Practice Prevalence of Blood Transfusion Practices in the Tertiary Cardiac Center of Nepal

Amatya AG, Pudasaini A, Gandhi A, Bhusal S, Dhakal S, Yadav RK, Shrestha A, Thapa R, Shrestha S, Shrestha BM, Pandey P, Shakya L, Karkee A, Bajracharya SM, Shrestha BK, Bhandari S

Consultant Anesthesiologist,

Shahid Gangalal National Heart Centre

Bansbari, Kathmandu, Nepal.

Corresponding Author

Ashish Govinda Amatya

Shahid Gangalal National Heart Centre

Bansbari, Kathmandu, Nepal.

E-mail: amatyaashish151@gmail.com

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ABSTRACT

Background

Cardiac surgery frequently results in bleeding, requiring transfusion of blood and blood components. Transfusion is associated with increased postoperative morbidity and mortality. Viscoelastic testing, such as rotational thromboelastometry, may reduce unnecessary transfusion.

Objective

To assess the prevalence of blood transfusion practices, morbidity and mortality of patients admitted during the study period.

Method

This cross-sectional descriptive study was conducted at Shahid Gangalal National Heart Centre, Kathmandu, Nepal. A retrospective analysis was performed on patients aged eighteen years and older who underwent open-heart surgery between June 30, 2022, and June 30, 2023. Data were collected on transfusion prevalence and use of viscoelastic testing. Postoperative outcomes, including re-exploration, acute kidney injury, acute lung injury, duration of intensive care, hospital stay, and in-hospital mortality, were recorded.

Result

Among 897 patients, 403 (44.9%) received blood transfusions. Viscoelastic testing could only be used in 20.3 percent of cases evaluated for transfusion, and transfusion was completely avoided in 18.5 percent following viscoelastic test-guided intervention. Major postoperative complications included acute lung injury (42.2%), acute kidney injury (9.1%), and re-exploration (6.8%). In-hospital mortality was 4.6 percent.

Conclusion

Transfusion was altogether avoided in 18.5% of cases and was instrumental in guiding the appropriate intervention in the remaining 81.4%, who were managed using rotational thromboelastometry , highlighting the role of viscoelastic testing in reducing as well as effectively managing postoperative bleeding in cardiac surgery. However, adhering to the standard goal-directed protocol might in all cases have resulted in even better outcomes.

KEY WORDS

Bleeding, Cardiac surgery, Point of care coagulation

INTRODUCTION

Coagulopathy in cardiac surgery, if it occurs, is presumed to be due to multiple factors. Major bleeding is, in itself, a risk factor for operative mortality. Its detrimental effects are further amplified by red blood cell (RBC) transfusions. This combination major bleeding, transfusion, and anemia is often referred to as the "deadly triad" in cardiac surgery, as described by Ranucci et al.[1] Other factors include protamine heparin mismatch, hyperfibrinolysis, platelet dysfunction, and reduced clotting factor levels.[2-4] Patients who receive blood transfusion are also at increased risk of developing complications as a consequence of the above-mentioned factors.[5]

Massive bleeding, mediastinal re-exploration, and transfusion of allogeneic blood products have been associated with poor clinical outcomes after cardiac surgery.6 Therefore, timely diagnosis and treatment are important to prevent such adverse events. The Point Of Care Coagulation (POC) viscoelastic testing using thromboelastogram (TEG) / rotational thromboelastometry (ROTEM) is being increasingly used as a guide to interventions such as blood products and pharmacologic agents, and drugs during cardiac surgery.[7] Furthermore, it results in a significantly lower re-exploration rate, decreased incidence of postoperative acute kidney injury, and thromboembolic events in these patients.[8]

Unguided transfusions of packed red blood cells (PRBC), fresh frozen plasma (FFP), cryoprecipitate, and platelet concentrates are strongly associated with increased morbidity and mortality in cardiovascular surgery.[4,9,10] This includes transfusion-related acute lung injury (TRALI), transfusion-associated circulatory overload (TACO), ischemic postoperative morbidity, and sepsis. Studies suggest that the implementation of POC viscoelastic tests coupled with algorithm-based management decreases transfusion requirements in cardiac surgery.[11]

