# Blood transfusion practices at a level one trauma centre: a one-year retrospective review

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## ABSTRACT

**Introduction: Knowledge of blood usage patterns helps to address major issues such as the management of massive transfusion events, minimisation of transfusion risks, as well as in dealing with blood shortages. The aim of our study was to audit blood component usage at a Level I trauma centre blood bank.**

**Methods: A retrospective analysis of the transfusion data of 4,320 patients who were admitted to the General Surgery, Neurosurgery, Orthopaedics and Emergency Medicine departments during a one-year period was conducted.**

**Results: A total of 4,054 patients underwent transfusion. 88 percent, 94 percent, 80 percent and 100 percent of patients admitted to the General Surgery, Orthopaedics, Neurosurgery and Emergency Medicine departments, respectively, received transfusions. Packed cells were the most commonly utilised component, followed by fresh frozen plasma (FFP) and platelets in the ratio 3:2:1. The highest number of FFPs (2,052 units) and platelet concentrates (950 units) were used in the General Surgery and Neurosurgery departments, respectively. The calculated cross-match to transfusion (C:T) ratio did not exceed 2.5 in any of the departments. Among those transfused, the massive blood transfusion rate was low (1.77 percent). The rates of transfusion reactions and non-group-specific transfusions were also low (0.42 percent and 0.07 percent, respectively).**

**Conclusion: The rate of transfusion of trauma patients was high (94 percent). Using the C:T ratio as a marker, optimal blood utilisation was noted in all departments. The methods of reporting transfusion reactions need to be revised. Future studies on the appropriateness of blood use and blood ordering schedules are required.**



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## INTRODUCTION

Blood transfusion is a life-saving strategy that is often utilised in a trauma care set-up. Improvement of tissue hypoxia as well as the restoration of haemoglobin status and blood volume are some of the advantages of transfusion.[1] However, transfusion is a double-edged sword that also has its own demerits.[2] The risk of contracting transfusion-transmitted infections, including the human immunodeficiency virus, hepatitis B and C, as well as emerging infections such as the new variant Cruetzfeldt-Jacob disease in the United Kingdom, does pose a significant threat to patients who require transfusion.[2] Although advanced blood screening techniques like the nucleic acid test have been introduced to improve the quality of blood products, the adverse effects of transfusion continue to be a cause for concern. Hence, it is essential that the usage of blood and blood products be kept to a bare minimum and used only when absolutely necessary. The aim of this study was to review blood and blood product use in our trauma centre, with a view to streamlining resources for the proper therapeutic benefit of trauma patients.

## METHODS

This study was conducted at a Level I trauma care centre, a 200-bed hospital that provides state-of-the art comprehensive trauma care services to acutely injured patients and those requiring specialised services around the clock. The hospital has a wide range of specialists who are assigned to various departments. The emergency department has a triage area that consists of a red, yellow and green area. Patients are initially wheeled into the triage desk where the triage officer evaluates their airway, breathing and circulation (ABCD) and then triages them to either the red (compromised ABCD), yellow (stable ABCD) or green (minor injuries with stable ABCD) areas. Unresponsive patients are treated according to the advanced trauma life support

**Table I. Ratio of the various blood components utilised.**

| Blood component | No. |
|---|---|
| Packed cells | 6,648 |
| FFP | 2,691 |
| Platelets | 1,292 |

FFP: fresh frozen plasma

and advanced cardiac life support protocols. Only the severely injured patients from the red area are admitted to the intensive care unit and subsequently, to the wards for further management of their injuries.

A retrospective chart review of the admitted patients who received blood transfusion from December 2007 to November 2008 was performed. The data analysed from the clinical and blood bank records included the patient demographic profile, clinical diagnosis, the number of patients admitted and transfused in the General Surgery, Orthopaedics, Neurosurgery and Emergency Medicine departments, and details of the transfusion, i.e. the total number of units transfused, cross-matched and the cross-match to transfusion (C:T) ratio. Patients who underwent transfusion in more than one department were classified under the 'mixed' category. The nature of the blood components transfused (packed cells, fresh frozen plasma [FFP] or platelet concentrate) and the transfusion reaction, if any, were also noted. Transfusion reactions were noted by the resident doctors on the blood bank transfusion forms which were issued along with the requested blood. The data was recorded on a predesigned proforma and managed on a Microsoft Excel (Microsoft Corporation, Washington, DC, USA) spreadsheet.

