ORIGINAL RESEARCH PAPER
Volume - 13 | Issue - 03 | March - 2024 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

COMPARISON BETWEEN ALBUMIN AND CRYSTALLOID AS PRIMING SOLUTION IN CARDIOPULMONARY BYPASS PAEDIATRIC CYANOTIC HEART DISEASE PATIENTS ADMITTED FOR SURGERY.

Anaesthesiology

Rimjim Chakma* Senior Resident, DM-PDT, Department of Cardiac Anesthesiology, Nilratan Sircar Medical College, Kolkata, West Bengal, India. *Corresponding Author

Sampa Dutta Gupta Professor & Head, Department of Cardiac Anesthesiology, Nilratan Sircar Medical College, Kolkata, West Bengal, India.

Avijit Karmaker Senior Resident, DM-PDT, Department of Cardiac Anesthesiology, Nilratan Sircar Medical College, Kolkata, West Bengal, India.

Siddhi Banerjee Senior Resident, DM-PDT, Department of Cardiac Anesthesiology, Nilratan Sircar Medical College, Kolkata, West Bengal, India.

Saptaki Majumder Senior Resident, DM -PDT, Department of Cardiac Anesthesiology, Nilratan Sircar Medical College, Kolkata, West Bengal, India.

ABSTRACT

Effects on platelet number and function are a central concern in choice of priming fluid on congenital cardiac patients. Aim to compare between albumin and crystalloid with FFP as priming solution in cardiopulmonary bypass for paediatric congenital cyanotic heart disease patients (CHD). A total of 66 CHD paediatric patients were divided into two groups to received either albumin or crystalloid solution +FFP as priming fluid. The primary endpoint was assessment of haemoglobin, platelet count and urine output immediately before induction and after cessation of CPB. Secondary endpoints considered blood loss and consumption of blood products in post operative 24 hrs period. Statistically significant difference revealed between the two groups for post CBP Hb,(Gr.albumin10.55±1.32:Gr.cr+FFP 9.91± 1.07; p0.033) post CBP platelet (Gr. Albumin 115151.52±29487.41: Gr.Cr +FFP 139393±23040.64; p 0.000), post CBP urine(Gr.Albumin 869.94±282.67:Gr.Cr+FFP 1051.67±235.48;p 0.006), left drain collection,(Gr albumin 25.30±4.49: Gr Cr 43.03± 7.88;p0.05) right drain collection Gr Albumin 15.15±3.36:Gr Cr 38.33± 7.01; p 0.005), PRBC transfused (Gr Albumin 50.91±13.77:Gr Cr+FFP 114.27±19.05 ;p0.009), and platelet transfusion(Gr Albumin 75.8%:Gr Cr+FFP 24.2%; p 0.003) . Albumin in the prime may attenuate the extravasations of fluid out of the vascular space, Moreover systemic inflammatory response associated trans-capillary leakage of plasma proteins is possible to prevent by increase serum albumin levels. To conclude albumin as priming solution revealed better than crystalloid +FFP in cardiopulmonary bypass surgery in paediatric age group.

KEYWORDS

Albumin, Crystalloid+ FFP, CHD. CPB

INTRODUCTION:

Children of cyanotic congenital heart diseases (CHD) are associated with secondary polycythemia, they are prone to cerebral thromboses, bruising, and excessive haemorrhage after corrective surgery . As CPB is often attended by potentially harmful physiologic derangements such as platelet activation, thrombosis, systemic inflammatory response syndrome, oedema, organ dysfunction, thrombocytopenia, and nonsurgical haemorrhage. Effects on platelet number and function are a central concern in choice of priming fluid on congenital cardiac patients**.** Fresh whole blood, collected 48 hours (h) before surgery, has an adequate concentration of coagulation factors, including fibrinogen, can provide adequate volume replacement and has been considered ideal for pump priming in children.[1] Fresh-collected blood products are not readily available at most institutions therefore, most convenient alternative source of fibrinogen is fresh frozen plasma (FFP), the use of FFP in pump priming in infants weighing <8-10 kg was previously shown to increase fibrinogen levels after CPB.[2.] While neonates and small infants are most vulnerable to post-bypass coagulation derangement, therefore, it has paramount importance to find out the effectiveness of human albumin and crystalloid solution in cyanotic heart disease patients admitted for the correction of congenital heart disease. Russell J A, and co-workers [3] found that albumin prime better preserves platelet counts than crystalloid. and also maintain colloid oncotic pressure on-bypass. Barbu M, and co-workers [4] established that, intra-operative, postoperative, and total bleeding volumes is not significantly different while using dextran- or crystalloid-based prime in adult cardiac surgery: Weiler P, and co-workers [5] studied on coronary artery bypass surgery and found that, the use of crystalloid priming is safe in adults. These results warrant further studies to examine fluid received, including 5% albumin, in bypass surgical children via randomized-controlled trials.

Therefore, aim is to compare between albumin and crystalloid +FFP as priming solution in cardiopulmonary bypass for paediatric congenital heart disease patients admitted for surgery.

OBJECTIVES:

a) To measure the changes of haemoglobin %, platelets and urine output from pre induction to immediate post bypass period in two groups respectively

b) To estimate blood loss and consumption of blood products in 24 hrs post operative period in both the groups and to compare.

Methodology:

After obtaining approval from the IEC and informed consent from parents this descriptive observational study conducted in a super speciality hospital with paediatric age group between 2-12 years . Emergency surgery, pre-op heart failure, end stage kidney disease, patient with coagulopathy, and patients on oral anticoagulants were excluded from this study.

Sample size calculated as difference per SD (DSD) = (M1-M2)/ σ, (where mean of group 1= M1; Mean of group 2= M2; Common standard deviation (SD) =σ). Absolute difference of M1 and M2 is used for calculation. As per previously done pilot study the mean (±s.d.) pallet drop (x 10^9L) of the patients with albumin and crystalloid were 53.7 ±6.3 and 58.8±8.3 respectively. Here M1=53.7, M2=58.8, Common SD=7.3. Thus the effect size = 0.69. From the Cohen Power tables for effect size it has been found that there was a need of 33 patients in each group with 80% power at 5% level of significance. The number of patients in each group was in the ratio 1:1.

Thus the required sample size for the study was 66 (N).All patients were divided into two groups of 33 in each to received either albumin (n=33) or crystalloid with FFP solution (n=33) as priming fluid. The primary endpoint was assessment of haemoglobin, platelet count and urine output immediately before induction and 30 minutes after cessation of CPB. Secondary endpoints included blood loss (ml) and consumption of blood products in post operative period. Postoperative bleeding was assessed by chest drain output during the first 24 hours of postoperative period. Age(yrs),sex(m/F),BMI (kg / mt^2), type of congenital heart disease, type of priming solution, blood picture, adverse effects if any, urine output were taken as study variable. Haemoglobin, platelets count and urine output were estimated and analysed. Various data obtained from blood gas analyser, chest tube drainage system collection and urine output were estimated and documented.

All the data were entered into Microsoft excel spreadsheet and was analysed using SPSS 24.0 and Graph Pad prism version 5. The continuous variables were presented with mean and standard deviation. The categorical variables were presented with frequency and percentage.. Statistical analysis was done using two sample t-tests, Chi-square test. p-value< 0.05 was considered for statistically significant.