METHODS

After obtaining approval from the Institutional Review Committee (IRC) of Shahid Gangalal National Heart Center (SGNHC), we conducted a retrospective analysis of data from open-heart surgeries performed on patients aged 18 years and older between June 30, 2022, and June 30, 2023. No a priori sample size calculation was performed; all consecutive patients who met the inclusion criteria during the study period were included (a census sample). As this was a retrospective analysis of existing clinical records, the Institutional Review Committee approved a waiver of individual written informed consent All adult patients undergoing elective and emergent surgery were included as per the inclusion criteria. Patients were evaluated for transfusion of blood or blood products according to routine clinical practice in our institute. Patients who declined blood transfusion on religious or personal grounds were excluded from the study. This exclusion reflected the clinical care pathway rather than religious affiliation, as transfusion status was a key variable in the outcome analysis, and was applied uniformly to any patient who did not receive the study transfusion protocol, regardless of reason. Traditionally, the decision for blood transfusion was based upon: perioperative hemoglobin levels (preoperative, intraoperative, and postoperative), the amount of blood loss, and the patient's hemodynamic status, with clinical correlation. Red blood cell (RBC) transfusion was administered based on hemoglobin concentration thresholds. Specifically, transfusion was initiated if the hemoglobin concentration dropped below 8 g/dL during cardiopulmonary bypass (CPB) and below 10 g/dL in the post-CPB period and intensive care unit (ICU). Throughout the study period, hemoglobin levels were monitored using point-of-care (POC) blood gas analyzers available in the operating room and ICU.

For non-erythrocyte component transfusion, standard indications were followed according to our institution's protocols as outlined:Platelet transfusion was administered in cases where the platelet count was less than 50 × 10^9/L, irrespective of bleeding, or in the presence of ongoing bleeding after heparin reversal with a platelet count of less than 80 × 10^9/L. Additionally, in bleeding patients with suspected platelet dysfunction, such as those with recent use of antiplatelet drugs or prolonged CPB, platelet transfusion was given regardless of platelet count. FFP transfusion, as per historical practices, was indicated for excessive microvascular bleeding due to coagulopathy, defined by PT > 1.5 times normal, INR > 2.0, or aPTT > 2 times normal. It was also used for coagulation factor deficiencies in patients transfused with > 70 mL/kg of blood, urgent warfarin reversal, unavailable specific factor concentrates, and heparin resistance due to antithrombin III deficiency.[12,13]

The rotational thromboelastometry assay (ROTEM, TEM International GmbH, Munich, Germany) performed included EXTEM, INTEM, HEPTEM, and FIBTEM. As a newer modality in our centre, initially, ROTEM was performed in patients with critical status defined by multiple factors which included complex cardiac surgery (valve-CABG, thoracic aortic surgery, aortic dissections, patients requiring deep hypothermic circulatory arrest), pre-operative thrombocytopenia (platelets < 100,000/mm^3), coagulopathy (PT/INR > 2.5), and CPB time of more than 180 minutes. ROTEM was also performed in the intensive care unit when there was a clinically significant drop in hemoglobin level with increasing demand for multiple inotropes supports (more than or equal to 3), significantly increasing blood loss from chest drains, and radiological collection in the pleural and/or pericardial cavity. Thereafter, the result of the POC viscoelastic test was used to guide blood or blood product transfusion according to the algorithm by Görlinger et al.[14]

Adverse events during hospitalization for the index surgery, such as thoracic re-exploration during the postoperative stay in the hospital, acute (new-onset) renal impairment, transfusion-related acute lung injury (TRALI)—diagnosed based on acute onset (< 6 hrs after blood transfusion) with PaO_2/FiO_2 ratio = Partial pressure of arterial oxygen (PaO_2) / Fraction of inspired oxygen (FiO_2) ratio less than or equal to 300, and in-hospital death during the index hospitalization were noted. Surgical re-exploration was considered when there was the acute onset of rapid bleeding (> 300 mL/h) or persistent bleeding above arbitrary bleeding threshold levels at various times after surgery.[15] The patient's total postoperative period was recorded. AKI was defined according to the Kidney Disease: Improving Global Outcomes (KDIGO) guidelines.[16] There were no major changes to the conduct of CPB and anesthesia practice during the study period.

RESULTS

Out of 897 patients, a total of 403 received blood transfusions, resulting in a prevalence rate of 44.9% for blood or product transfusions. The proportion of patients considered for transfusion based on the conventional method was 46.93%. The rate of ROTEM use was 23.04% among those considered for blood or product transfusion. Transfusion was avoided in 18 patients (18.5%) where ROTEM was used (Fig. 1).

