

Blood Component Therapy in Pediatric Intensive Care Unit in Tertiary Care Center: An Audit

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ABSTRACT

Introduction: The skill of dealing with the fluids thus offering the hemodynamic aid is crucial while treating critically ill. With alarm regarding rate of inappropriate transfusion being carried out especially as against the rainbow of adverse effects of transfusion. Aim of the study was to investigate the current transfusion practice in the critically ill children and see whether the transfusions were in accordance to the Indian Academy of Pediatrics [IAP] recommendations.

Material and methods: Prospective observational exploratory study in Pediatric intensive care unit [PICU] of a Tertiary care center. The study enrolled 122 patients admitted in PICU with age 29 days to 12 years who received blood component therapy from the initiation of the study in 2012 over a period of 12 months. The qualitative data was represented in the form of frequency and percentage tables with the help of SPSS version 21.

Results: We found in our study that a total of 161 transfusions, 74.53% patients received packed cells, 14.28% received platelets and 11.18% patients received fresh frozen plasma. Twenty five percent packed cell transfusions were not in accordance to IAP recommendations and 44.5% were transfused with pre-transfusion hemoglobin more than 7 gm%. Among the packed cell transfusions received mean pretransfusion hemoglobin was found to be 7.45+/- 1.58. The platelets and fresh frozen plasma transfusions that were in accordance to IAP recommendations were 73.91% and 83.33% respectively.

Conclusion: Red blood cells are most frequently transfused blood component in PICU. Inappropriate transfusions of blood components are plaguing the optimal utility of this valuable resource. Thus regular audit of blood component therapy to review the optimum utilization of blood components becomes necessary.

Keywords: Blood component therapy, packed cell transfusion, Platelet transfusion, Fresh frozen plasma transfusion, Pediatric Intensive Care Unit.

current transfusion practices. Our aim was to investigate the current transfusion practice in PICU at tertiary care center in the critically ill patients and see whether the transfusions were appropriate as per the Indian Academy of Pediatrics [IAP] recommendations as standard in our study.^{7,8} We use these recommendations as these are locally applicable in this region.

MATERIAL AND METHODS

The prospective observational exploratory study was initiated after obtaining permission from the Institutional Ethics Committee. Waiver of consent was also obtained as ours being an observational study. There was no direct contact between the investigators and the participants or their guardians. The study was carried out in 2012 over a period of 12 months in the PICU of a Tertiary care center in Mumbai, with seven beds, seven ventilators; which admits only medically-critically ill children. The admissions in PICU during our study period were 510. The study enrolled the patients admitted in PICU of age 29 days to 12 years who received blood component therapy during 12 months period from the initiation of the study. We collected patients' demographic data [Inpatient number, age, and sex], diagnosis, duration of PICU stay, details of blood component therapy used [type, indication] the reason for transfusion was entered in the case record form. The recommendations that followed were IAP recommendations as these are locally based guidelines for blood component therapy. The transfusions being given to the cases was assessed whether they were in accordance to the recommendations. Being an exploratory study, no formal sample size calculations were carried out. We considered only packed cells, platelets and fresh frozen plasma [FFP] in our study as these are commonly transfused. As all patients admitted who received blood component therapy in the PICU during the study period of twelve months were enrolled, the effect of seasonal variations were minimized, though could not be nullified. Data analysis was done with the help of PSPP version 3. Qualitative data was represented in the form of frequency and percentage tables. Association among various study parameters, including frequency of blood components transfused, mean and median

INTRODUCTION

Blood component therapy is a life-saving treatment to provide hemodynamic stability in critically ill children in intensive care settings. About half of Pediatric intensive care unit [PICU] admissions are transfused with blood.¹ Many studies have shown inappropriate utilisation of blood components.²⁻⁵ The alarm regarding rate of inappropriate transfusion being carried out especially as against the spectrum of adverse effects of transfusion. In a randomised trial involving stable critically ill children and adult, 7 g per decilitre was taken as haemoglobin threshold thus reducing the transfusion requirements with no rise in adverse results.⁶ Despite this restrictive strategies are not commonly applied and liberal transfusion continue. Hence a need for audit of

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of pre transfusion hemoglobin of packed cells transfusion, percentage of packed cells transfusions below seven g%, recorded most common indications of each blood component transfusion and the percentage of transfusions of each blood component not in accordance to IAP recommendations were also analysed.

