ratio of emergency department was 1.72 and TI came out to be 0.88 that was related to our study that showed CT ratio of 2.5 & TI (0.40). These comparable results indicate that the emergency department was effectively utilizing blood products.⁸ A Study done by Akansha sharma et al in Obstetric and Gynaecological department Sikkim India in 2023 presented with C:T ratio (6.6), TP (12%) & TI (0.23) comparable with the our results that showed CT ratio (6.6), TP (15%) and TI (0.15). Most of cross-matched red cell concentrates were not transfused. The high CT ratio in both studies were due to over ordering of blood products driven by over estimation of intra-operable blood loss.⁹ In order to prevent ineffective utilisation of blood products, it is important to review the indications required for transfusion.

A study done in surgical department of a hospital in Ethiopia in 2023 revealed CT ratio (2.26), TP (22.7) & TI (0.5) that was relatable with our study.¹² In a 2022 study conducted in hospital located in South India by Pruthvi Raj et al included all departments who had elective surgeries, the CT ratio was found to be 4.57 that was not comparable with our study results as our study includes all surgical departments that

performed both elective and emergency surgeries.¹³

In our study B+ve came out to be commonest blood type that was cross matched. However, study led by Sehar K et al in Rawalpindi found that blood group O had the highest rate.¹⁴ Another study conducted in 2021 at PIMS, Islamabad showed, blood group B had the greatest rate, then blood groups O, A, and AB amongst donors, which had comparable outcomes with our study.¹⁵ We emphasized on most common and rarest blood group distribution among persons living in north of Pakistan by determining the frequency of blood groups among blood donors. This would help blood bank to maintain their blood product storage according to the demand.

As this is a single-centre study, our findings may not be applicable to other centre that follow different transfusion practices and technical protocols for various surgical procedures.

Another limitation of this study is lack of information regarding indications for blood transfusion requests generated by various departments. This research gap can be addressed in future studies to provide a more thorough analysis in order to prevent over ordering and cross matching.

Conclusion

The study demonstrated that the overall cross-match to transfusion (CT) ratio of 2.6 is close to the targeted standard, indicating acceptable blood utilization practices at the blood bank. However, significant departmental differences were observed. The surgical department's CT ratio of 2.1 reflects efficient blood usage, whereas the higher ratios in Gynaecology/Obstetrics and Liver Transplant (6.6) suggest over-ordering and potential wastage of blood products. These findings underscore the importance of implementing targeted strategies—such as developing department-specific blood ordering protocols and regular audits—to optimize blood usage and improve overall quality management in the blood bank.

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CONFLICT OF INTEREST

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DATA SHARING STATEMENT

The data that support the findings of this study are available from the corresponding author upon request.

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