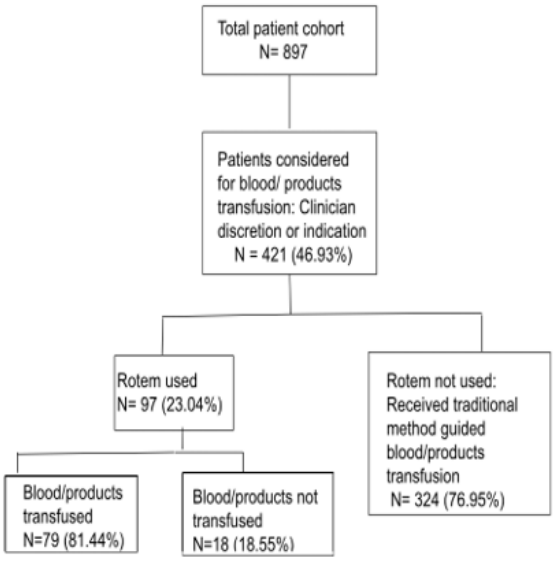

Figure 1. Flow diagram of the study findings on blood transfusion and VET use.

Overall, a total of 61 patients (6.8%) required surgical re-exploration. AKI was observed in 82 patients (9.1%). Acute lung injury, defined as a PaO_2/FiO_2 ratio of less than 300, occurred in 379 patients (42.2%). The average duration of ICU stay was 3.21 days, with a standard deviation of 1.89 days. The average hospital stay was 3.92 days, with a standard deviation of 3.54 days. There were 41 in-hospital deaths, accounting for a mortality rate of 4.6%.

Table 1. Patient's demographics and clinical characteristics.

Patient's variables	Total (N= 897)	
Age yrs (mean ± SD)	48.96 ± 14.40	
Sex (N%)	Male	534 (59.5%)
	Female	363 (40.5%)
ASA PS **(N%)**	1	2 (0.2%)
	2	27 (3.0%)
	3	805 (89.7%)
	4	63 (7.0%)
Type of Surgery (N%)	Elective	886 (98.8%)
	Emergency	11 (1.2%)
Pre-op Hb (gm%) (mean ± SD)		13.53 ± 1.70
DAPT (N%)		228 (25.4%)
GP IIb III a (N%)		10 (1.1%)

N= Numbers,
DAPT= Dual Antiplatelet therapy,
ASA PS= American Society of Anesthesiologist Physical Status,
GP IIb IIIa= glycoprotein IIb/IIIa,
Hb= Hemoglobin

Table 2. Outcome of patients involved in the study

Patient's outcome	Total (N= 897)
Re-exploration (N)	61 (6.8%)
AKI (N)	82 (9.1%)
Acute lung injury (PaO_2/FIO_2 < 300)	379 (42.2%)
Length of ICU stay (days) mean ± SD	3.21 ± 1.89
Length of hospital stay (days) (mean ± SD)	3.92 ± 3.54
Mortality (N)	41 (4.6%)

AKI: Acute kidney injury, PaO_2: partial pressure of oxygen, FIO_2: Fraction of inspired oxy-gen, ICU= Intensive care unit, SD: Standard deviation

Table 3. Overall Transfusion rate of blood and blood products

Blood Components	Total (N=897)
Whole blood	70 (7.8%)
PRBC	362 (40.36%)
FFP	110 (12.26%)
Platelet concentrate	38 (4.24%)
Cryoprecipitate	27 (3.01%)

DISCUSSIONS

The results of our study provide insight into the prevalence of blood transfusion and overall morbidity and mortality associated with blood transfusion in adult cardiovascular surgery at a tertiary cardiac center in Nepal. Eighteen patients were not transfused based on ROTEM evaluation, which showed normal coagulation parameters. This aligns with Meco et al.'s findings, which advocated that routine use of viscoelastic tests in adult cardiac surgery patients reduces the transfusions with blood components.[17,18] Three hundred and seventy nine (379) patients out of 897 patients undergoing surgery developed acute lung injury, highlighting it as one of the most common complications

in our setting. Cardiovascular surgery in itself poses a significant risk for acute lung injury, especially in those cases where the pleura has been opened intraoperatively. Cardiovascular surgery is associated with a significant amount of blood and blood component transfusions. Although transfusion is recognized to affect early and late outcomes, it remains common after cardiac surgery despite improvements in transfusion medicine and system-based protocols.[19] The fact that only 97 out of 897 patients were managed using viscoelastic guidance in our center shows the poor level of utilization of point-of-care (POC) coagulation monitors and the use of novel therapeutic strategies for perioperative hemostasis, such as the use of coagulation factor concentrates. Although adoption increased significantly over the last decade, they are still not widely available in every institution.

