ORIGINAL ARTICLE

PRIMING THE CARDIOPULMONARY BYPASS CIRCUIT WITH FRESH FROZEN PLASMA REDUCES BLEEDING IN COMPLEX CARDIAC SURGERY

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Background: Every year, about 400 000 open-heart procedures are conducted utilising the cardiopulmonary bypass (CPB) technique. In the majority of disciplines associated with on-pump cardiac surgery, numerous studies have been undertaken to investigate factors such as coagulation cascades, surgical stress response, blood transfusion demand, inflammatory indicators, and hypoxia. The purpose of this study was to examine if fresh frozen plasma (FFP) could potentially use to prime the cardiopulmonary bypass (CPB) circuit and minimize bleeding in complicated cardiac surgery. This was a comparative cross-sectional study, conducted from May 10, 2022 to May 10, 2023, this study was carried out in department of Cardiac Surgery, PIC, Lahore. **Methods:** A sample size of 40 subjects in each group and a total sample size of 80 patients were enrolled. A random allocation method was implemented for classifying the patients into the control or case (FFP) groups. **Results:** The average age of participants in Group-A was 47.96±5.14 years, whereas in Group-B, it was 50.12±6.09 years. Group A comprised 25 males (62.5%) and 15 females (37.5%), whereas Group B comprised 23 males (57.5%) and 17 females (42.5%). In our data there was significant difference found in packed cells infusions in prime 70.38±33.97 and 96.15±24.15 with *p*-value 0.05 and FFP and platelets transfusions with *p*-value 0.03 and 0.02 respectively. However, no difference was found in packed cells infusions and FFP infusions intra-operatively between both groups with *p*-values 0.61 and 0.35 respectively. **Conclusion:** The results of this study showed that, the inclusion of FFP in pump priming for cardiac surgery reduces packed cells and platelets requirements.

Keywords: Fresh Frozen Plasma; CPB; Packed cells; Prime

Citation: Hassan A, Riaz W, Gul S, Sher D, Mumtaz MH, Rao F, *at al*. Priming the cardiopulmonary bypass circuit with fresh frozen plasma reduces bleeding in complex cardiac surgery. J Ayub Med Coll Abbottabad 2025;37(1):74–7.

DOI: 10.55519/JAMC-01-14274

INTRODUCTION

Every year, about 400 000 open-heart procedures are conducted utilising the cardiopulmonary bypass (CPB) technique.[1] In the majority of disciplines associated with on-pump cardiac surgery, numerous studies have been undertaken to investigate factors such as coagulation cascades, surgical stress response, blood transfusion demand, inflammatory indicators, and hypoxia.[2–7] Severe bleeding has been recognized as the major cause of complications and death in on-pump cardiac surgery. A prospective research found that patients undergoing surgery using a CPB device received more blood, albumin, and fresh plasma during the procedure, as well as more platelets afterward, than other patients.[8] Complications associated with the use of this machine have also been attributed to mechanical damage resulting from the surgeon's direct manipulation of blood vessels, dilutional coagulopathy induced by the supplementation of the CPB system with crystalloid and colloidal solutions, consumptive coagulopathy, and fibrinolysis. [9] According to the findings of multiple studies, the use of various solutions to prepare the on-pump cardiac system is the leading cause of coagulopathy and haemorrhage both prior to and following the procedure. Under certain circumstances, these solutions may cause individuals to exhibit a 35% reduction in fibrinolytic factor proteins and coagulation. Conversely, activation of the fibrinolysis and coagulation pathways reduces coagulation factors to below 1%.[10] The optimal method for CPB priming continues to be a complex issue in cardiac surgery. Prior to this change, the electrolyte content and osmolarity of the preparation solutions were comparable to those of intravascular fluids. As a result, patients' oxygenation, carbon dioxide ejection, and physiological homeostasis would have been preserved upon mixing the solutions with the blood. Blood dilution during cardiac surgery has been investigated since the mid-twentieth century, and substantial study has been conducted to identify an appropriate method for preparing CPB system. The most significant consequence of blood dilution in this system is the detrimental effects on the coagulation system caused by a significant decrease in the concentration of coagulation components.[11] At present, there are several methods utilized to decrease the volume of solution required for the setup of the CPB system, including the removal of certain circuit segments such the artery filters. However, this can endanger the health of the patients.[10] Because dilutional coagulopathy is impacted by the kind of solution used to form the CPB system, the current study hypothesizes that using FFP during the CPB system preparation stage will reduce dilutional coagulopathy during the bypass.[11] As a result, the purpose of this study was to assess the efficacy of FFP for priming of the CPB circuit to minimise bleeding in difficult cardiac surgery.