STATISTICAL ANALYSIS

The qualitative data was represented in the form of frequency and percentage tables with the help of SPSS version 21.

RESULTS

During the study period of 12 months in the year 2012, there were 510 admissions in PICU include only medically critically ill children between 28 days and 12 years. 82 patients required mechanical ventilation, 152 being respiratory cases and 48 being hematological cases.

We found total of 122 patients received 161 blood components as transfusion, 20 patients were transfused twice and 10 patients were transfused thrice. 120 (74.53%) patients received packed cell transfusion, 23 (14.28%) received platelet transfusion and 18(11.28%) patients received FFP [Table-1]. Packed cells were most commonly transfused, followed by platelets and FFP.

As seen in Table-2, of all the blood component transfusions 24.84% were not in accordance to IAP recommendations. The packed cell transfusions that were not in accordance to IAP recommendations were 25.84 %. Among the red blood cell transfusions received mean pretransfusion hemoglobin was found to be 7.45+/- 1.58 and mean pretransfusion hematocrit was 27.68 +/- 5.99. The median hemoglobin transfusion threshold in our study is 7.60g/dl (Interquartile range 4.15, 9.14g/dl). 44.5% of Red blood cell transfusions were with pretransfusion hemoglobin more than 7 g/dl. The indications not in accordance to IAP recommendations are anemia critically ill hemoglobin more than seven g/dl and, anemia with hemoglobin more than seven g/dl requiring >35% supplemental oxygen on Continuous Positive Airway Pressure [CPAP] and anemia with hemoglobin more than seven g/dl requiring Mean Alveolar Pressure [MAP] > 6 cm of water by invasive mechanical ventilation.

Name of the Blood Component	Frequency	Percent
Fresh frozen plasma	18	11.18%
Red cell cells	120	74.53%
Platelets	23	14.28%
Total	161	100.00%

Table-1: Distribution of study group as per frequency of blood component therapy

Blood component	In accordance to IAP recommendations
Red blood cells (n= 120)	89 (74.16)
Platelets (n= 23)	17(73.91)
Fresh frozen Plasma (n= 18)	15(83.33)
Total	121(75.15)

Figures in parentheses indicate percentages*

Table-2: Distribution as per accordance with IAP recommendations of each blood component.

Platelet Transfusions: All the 23 platelets transfusions were in the age group above four months of which 26.09 % transfusions were not in accordance to IAP recommendations. The transfusions that were not in accordance to IAP recommendations were done in cases of dengue and idiopathic thrombocytopenia without bleeding.

FFP Transfusion: Fresh frozen plasma transfused 18 patients received, 83.33% were in accordance to IAP guidelines. The indications not in accordance to IAP guidelines include altered Ryle tube aspirate and replacement in view of ascitic tapping with pretransfusion International Normalised Ratio [INR] < 1.5.

Table-3 gives frequency of transfusions of blood components in accordance to IAP guidelines of which most commonly adhered recommendations among packed cell transfusions above four months of age were anemia with congestive heart failure (30.4%) and anemia critically ill less than seven g/dl (25 %) and less than four months was packed cell volume < 36% requiring > 35% supplemental oxygen. Among platelet transfusions the most adherence were seen with bleeding with platelet counts less than 50000/dl (44 %) and platelet count less than 20000/dl and marrow failure with hemorrhagic risk factors (19%). Bleeding in a case of DIC (50%) was most adherent indication amongst FFP transfusions.

DISCUSSION

The problem of excessive transfusion of blood components do exists also that a significant number of transfusions are not in accordance to IAP recommendations.^{7,8} Though IAP recommendations are not the standard of guidelines but are locally applicable thus have been used as a benchmark for our study.

We found in our study that red cell transfusions were most frequently transfused followed by platelets and fresh frozen plasma. This is similar to findings in studies by Slonim et al, Bahadur et al and by other studies.⁹⁻¹²

Overall about one-fourth of all blood component therapy were not in accordance to IAP recommendations, of which 25.84% of red blood cell transfusions were not adherent to the recommendations. Wade et al showed 10.86% of overall transfusions were inappropriate, of these 11.1% red cell transfusions were inappropriate.¹³ Bahadur et al found 59.65 % of appropriate usage of blood components.¹⁰ Thus the inappropriate transfusions still continue. Thereby necessity to improve transfusion practices by standardising the indications of blood transfusion with more appropriate randomised clinical trials in critically ill children.