## RESULTS

During the study period, there were 39,572 casualty attendants and 4,320 admissions. Of these admitted patients, 1,207 (28%) were from the General Surgery department, 1,341 (31%) from Orthopaedics, 1,851 (43%) from Neurosurgery and 11 (0.25%) from the Emergency Medicine department. Overall, 4,054 (94%) patients received transfusions; the mean age of these patients was 32.8 years, and 83.3% of them were male. 88% (1,065/1,207) of the General Surgery patients, 94% (1,259/1,341) of the Orthopaedics patients, 80% (1,481/1,851) of the Neurosurgery patients and all 11 patients admitted to the Emergency Medicine department received transfusions. 246 patients who were classified under the mixed category received a total of 329 transfusions.

**Table II. Blood component use in the various departments.**

| Department | No. (%) | | |
|---|---|---|---|
| | Packed cells | FFP | Platelet concentrate |
| Orthopaedics | 1,869 (28.1) | 1,026 (21.0) | 388 (16.5) |
| General Surgery | 2,285 (34.4) | 2,052 (42.0) | 860 (36.5) |
| Neurosurgery | 2,157 (32.4) | 1,564 (32.0) | 950 (40.2) |
| Emergency Medicine | 9 (0.1) | 20 (0.4) | 71 (3.0) |
| Mixed | 329 (4.9) | 221 (4.5) | 89 (3.8) |

FFP: fresh frozen plasma

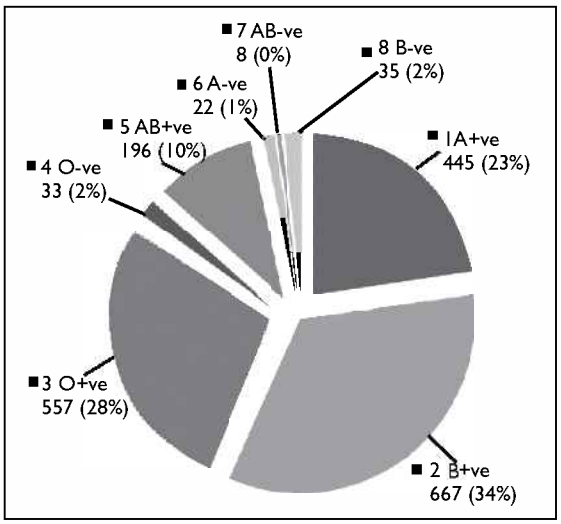


**Fig. 1** The frequency of occurrence of the blood groups.

As our institution is a trauma centre, 90% of the requests were processed on an urgent basis. Overall, packed cells were the most commonly utilised component, followed by FFP and platelet concentrates in the ratio 3:2:1 (Table I). Table II provides a summary of the packed cell, FFP and platelet concentrate use in each department. The number of units that were cross-matched and transfused in each department is tabulated and shown in Tables III, IV and V. The highest number of FFPs (2,052 units) was used in the General Surgery department. The highest use of the platelet concentrate (950 units) was reported in the Neurosurgery department. Single donor apheresis platelets (SDP) were transfused in only seven (0.3%) patients, while all the other patients received random donor platelets.

