Section: Cardio Vascular and Thoracic Surgery

Original Research Article

BLOOD CONSERVATION STRATEGIES IN CARDIAC SURGERY: A RETROSPECTIVE STUDY IN A GOVERNMENT HOSPITAL SETTING

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Abstract

Background: Bleeding in cardiac surgery is managed with antifibrinolytics and blood transfusions. However, transfusions pose risks and may reduce long-term survival. Blood conservation strategies, including restrictive transfusion thresholds and haemostatic techniques, aim to optimise outcomes. This study compared haemodynamic stability and ventilation duration between transfused and non-transfused post-cardiac surgery patients with haemoglobin levels >8 g/dL. **Materials and Methods:** This retrospective cross-sectional study included 39 patients who underwent cardiac surgery at TNGMSSH, Chennai, between June 2023 and October 2023. Patients were divided into two groups based on whether they received blood transfusion (n=26) or were managed with blood conservation (n=13). Data on age, cardiopulmonary bypass (CPB) duration, blood pressure (BP), 24-hour intercostal drain (ICD) output, transfused blood units, and ventilation time were collected. **Result:** The mean ages of the transfusion group (39.7±11 years) and blood conservation group (41.5±14 years) were comparable (p=0.67). CPB duration was significantly longer in the transfusion group (129 min [102–138]) than in the conservation group (62.5 min [0–83], p<0.001). Postoperative systolic BP (110 vs. 110 mmHg, p=0.418) and diastolic BP (60 vs. 60 mmHg, p=0.268) were comparable. The 24-hour ICD drain output was not significantly different (250 vs. 225 mL, p=0.294). As expected, the number of blood transfusion units was significantly higher in the transfusion group (1 [1–2] vs. 0, p<0.001). Ventilation time was similar (390 min vs. 372 min, p=0.353). **Conclusion:** There was no significant difference in haemodynamic parameters and ventilation duration between transfused and non-transfused post-cardiac surgery patients with Hb levels >8 g/dL. Blood conservation can be effectively implemented through judicious transfusion practices without compromising patient stability, thereby reducing the reliance on limited blood bank resources.

INTRODUCTION

Bleeding and coagulopathy are significant challenges that can be managed with anti-fibrinolytic agents, allogeneic red cell transfusion, and timely correction of coagulation abnormalities. Studies report that 40–90% of cardiac surgery patients receive perioperative blood transfusions.[1] Blood transfusion components, mainly packed red blood cells(PRBC), are vital resources whose availability is limited carries several risks including infections and rare complications like transfusion-related acute lung injury.[2] Moreover, a meta-analysis of more than thirty-nine studies has shown that peri-operative transfusion is associated with a significant decrease in long-term survival of patients undergoing cardiac surgery.[3] In recent years, various international guidelines have evolved keeping these data in mind which has led to the use of blood conservation strategies in routine practice.[4,5]

Blood conservation refers to techniques used to minimise blood loss and reduce the need for allogeneic blood transfusions in surgical settings.[6] Blood conservation can be done through the use of antifibrinolytics like tranexamic acid intra-operatively, use of minimally invasive procedures, meticulous surgical haemostatic techniques and intraoperative cell saver.[7] In the perioperative period, using restrictive transfusion thresholds, maintaining haemostasis, and early mobilisation can help to improve patient outcomes and preserve limited blood resources.[8]

In cardiac surgery, the choice between liberal and restrictive transfusion strategies is critical.9 Restrictive strategies use lower thresholds (e.g., 7-8 g/dL) and focus on minimising transfusions to reduce

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complications while ensuring adequate tissue oxygenation.10 However, clinical context matters; patients with active bleeding, severe ischaemia, or haemodynamic instability require a strong-handed approach where transfusions cannot be restricted. Current guidelines generally recommend restrictive transfusion strategies for stable cardiac surgery patients.[11]

Aim

This study aimed to analyse the haemodynamic stability and ventilation duration between post-cardiac surgery patients who received transfusions and those who did not (blood conservation) with haemoglobin levels > 8 g/dl.

MATERIALS AND METHODS

This retrospective cross-sectional study included 39 patients in the Department of Cardiovascular and Thoracic Surgery, TNGMSSH, Chennai, from June 2023 to October 2023. This study was approved by the Institutional Ethics Committee before initiation, and informed consent was obtained from all patients.

Inclusion criteria

All the patients who underwent cardiac surgery were included in this study.

Exclusion criteria

Patients who underwent surgery as an emergency procedure with incomplete data points and haemoglobin levels < 8gm/dl were excluded.