The mean pretransfusion hemoglobin for red blood cell transfusion was found to be 7.45+/- 1.58. Few studies show mean haemoglobin level as ranging from 7.7 to 10.5 g/dl.¹¹⁻¹⁶ Red blood cell transfusions with pretransfusion hemoglobin more than seven g/dl were 44.5%. Marvulo NL et al 58.1% varied from 7 to 10 g/dL, findings are similar to our study.¹⁵ Valentine SL et al showed 71% of patients were transfused at a hemoglobin threshold more than 7 g/dL.¹⁷ Demaret et al found that 96.4% of the first transfusion events aligned to main recommendation of the Transfusion Requirements in Pediatric Intensive Care Unit (TRIPICU) study, whereas in our study it was applied only in 55.4% of events.¹¹ The

Sl. No.	Indications	Frequency
A	Indications for RBC transfusion in children (<4 month)	
1.	Packed cell volume [PCV] < 36% requiring 35% supplemental oxygen MAP > 6-8 cm of water by CPAP or mechanical ventilation	10 1
2.	PCV < 31% and Requiring > 35% supplemental oxygen or MAP > 6 cm of water by CPAP or IMV	1
3.	PCV < 40% and Heart rate > 180 per minute or respiratory rate > 80 per min, persisting for > 24 hrs	3
4.	Hypovolemic shock associated acute blood loss	4
B	Indications for RBC transfusion in children (>4 months)	
1.	In deficiency anemia, with features of overt congestive heart failure	33
2.	Critically ill children < 7 gm %	29
3.	Significant preoperative anemia with cardio-respiratory disease < 8 gm/dl	1
4.	Malignancies with Hb < 8 gm/dl	6
5.	Aplastic anemia with Hb < 6-7 gm/dl	1
C	Indications for Platelet transfusion in children (> 4 months)	
1.	Platelet counts less than 50000/dl and bleeding.	11
2.	Platelet counts less than 50000/dl and an invasive procedures	0
3.	Less than 20000/dl and marrow failure with hemorrhagic risk factors.	5
4.	Less than 10000/dl and marrow failure without risk factors	1
D	Indications for transfusion of Fresh Frozen Plasma	
1.	Severe clotting factor deficiency and bleeding	3
2.	Severe clotting factor deficiency and planned invasive procedure	2
3.	DIC with bleeding	10

Table-3: Frequency of transfusions of blood components in accordance to IAP guidelines.

restrictive strategy with threshold for packed cells to be transfused is taken as 7 g/dl hemoglobin which has shown to decrease transfusion requirements without increasing adverse outcomes also reduce transfusion exposure in recipients.^{6,18-22} Hence the need to adopt restrictive transfusion policy need in our PICU. Further it is necessary to follow up the study down the lane to not only to see whether the recommendations will be followed but also assess the hemoglobin trigger for red cell transfusion and adoption of restrictive strategy red blood cell transfusion.

It has been seen in our study among the inappropriate red cell transfusion were given considering the oxygen requirement whether on CPAP or mechanical ventilation. The recommendations of IAP do not consider the oxygen requirement of the children above four months of age. This points out that should the transfusion only be based on hemoglobin level or whether the oxygen requirement should also be considered.

Platelet transfusions: In our study 26.09% of platelets transfusions were non-adherent to IAP recommendations. A study in India by Wade et al showed 7.14% of inappropriate transfusions, a South African study showed 34% and a Malaysian study found 18.5% also other studies too show inappropriate platelet transfusions.^{5,13,22,23} Our study did show a lower adherence to IAP recommendations. Thus inappropriate platelet transfusions do exist which calls for our attention.

Inappropriate platelet transfusions mainly were in patients with dengue with thrombocytopenia with no clinical bleeding and idiopathic thrombocytopenia without bleeding as a prophylaxis to prevent bleeding. With no clinical bleeding and platelet count above 10,000 does not require platelet transfusion even as prophylaxis for bleeding.²⁴ Hence we

could have averted these prophylactic platelet transfusions. Here we think a need for with more studies with regard to prophylactic versus therapeutic platelet transfusion.