The C:T ratio for the General Surgery, Orthopaedics and Neurosurgery departments was calculated to be 2.5, 2.4 and 2.1, respectively. Among the patients who received blood transfusion, massive transfusion was noted in 72 (1.77%) patients during the study period. The most common blood group among the patients was

**Table III. Red cell utilisation pattern in the Neurosurgery department.**

| Diagnosis | No. of patients | Total units cross-matched | Total units transfused | C:T ratio |
|---|---|---|---|---|
| Head injury | 1,194 | 4,493 | 1,939 | 2.3 |
| Spinal injury (excluding cervical) | 81 | 282 | 112 | 2.5 |
| Cervical injury | 102 | 331 | 99 | 3.3 |
| CSF rhinorrhoea | 10 | 32 | 6 | 5.3 |
| Brachial plexus injury | 83 | 237 | 1 | 237 |
| Other nerve injuries | 11 | 39 | 0 | - |

Overall C:T ratio is 2.1.
CSF: cerebrospinal fluid; C:T ratio: cross-match to transfusion ratio

**Table IV. Red cell utilisation pattern in the Orthopaedics department.**

| Diagnosis | No. of patients | Total units cross-matched | Total units transfused | C:T ratio |
|---|---|---|---|---|
| Multiple fractures | 354 | 1591 | 609 | 2.6 |
| Fracture upper limb | 68 | 172 | 41 | 4.1 |
| Fracture lower limb | 572 | 1737 | 611 | 2.8 |
| Fracture pelvis and spine | 179 | 777 | 476 | 1.6 |
| Crush injury | 42 | 60 | 43 | 1.3 |
| Traumatic amputation | 44 | 166 | 89 | 1.8 |

Overall C:T ratio is 2.4.
C:T ratio: cross-match to transfusion ratio

**Table V. Red cell utilisation pattern in the General Surgery department.**

| Diagnosis | No. of patients | Total units cross matched | Total units transfused | C:T ratio |
|---|---|---|---|---|
| Polytrauma | 542 | 2,393 | 1,166 | 2.0 |
| Blunt trauma abdomen/chest | 206 | 953 | 450 | 2.1 |
| Penetrating injury | 146 | 612 | 248 | 2.4 |
| Crush injury | 91 | 453 | 273 | 1.6 |
| Traumatic amputation | 31 | 173 | 125 | 1.3 |
| Degloving injury | 35 | 141 | 96 | 1.4 |
| Electric burns | 6 | 18 | 2 | 9 |

Overall C:T ratio is 2.5.

B positive (35%), followed by O positive (28%) (Fig. 1). Group-specific blood transfusion was conducted in 4,051 patients, while non-group-specific blood was transfused in only three (0.07%) patients. The transfusion reactions were noted in 17 (0.42%) patients, and these were of the mild, febrile and allergic types.

## DISCUSSION

Blood transfusion is an essential aspect of trauma services. The primary goal of blood transfusion is to ensure that it is done safely and used appropriately for specific clinical conditions, thereby avoiding the unnecessary use of donor blood in clinical practice. As patients rarely require all the components of whole blood, transfusion of the required component is a meaningful and useful alternative to whole blood transfusion. This allows several patients to benefit from one unit of donated whole blood. Blood is a precious and scarce commodity that is dependent on public donations, and should therefore be used effectively in order to avoid misuse and wastage.

The present study has analysed the usage of blood components in various departments. As our institution functions solely as a trauma centre, the blood transfusion rates were very high (90%). This was primarily due to the critically injured and the highly unstable patients in the red area who were admitted for further management. A prospective study by Beale et al reported a similar transfusion rate of 87% at a Level I trauma centre.[3] Overall, packed cells were the most commonly utilised component, and bleeding due to haemorrhage was the most common indication. FFP and platelet concentrates were transfused at comparatively higher rates in the surgical and neurosurgical departments. The most common indication for the transfusion of these components was derangement of the coagulation profile. Most of the severely injured patients presenting to the emergency department were already coagulopathic, with an incidence rate of 24%–28%.

This coagulopathy aggravates bleeding and has been correlated with increased mortality rates.[4,5] Studies have shown that prompt treatment with these clotting factor components benefits these patients and reduces mortality.[6-8]

Our data showed that random donor platelets were used more often than single donor apheresis platelets in this study. This is due to the ready availability of random donor platelets for emergency patients. Another reason is that the equipment facilities for apheresis were accessible only at our sister institution, and hence, it would require intense motivation on our part to mobilise the donors for apheresis donation. Single donor platelets were administered only to head injury patients in the Neurosurgery department who were refractory to multiple platelet transfusions. However, many donors were noncompliant due to the urgent requirement, the time-consuming process and the tedious procedure.