MATERIAL AND METHODS

Between 10 May 2022 and 10 May 2023, a comparative cross-sectional study was conducted at the Department of Cardiac Surgery, Punjab Institute of Cardiology (PIC), Lahore. This study included 80 patients, selected according to specific inclusion criteria: individuals aged 18–85 years, with no prior history of liver disease, clotting disorders, or cardiac surgeries, and comprising both male and female participants. Patients undergoing emergency surgery, those who died prior to the procedure, or those who had received blood transfusions within the last 24 hours were excluded. After obtaining informed written consent, eligible patients were randomly assigned to either the case group (receiving Fresh Frozen Plasma, FFP) or the control group. The control group was administered 10–20 cc/kg hydroxyethyl starch (130–0.4) with 100–200 ml of Ringer's crystalloid solution, while the case group received 10–20 cc/kg FFP alongside 200–300 ml of Ringer's solution. During cardiopulmonary bypass, age-adjusted mean arterial pressure (MAP) was maintained between 40–70 mm Hg, and hematocrit (Hct) levels were kept between 25–30%. For statistical analysis, the data were entered into SPSS software. Quantitative variables were assessed using mean and standard deviation, while qualitative data were analyzed through frequencies and percentages. The chi-square test was applied to compare quantitative variables, and independent sample t-tests were used for evaluating qualitative data, with a p-value of less than 0.05 considered statistically significant.

RESULTS

The average age in Group-A was 47.96±5.14 while in Group-B was 50.12±6.09. In Group A there were 25 (62.5%) males and in Group B there were 23 (57.5%) males. In this research, the mean height, and weight was 165.0 ± 6.27, and 70.24±1.12 in Group-A, while 167.2±4.85 and 77.30±4.22 in Group B, respectively. The average of CPB time in Group-A was 79.19±1.20 and 78.18±2.09 in Group-B. Similarly, the average x-clamp time in Group A was 47.33±2.14 and 51.66±3.16 in Group B. (Table 1)

In our data there was significant difference found in packed cells infusions in prime 70.38±33.97 and 96.15±24.15 with *p*-value 0.05 and FFP and platelets transfusions with *p*-value 0.03 and 0.02 respectively. However, no difference was found in packed cells infusions and FFP infusions intra-operatively between both groups with *p*-values 0.61 and 0.35 respectively. (Table 2)

Table-1: Descriptive Statistics of Demographics and Intra-opertaive variables

		FFP (Group A)	Control (Group B)
Age		47.96±5.14	50.12±6.09
Gender	**Male**	25 (62.5%)	23 (57.5%)
	Female	15 (37.5%)	17 (42.5%)
Height (cm)		165.0±6.27	167.2±4.85
Weight (kg)		70.24±1.12	77.30±4.22
CPB time		79.19±1.20	78.18±2.09
X-Clamp time		47.33±2.14	51.66±3.16

Table-2: Post-operative outcomes in both Groups.

	FFP (Group A)	Control (Group B)	*p*-value
Packed cells in Prime (cc)	70.38±33.97	96.15±24.15	0.05
Packed cells infusions intra-operative (cc)	87.19±65.21	98.40±63.63	0.61
Fresh Frozen Plasma infusion intra-operative	11.85±3.19	7.01±3.12	0.35
Packed cells infusions at ICU (cc)	98.12±44.13	105.69±31.06	0.65
Fresh Frozen Plasma infusions at ICU (cc)	51±37.38	71.05±35.18	0.03
Platelets (cc)	3.07±1.41	7.60±0.67	0.02

DISCUSSION

The purpose of this study was to determine the effect of utilizing FFP for CPB priming on thromboelastometric parameters and blood product transfusion in the operating room and intensive care unit. FFP is a relatively new material utilized for priming the CPB circuit. Nevertheless, researchers came into issues with prophylactic priming with FFP and CPB safety in a few randomised clinical trials.[12] In terms of postoperative blood loss and transfusion of allogeneic blood products, Dieu et al. observed that priming the CPB circuit with crystalloids is equivalent to priming with FFP.[13]

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According to the findings of Abbaszadeh Ghanavati *et al*., the proportion of children and infants who received blood products such as FFP was greater in the test group than in the control group, based on the quantity used in the CPB machine preparation phase. However, the proportion of packed red blood cells infused was identical in both groups.[8]

According to Balajudia's research, incorporating freshly frozen plasma into the CPB machine's preparation phase would decrease postoperative haemorrhage. Thus, blood product administration would become less necessary.[14] Kachoueian *et al*. (2020) examined the impacts of FFP during the CPB preparation phase in a separate investigation. Adding FFP during the preparation phase was discovered to decrease hypofibrinogenemia.[5] Hypofibrinogenemia is the most significant dilutional coagulopathy that occurs after cardiopulmonary bypass surgery, according to multiple studies. The incidence of this complication can be reduced in 24 hours with the use of FFP. An examination of the current study and other research in this field reveals that using FFP as a colloidal solution during the preparation phase of a CPB machine in children preserves thrombus resistance and improves coagulation factors. As a result, they require fewer blood products, particularly platelets, throughout the operation. The extent of blood product administration did not differ substantially between the two groups, however, 24 hours after ICU admission. The effect of FFP administration on inflammatory factors, patient temperature in intensive care units, and the dosage of blood products given to patients with cardiac diseases should all be investigated further in future research, given the study's executive limitations in terms of data collection required for a more thorough analysis.

CONCLUSION

The results of this study showed that, the inclusion of FFP in pump priming for cardiac surgery reduces packed cells and platelets requirements.

Recommendations: Further research with a large number of participants is required to obtain conclusive results in order to determine which dose is better for patients.

Conflict of interest: None
Funding: None
Ethical approval: Not Applicable

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Submitted: July 3, 2024	Revised: November 11, 2027	Accepted: December 23, 2024

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