Methods

The sample size for the study was calculated using an online OpenEpi sample size calculator.12 The sample size was calculated with a 5% significance level and 80% power. Based on the expected transfusion rates in cardiac surgeries in a previous study, the estimated sample size based on the primary objective of this study was 39.

Patients were divided into two groups based on whether they had received a blood transfusion (26 patients) or not (13 patients). A consecutive sampling method was used for data collection. The following parameters were collected from the patients: age, cardiopulmonary bypass duration, postoperative systolic blood pressure, postoperative diastolic blood pressure, 24-hour postoperative day, ICD drain output, number of blood units transfused, and ventilation time.

Statistical analysis

Data are presented as Median with Interquartile Range (IQR) or mean ± standard deviation (SD) based on the normality of the variables. The comparison was performed using an independent sample t-test or Mann-Whitney U test as the test of significance, as applicable. Significance was defined as $p < 0.05$, using a two-tailed test. Data analysis was performed using IBM SPSS version 21.0.

RESULTS

The mean age of the patients in the blood transfusion group (39.7±11 years) was similar to that in the blood conservation group (41.5±14 years), with no statistically significant difference (p=0.67). Cardiopulmonary bypass duration was significantly longer in the blood transfusion group (129 min [102–138]) than in the blood conservation group (62.5 minutes [0–83]) (p<0.001). Postoperative systolic blood pressure was comparable between the blood transfusion (110 mmHg [105–135 mmHg]) and blood conservation (110 mmHg [100–123 mmHg]) groups (p=0.418). Similarly, the postoperative diastolic BP showed no significant difference (60 mmHg [55–62] vs. 60 mmHg [60–65], p=0.268).

Table 1: Comparison of peri-operative parameters in cardiac surgery patients with blood transfusion and blood conservation

Parameter	Blood transfusion group (n=26)	Blood conservation group (n=13)	P value
Age (years)	39.7 ± 11	41.5 ± 14	0.67
CPB duration (min)	129 (102-138)	62.5 (0-83)	<0.001
Post-operative systolic BP (mmHg)	110 (105-135)	110 (100-123)	0.418
Post-operative diastolic BP (mmHg)	60 (55-62)	60 (60-65)	0.268
24-hour 0-POD ICD drain (ml)	250 (150-250)	225 (200-312)	0.294
Number of blood units transfused	1 (1-2)	0	<0.001
Ventilation time (min)	390 (330-422)	372 (337-393)	0.353

CPB, Cardiopulmonary bypass; BP, blood pressure; POD, Postoperative day; ICD, intercostal drainage

The 24-hour postoperative ICD drain volume did not differ significantly between the blood transfusion group (250 mL [150–250 mL]) and the blood conservation group (225 mL [200–312]) (p=0.294). The number of transfused blood units was significantly higher in the blood transfusion group (1 unit [1–2]) than in the blood conservation group (p<0.001). The ventilation time was similar between both groups, with the blood transfusion group requiring 390 minutes [330–422 minutes] and the blood conservation group requiring 372 minutes [337–393 minutes], showing no significant difference (p=0.353) [Table 1].

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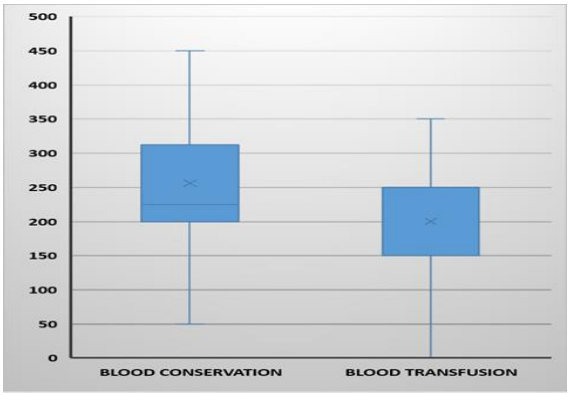

Figure 1: Postoperative day 1 drain output

Box whisker plot comparing the intercostal drain volume on the first postoperative day (ml) between the blood conservation and blood transfusion groups (p=0.294) [Figure 1].