The C:T ratio is the ratio of the number of units cross-matched to the number of units transfused, thereby providing an estimate of the number of unnecessary cross-matches that are being performed. A C:T ratio greater than 2.5 is indicative of poor blood utilisation.[9] The overall C:T ratio calculated did not exceed 2.5 for any of the departments in our centre. However, a more ideal approach would be to compute the C:T ratio for each procedure or operation separately. This would aid in formulating the blood ordering schedule accurately for each department. The massive transfusion rate recorded during the study period was low (1.77%), and this was comparable to the results observed in other studies.[10,11] Orimolade et al analysed the blood transfusion practice among 85 patients in an orthopaedic and trauma hospital and reported a transfusion reaction rate of 7.1%.[12] Low rates of transfusion reactions (0.42%) were also observed in our trauma centre during the study period. Transfusion reactions are noted by the resident doctors in the blood bank transfusion forms that are issued along with the requested blood. In cases of acute transfusion reaction, the blood bank protocol necessitates the reporting of such cases to the blood bank technician on duty. No cases of acute transfusion reaction were reported in our centre during the study period. One reason for such low rates may be the inability of the severely injured trauma patients to report symptoms. Moreover, the retrospective nature of the data does not warrant an accurate reporting of cases and discrepancies, although small numbers were expected.

Although our centre lacks the equipment for leucodepletion or a single donor apheresis unit, the calculated rates of transfusion reaction were very low. The clinically useful benefit of prestorage leucoreduction, especially in a trauma setting, remains doubtful.[13] Nathens et al performed a randomised controlled trial on leucoreduced vs. standard, non-leucoreduced blood in trauma patients to evaluate whether leucoreduction might improve outcomes and decrease febrile episodes, and found no difference in the mortality rates or febrile episodes among the 268 patients in their study.[14]

The rate of non-group-specific blood transfusion during the study period was 0.07%, which is low for a trauma setting. This was due to an adequate amount of backup provided by our sister institutions, as well as a constant inflow of replacement donors. In addition, voluntary health workers from the blood bank counselled the patients' relatives regarding the replacement of transfused blood. With a high workload, the rate of non-group-specific transfusion in the present scenario appears to be increasing. Allogenic blood is not completely safe from the potential risk of transfusion-transmitted infections, and hence the use of blood salvage modalities needs to be emphasised, especially in a trauma set-up. This has reportedly reduced the rates of emergency allogenic transfusion, especially after abdominal trauma.[15-17]

There are certain limitations to this study. As this was a retrospective data analysis, the possibility of bias during data collection cannot be ruled out. The system of reporting transfusion reactions also needs to be improved by the hospital transfusion committee. Prestorage leucodepletion needs to be implemented, and its effects on trauma patients must be explored. As this study was primarily an audit of the use of blood components, it has provided us with useful information regarding the blood component usage and requirements in each department. This information can form the basis for blood conservation strategies, and plans to analyse the appropriateness of use of the various components in each department. This would assist in structuring and formulating blood ordering schedules, as well as optimising the use of blood components and avoiding wastage of blood.

In conclusion, this study found a high transfusion rate (94%) among trauma patients. Packed cells were the most commonly utilised component of blood, followed by FFP and platelet concentrates in the ratio 3:2:1. The calculated C:T ratio did not exceed 2.5 in any of the departments, thus signifying optimal blood utilisation. Among patients who underwent transfusion, the massive blood transfusion rate was low (1.77%). Although our institution is a trauma care centre, the rates of transfusion reactions and non-group-specific transfusions were observed to be low (0.42% and 0.07%, respectively). Studies on the appropriateness

of blood use and blood ordering schedules need to be conducted in the future.

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