Despite advances in transfusion practices, the prevalence of blood transfusions in cardiac surgery remains high, exceeding 50% in high-risk patients. Overall, the prevalence of transfusion in our hospital was 46.13% This underscores the importance of using strategies like Goal-directed bleeding management to optimize, guide, and justify all interventions to reduce unnecessary usage of transfusion and other agents in the process of hemostasis.[15] ROTEM or TEG-guided algorithms for the management of coagulopathic bleeding reduce transfusion requirements, as pointed out by Sarrino et al.[20] ROTEM provides detailed, real-time information on a patient's hemostatic status, enabling clinical teams to identify specific deficiencies of coagulation parameters and stop the bleeding. This precision of ROTEM guided coagulation management enables clinicians to administer the correct blood products to correct these deficiencies promptly. Our findings should be interpreted in the context of a broader literature that consistently supports viscoelastic testing as a means of reducing unnecessary allogeneic transfusion in cardiac surgery. Whiting et al. and Meco et al. both concluded, through systematic review and meta-analysis, that viscoelastic-guided algorithms reduce exposure to red blood cells, plasma, and platelets without compromising safety, findings that are broadly consistent with the reduction in transfusion we observed when ROTEM was used to guide decision-making.[17,18] Similarly, Serraino and Murphy reported that routine viscoelastic testing lowers the rate of surgical re-exploration for bleeding, a complication that affected 6.8% of our cohort. Taken together, these observations reinforce the plausibility that wider ROTEM utilisation in our setting, currently applied in only about a quarter of patients considered for transfusion, could translate into further reductions in transfusion-related morbidity.[4,20] Importantly, expanding point-of-care testing would require concurrent investment in trained personnel and standardised institutional protocols, without which the benefits of viscoelastic-guided management observed here may not be reliably reproduced across other resource-limited cardiac surgery centers.

The high prevalence of acute lung injury (42.2%) in our cohort deserves particular comment. Cardiopulmonary bypass itself triggers a systemic inflammatory response that predisposes the lung to injury, and this effect is compounded when allogeneic blood products are administered, a mechanism well described in the transfusion-related acute lung injury (TRALI) literature.[21] Because nearly half of our patients received a transfusion, it is plausible that unguided or empirically driven transfusion practice contributed to the high rate of pulmonary complications observed. This underscores why reducing unnecessary transfusion through point-of-care coagulation testing is not simply a matter of resource stewardship but may have a direct bearing on postoperative pulmonary outcomes.

The relatively low uptake of ROTEM in our center mirrors experiences reported from other resource-limited settings, where the cost of viscoelastic cartridges, the need for dedicated trained personnel, and the absence of an institution-wide algorithm are recurring barriers to adoption. In our practice, ROTEM was reserved largely for patients already identified as being at higher risk of bleeding, such as those undergoing complex valve-CABG or aortic surgery, rather than being used as a first-line test for all patients being considered for transfusion. This selective use likely explains why the overall proportion of ROTEM-guided cases remained modest despite a clear signal of benefit, avoiding transfusion altogether in over 18% of those in whom it was used, when it was applied.

Based on these findings, we recommend that institutions performing cardiac surgery work toward incorporating point-of-care viscoelastic testing into a standardized, protocol-driven transfusion algorithm rather than reserving it for selected high-risk cases alone. Expanding access to ROTEM or equivalent viscoelastic assays, together with structured training of anesthesiology, perfusion, and nursing staff in interpreting and acting on these results, would likely improve consistency of transfusion decisions and reduce inter-clinician variability. We also recommend prospective, multicenter studies within Nepal and similar resource-limited settings to confirm whether wider viscoelastic-guided practice translates into measurable reductions in re-exploration, acute lung injury, and mortality, and to identify the specific administrative and logistical barriers that need to be addressed to make such testing routinely available.

It was conducted at a single tertiary cardiac center, which may limit the generalizability of the findings. As a retrospective analysis, the study relied on existing clinical records, and incomplete documentation may have affected data accuracy. ROTEM was selectively used in patients perceived to be at higher risk, introducing potential selection bias and limiting the ability to evaluate outcomes if applied universally. Transfusion decisions were partially based on clinician judgment, and the absence of a universally applied transfusion protocol may have introduced practice

variability. Additionally, only in-hospital outcomes were assessed, and long-term postoperative morbidity and mortality were not evaluated.

CONCLUSION

Our blood and blood product transfusions are largely based on conventional methods under the clinician's discretion. Although newer modalities like ROTEM are used only in critical cases in our center, there has still been a decline in overall transfusion rates, highlighting their positive impact. Despite the increased evidence of better patient outcomes with point-of-care coagulation management, the use of ROTEM as a newer technology is still not widely adopted in a larger fraction of patients, which can be attributed to administrative, educational, and logistical difficulties, among others. The use of ROTEM in only about one-fourth of the cases considered for blood transfusion demonstrates limited adoption despite its potential benefits.

Further training and resource allocation will improve the implementation and use of VHA, such as ROTEM. This will optimize transfusion protocols, reducing associated complications and improving patient outcomes in cardiac surgery.

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