Fresh Frozen Plasma transfusions: Our study reveals that 16.67% Fresh frozen plasma transfusions were not in accordance to IAP recommendations. In study by Wade et al 43.90% of FFP were given inappropriately, a significantly higher inappropriate FFP transfusions when compared to our study.¹³ Karam O et al found 34% and Moiz B et al study showed 21.3% of transfusions were used without any supportive evidence, results are consistent with our study that inappropriate transfusions of FFP are a problem.²⁵⁻²⁹

Inappropriate FFP transfusions were altered Ryle tube aspirate though INR was given as prophylaxis and replacement in view of ascitic tapping in both cases INR was less than 1.5. Wade et al also recorded inappropriately transfused were patients admitted in intensive units with coffee brown gastric aspirate and a child with hematemesis without deranged prothrombin time and INR.¹³ In fact clinical advantage plasma transfusion is minimal with INR value 1.7 and below.⁴ In keeping with risk posed by plasma transfusion and with no substantial evidence for prophylactic plasma transfusion as shown by 80 randomised control trials there should be a systematic approach to increase the understanding among clinicians about the adverse effects of transfusions and proper dissemination of information about the role of prophylactic plasma transfusion.^{30,31}

The limitations of our study is that it's an observational study with a small sample size involving single tertiary care centre hence the findings cannot be generalised. We did not study all the blood components like cryoprecipitate, intravenous immunoglobulin etc. The sample contains a heterogeneous group which included unstable critically ill children as well.

The decision to transfuse were made on subjective basis, customised criteria often included mechanical ventilation or oxygen requirement, a matter that can finally be resolved by further randomised clinical studies. The study only reviewed at 'Excessive transfusion' and did not study the aspect of patients who must have received the transfusion but did not.

CONCLUSION

Inappropriate transfusions of blood components are plaguing the optimal utility of this valuable resource. Thus a standard guidelines, restrictive transfusion policy and regular audit of blood component therapy to review the optimum utilization of blood components becomes necessary. The appropriate transfusions can be improved by increasing awareness among treating Pediatric intensivist and also frequent interactions with transfusion centre will lead to better utilisation of limited resources.

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Appendix 1: IAP Recommendations for Blood Component Therapy^{7,8}:-

Indications for RBC transfusion in children (<4 months)

1. Packed cell volume <36% requiring
 - a. >35% supplemental oxygen
 - b. Mean airway pressure > 6-8 cm of water by CPAP or IMV
2. PCV < 31% and
 - a. Requiring >35% supplemental oxygen or MAP >6 cm of water by CPAP or IMV
 - b. >9 episodes of apnea and bradycardia in 12 hrs. or 2 episodes in 24 hrs., requiring bag and mask ventilation while on methyl xanthine
3. PCV <40% and
 - a. Heart rate > 180 per minute or respiratory rate >80 per min, persisting for >24 hrs.
 - b. Weight gain <10 gm per day for 4 days while on 100 cal/kg/day
 - c. Undergoing surgery
4. PCV <21% and
 - a. Asymptomatic with reticulocytosis <2%
5. Hypovolemic shock associated acute blood loss

Indications for RBC transfusion in children (>4 months)

1. In deficiency anemia, with features of overt congestive heart failure
2. Critically ill children <7 gm %
3. Postoperative Hb <8 gm/dl with symptoms and signs of anemia
4. Significant preoperative anemia with cardio-respiratory disease <8 gm/dl
5. Malignancies <8 gm/dl
6. Aplastic anemia <6-7 gm/dl
7. Thalessemia major <9gm/dl

Indications for Platelet transfusion in (<4 months)

1. Platelets and < 1 lakh/dl and bleeding
2. Platelets <50000/dl and an invasive procedure
3. Platelets <20000/dl clinically stable
4. Platelets <1 lakh and clinically unstable
5. Platelets any count, but with platelet dysfunction plus bleeding or an invasive procedure.

Indications for Platelet transfusion in children (> 4 months)

1. Platelet counts less than 50000/dl and bleeding.
2. Platelet counts less than 50000/dl and an invasive procedures
3. Less than 20000/dl and marrow failure with hemorrhagic risk factors.
4. Less than 10000/dl and marrow failure without risk factors
5. Platelets any count, but with platelet dysfunction plus bleeding or an invasive procedure.

Indications for transfusion of Fresh Frozen Plasma (FFP)

1. Severe clotting factor deficiency and bleeding
2. Severe clotting factor deficiency and planned invasive procedure
3. DIC with bleeding
4. Reversal of warfarin effects emergently
5. Anticoagulant protein (antithrombin III, protein and protein S) replacement
6. Thrombotic thrombocytopenic purpura for exchange transfusion.