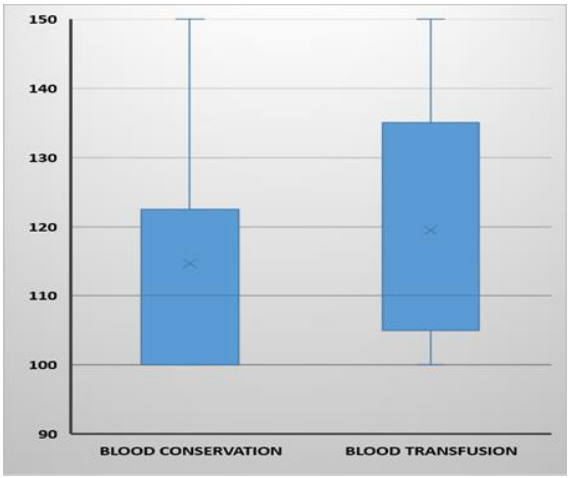

Figure 2: Postoperative systolic blood pressure

Box whisker plot comparing postoperative systolic blood pressure (mmHg) between the blood conservation and blood transfusion groups (p=0.418) [Figure 2].

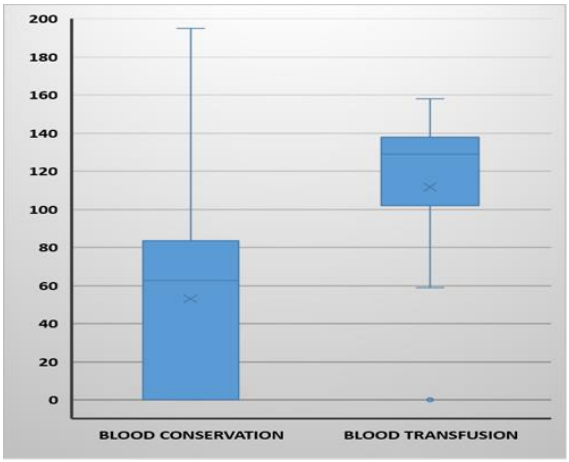

Figure 3: Cardiopulmonary bypass duration

Box whisker plot comparing cardiopulmonary bypass duration (min) between the blood conservation and blood transfusion groups (p<0.001) [Figure 3].

DISCUSSION

In our institute, the routine practice is to administer 500 mg of tranexamic acid to any cardiac surgery patient before incision and another 500 mg of tranexamic acid during the wean-off period from the cardiopulmonary bypass machine.[13] Other strong motivating factors to transfuse would be any clinical signs of haemodynamic instability, where we would take all measures, including multiple transfusions until the patient is stable. We monitored serial ABG in the intra-and postoperative periods for haemoglobin levels and other acid-base changes and managed them accordingly. Some factors, such as comorbidities, also influence our decision for transfusion. In this study, we classified patients according to those who received blood and blood products as routine practice in our government set-up after surgery and those who did not, even if the blood haemoglobin level was > 8gm/dl.

In our dataset, age (years) was distributed normally, whereas the postoperative systolic BP, postoperative diastolic BP, 24-hour 0-POD ICD drain (ml), and no. of blood units transfused, and the ventilation time (min) were of non-normal distribution. We found that the distribution of age (years, p=0.67), postoperative systolic BP (mmHg, p=0.418), postoperative diastolic BP (mmHg, p=0.268), 24-hour 0-POD ICD drain (ml, p=0.294), and ventilation time (min, p=0.353) was similar between the groups (Table 1). This implies that there is no significant difference between any of these parameters between the patients in the blood transfusion and blood conservation groups. When we closely examine the data, we can also observe that the 24-hour postoperative drain in the blood conservation group was higher than that in the transfusion group, although the difference was not statistically significant.

In general, haemoglobin concentration below 7-8 g/dL can be used as transfusion thresholds in haemodynamically stable patients, which will reduce transfusion rates without compromising outcomes. In our study, prolonged bypass time was also a common trigger for blood transfusions. However, our results showed that irrespective of the bypass duration, the outcomes were similar in the blood transfused and conserved groups.

In resource-limited settings, such as ours, we must insist on and implement blood-sparing surgical techniques and train surgical teams in meticulous haemostasis techniques. Unnecessary transfusions must be avoided based on outdated liberal thresholds. By adopting resource-efficient practices, even in resource-constrained settings, safe and effective blood conservation during cardiac surgery can be ensured.

Limitations: We studied only the immediate postoperative care of the patient until discharge. We

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did not study the long-term follow-up of the patient which could have added more insights into our conclusions.

CONCLUSION

There was no significant difference in haemodynamic parameters and ventilation duration between post-cardiac surgery patients with haemoglobin > 8gm/dl who received transfusions and those who were blood conserved. Blood conservation can be effectively achieved through simple, yet strategic, intraoperative, and postoperative decisions without the need for complex algorithms or rigid protocols. Strategic intraoperative and postoperative decisions can significantly enhance blood conservation efforts and alleviate the burden on the blood bank resources.

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