RESULTS:

Table 1. Distribution Of Patients In Two Groups (gr Albumin; Gr. Crystalloid+FFP) Based On Type Of Congenital Anomaly Posted For Corrective Surgery Corrective Surgery

Parameter			Group		Total	P-value
			Albumin	Crystalloid +FFP		
Diagnosis	VSD +PS	N	7	17	24	146
		%	21.2%	51.5%	36.4%	
	Coarctation +tricuspid atresia	N	1	0	1	
		%	3.0%	0.0%	1.5%	
	Pulmonary atresia	N	3	0	3	
		%	9.1%	0.0%	4.5%	
	TAPVC	N	6	2	8	
		%	18.2%	6.1%	12.1%	
	TGA	N	7	6	13	
		%	21.2%	18.2%	19.7%	
	Hypopastic left heart	N	0	2	2	
		%	0.0%	6.1%	3.0%	
	TOF	N	9	6	15	
		%	27.3%	18.2%	22.7%	
	Total	N	33	33	66	
		%	100.0%	100.0%	100.0%	

Table 1 shows, distribution of patients in two groups (Gr albumin; Gr. Crystalloid +FFP) based on type of congenital anomaly posted for corrective surgery corrective surgery done. No statistically significant difference exists between the groups.

Table 2. Distribution of age, sex, preoperative Hb%, platelet count, urine output, post CPB Hb gm%, Post CPB Platelet, Post CBP urine output, left drain Collection, right drain collection, post CPB PRBC and FFP transfused, between the two groups (Gr Albumin; Gr. Crystalloid +FFP).

Parameter			Group		Total	P-value
			Albumin	Crystalloid +FFP		
Diagnosis	VSD +PS	N	7	17	24	146
		%	21.2%	51.5%	36.4%	
	Coarctation +tricuspid tresia	N	1	0	1	
		%	3.0%	0.0%	1.5%	
	Pulmonary atresia	N	3	0	3	
		%	9.1%	0.0%	4.5%	
	TAPVC	N	6	2	8	
		%	18.2%	6.1%	12.1%	
	TGA	N	7	6	13	
		%	21.2%	18.2%	19.7%	
	Hypopastic left heart	N	0	2	2	
		%	0.0%	6.1%	3.0%	
	TOF	N	9	6	15	
		%	27.3%	18.2%	22.7%	
Total		N	33	33	66	
		%	100.0%	100.0%	100.0%	

Table 3 shows that , there is no statistically significant difference exists between the two groups pre-operatively in terms of Hb% platelets and urine output.

Statistically significant difference exists between the two groups for post CBP Hb, post CBP platelet, post CBP urine, left drain collection, right drain collection, PRBC transfused, and platelet transfusion.

DISCUSSION:

Colloid solutions, due to their volume expansion capacity, maintain intravascular volume better than crystalloids. Albumin has been commonly added as a constituent of the cardio pulmonary circuit as a priming fluid during heart surgery which can coat the fluid pathway surface, thereby diminishing contact between the blood and non biological materials that could otherwise result in platelet activation and consumption coagulopathy. When a crystalloid is used then hemodilution occurs during CPB, with a decrease in oncotic pressure, resulting in a shift of fluid over the capillary bed to the interstitial compartments which may contribute to interstitial oedema therefore addition of FFP to increase fibrinogen levels as well as to increase colloidal oncotic pressure after CPB. Results before induction and before going to bypass revealed that, preoperative Hb between two groups were comparable. (Albumin 13.96 ± 2.18 ; Crystalloid +FFP ;12.48 ± 1.87; p-0.004); preoperative platelets was also comparable .(Albumin 180181.82 ± 60279.27 ; Crystalloid+FFP; 182424.24 ± 24402.91. p - .844). and urine output (Gr.. Albumin 13.91±9.28 : Gr Cr 17.39± 10.43;p 0.157).. Immediately after cessation of CPB statistically significant difference revealed between the two groups as post CBP Hb,(Gr.albumin10.55±1.32:Gr.cr+FFP 9.91± 1.07; p0.033) post CBP platelet Gr. Albumin 115151.52±29487.41: Gr.Cr +FFP 139393±23040.64; p 0.000), post CBP urine(Gr.Albumin 869.94±282.67:Gr.Cr+FFP 1051.67±235.48;p 0.006), left drain collection,(Gr albumin 25.30±4.49: Gr Cr 43.03± 7.88;p0.05) right drain collection (Gr Albumin 15.15±3.36:Gr Cr 38.33± 7.01; p 0.005), Result of secondary end point shows that, PRBC transfused (Gr Albumin 50.91±13.77:Gr Cr+FFP 114.27±19.05 ;p0.009), and platelet transfusion(Gr Albumin 75.8%:Gr Cr+FFP 24.2%; p 0.003) , which also shows statistically significant difference which is very much similar to the results of Manno CS and coworkers [1] and McCall MM and coworkers[2].

Difference of opinion thus persist over the superiority of these two prime solutions. Russell J A, et al. found that albumin prime better preserves platelet counts than crystalloid. Albumin also favourably influences colloid oncotic pressure on-bypass positive fluid balance, postoperative weight gain, and colloid usage.[3] Barbu M,et al revealed that Intra-operative, postoperative, and total bleeding volumes is not significantly different in the two groups.[4] Weiler P,et al found that the use of crystalloid priming is safe in coronary artery bypass grafting surgery in adults. However, there might be a greater need for crystalloid fluids during surgery.[3]

Glycocalyx regulates vascular permeability and inflammation and coagulation on the endothelial surface. Sphingosine-1-phosphate (S1P) in plasma regulates the synthesis and degradation of glycocalyx Furthermore, S1P modulates continuity of tight junctions, another factor related to vascular permeability. Serum albumin is essential for the bioavailability of S1P. as not only triggers the release of S1P from red blood cells, the main reservoir of S1P in blood, but also carries it to S1P-receptors on endothelial cells. Activation of S1P-receptor 1 on endothelial cells inhibits matrix metalloproteinase 9 and matrix metalloproteinase 13 dependent shedding of syndecan-1 ectodomain, an important component of glycocalyx undoubtedly beneficial for cardiopulmonary bypass surgery. Thus, colloids mainly albumin may be more suitable for restrictive fluid therapy in cardiac surgery. Albumin solutions do not impair coagulation and also consider safe with regard to kidney function also. Increased transfusion rate and its inherent risks, and potential benefits of an albumin prime may be diminished when used with ultra filtration during CPB and modified ultrafiltration (MUF) after CPB.

CONCLUSION:

Albumin as priming fluid is preferred over crystalloid + FFP combination priming in cardiopulmonary bypass for corrective surgeries of paediatric cyanotic heart diseases in terms of maintenance of Hb%, platelet count, urine output, and also less requirements of post CPB platelet, PRBC and FFP shows less. Moreover post CPB drain collection also was significantly less on albumin priming recipient children in this study.

REFERENCES:

1. Manno CS, Hedberg KW, Kim HC, Bunin GR, Nicolson S, Jobes D, et al. Comparison of the hemostatic effects of fresh whole blood, stored whole blood, and components after open heart surgery in children. *Blood.* 1991;77:930–936.
2. McCall MM, Blackwell MM, Smyre JT, Sistino JJ, Acsell JR, Dorman BH, et al. Fresh frozen plasma in the pediatric pump prime: a prospective, randomized trial. *Ann Thorac Surg.* 2004;77:983–987.
3. Russell JA, Navickis RJ, Wilkes MM. Albumin versus crystalloid for pump priming in cardiac surgery: meta-analysis of controlled trials. Journal of cardiothoracic and vascular anesthesia. 2004 Aug 1;18(4):429-37.
4. Barbu M, Kolsrud O, Ricksten SE, Dellgren G, Zetterberg H, Blennow K,et al. Dextran-versus crystalloid-based prime in cardiac surgery: a prospective randomized pilot study. The Annals of Thoracic Surgery.2020 Nov;110(5):1541-1547.

5. Weiler P, Hamiko M, Mellert F, Roell W, Roell M, Welz C, Duerr GD. Impact of crystalloid or albumin priming of the heart–lung machine on in hospital outcome after coronary artery bypass surgery. The Thoracic and Cardiovascular Surgeon. 2019 Sep;67(06):475-83.