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BLOOD COMPONENTS UTILIZATION, ASSESSMENT OF APPROPRIATENESS OF PRACTICES AND ERRORS DURING BLOOD TRANSFUSIONS IN NEONATES.

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ABSTRACT **Background:** Blood components is important part of treatment in N.I.CU. in treating anemia , prematurity , sepsis ,coagulopathies , exchange transfusion ,Intracranial hemorrhage and other conditions. **Aims & Objectives:** To evaluate utilization of blood components assessment of appropriateness of practices and errors during transfusions in Neonatal Intensive Care unit. **Material & Methods:** A prospective observational study, approved by ethical committee, included 40 Neonates ,who received blood components ,satisfying inclusion criteria. Quantity and type of blood components transfused and its correlation with gestational age , weight and Apgar score was recorded. Monitoring of transfusion guidelines and types of errors committed during study was also recorded . Data were statistically analyzed. **Results :** . Of 164 blood transfusions in forty neonates (20 preterm & 20 term),117 transfusions were required in first seven days of life , majority (87) was Fresh frozen plasma. Prematurity and low birth weight formed majority in receiving transfusions. Range of appropriateness of transfusions was (63-96%.) in following Guidelines and Indications for transfusion. Errors were found in taking consent documentation and sample labeling. **Conclusion :** Blood component therapy is vital and integrated practice in the management of neonates. Guidelines for transfusion should be meticulously followed to minimize errors.

KEYWORDS : Transfusion, P.R.B.C. , F.F.P, Neonate ,N.I.C.U.

INTRODUCTION:

Blood and blood component transfusion play a critical role in the management of neonates in the Neonatal Intensive Care Unit (NICU), addressing conditions like anemia, thrombocytopenia, and coagulopathies[1]. Anemia in neonates can result from prematurity, frequent phlebotomy, sepsis, or hemolytic diseases, necessitating red blood cell (RBC) transfusion[2]. Platelet transfusions are frequently administered to neonates with thrombocytopenia to prevent or manage bleeding, while plasma transfusions are used for coagulopathies or volume expansion[3]. Gestational age, birth weight, and APGAR scores are critical indicators of neonatal health and significantly influence the requirement for transfusion. Transfusion-associated circulatory overload (TACO) and transfusion-related acute lung injury (TRALI) are particularly concerning due to their life-threatening nature[4]. Despite advancements in transfusion safety, gaps in blood utilization practices, storage, and monitoring remain challenges in many Indian healthcare settings[5]. Studies have reported an incidence of transfusion-related adverse events in neonates ranging from 0.5% to 3%,with higher rates observed in premature infants[6].

MATERIAL AND METHODS:

This is a prospective observational study conducted for 15 months during 2024-25 in Neonatal Intensive care unit of a tertiary care hospital with approval from institutional ethical committee. Neonates up to 28 days ,who received blood components and their parents , who consented for participation were included in the study. Confidentiality of neonates included in the study was strictly maintained. Neonates with major congenital anomalies and who took discharge against advice were excluded from study. Total 40 neonates were included in study. Proforma was designed to include details about sex, gestational age ,weight ,Apgar score, diagnosis, indications , frequency and type of blood component transfused were noted .Sample labeling ,mode of consent taken ,monitoring of blood transfusion ,verification of patient ,blood group ,blood product and types and adherence to guidelines for component transfusion were recorded. These Guidelines or protocols were taken from Textbook of Cloherty and Stark Manual of Neonatal Care edition 2024[7] & All India Institute of Medical Sciences protocol in Neonatology [8,9,10].

Sample Size:

It was calculated considering the proportion of need of blood transfusion in neonates out of total admission is 12.3% from last 6 months data record, Dept of Pediatrics, tertiary care hospital.

$$n = \frac{Z^2 \times pq}{L^2}$$

Where p =25.8% , L= 5% , Z = 1.96 . Answer of equation ~ 164

The study population was stratified based on key variables such as gestational age (e.g., preterm vs. Term), birth weight categories, and clinical conditions. Comparative analysis was performed using: Chi-square test for categorical variables (e.g., indications for transfusion across gestational age groups). Pearson or spearman correlation was used to evaluate the relationship between transfusion requirements and clinical parameters such as birth weight, gestational age, and APGAR scores.

Data from total 40 neonates and 164 blood components transfusions in them were subjected to statistical analysis. Data were coded and entered into a statistical software package Microsoft Excel 2021 for analysis. p value of <0.05 was taken as statistically significant.

RESULT :

Out of 40 neonates 23 were male and 17 were female. One neonate was extremely premature < 28 weeks , 19 premature (28-37 week) and 20 (37-42 weeks) were term. Considering weight 3 (7.5%) extremely low birth weight , 9 very low birth weight (22.5%) 16 were low birth weight (40%) 12 ,normal (30%). 80% inborn and 20% were admitted from outside. Majority of mother (65%) were young < 25 years. 5% of neonates had Apgar score of <3 and 30 % had Apgar score between 4-7. Out of 40 neonates ,maximum had been admitted because of respiratory distress 57.5% (23) followed by prematurity 45% (18%). Maximum number of neonates 30 (75%) received first transfusion in first 7 days of life. An additional 15% were in the second week, 7.5% in the third week, and only 2.5% in the fourth week.

Table 1: Correlation Of Chronological Age Of Neonates With Blood Component Transfusion

Age of Neonate at Which components were Given	No. of Packed Red Blood cell Transfusion (P.R.B.C.)	No. of Platelet Transfusion	No. of Fresh Frozen Plasma Transfusion (F.F.P)	No. of Whole Blood Transfusion	Total No. of Transfusions	Chi Square p Value
0 - 7 Days	14	12	87	4	117	<0.0001
8 - 14 Days	9	5	11	0	25	
15 - 21 Days	8	5	1	0	14	
22 - 28 Days	4	0	0	0	4	
29 - 35 Days	2	1	0	0	3	
36 - 42 Days	1	0	0	0	1	
Total	38	23	99	4	164	

Of the 164 transfusions, (Table-1),the majority occurred in the first week (117), out of which PRBCs (14), platelets (12), FFP (87) and Whole blood transfusions (4) were transfused. This result is statistically significant, (p-value < 0.05) indicating that, the distribution of blood component transfusions varies significantly with the age of the neonates at the time of transfusion. FFP was the most frequently transfused component, accounting for 60.4% of all transfusion episodes. PRBCs constituted 23.2%, platelets 14%, and whole blood only 2.4%. As regards frequency of blood component transfusions, maximum neonates 15(37.5%)received (PRBC) ,6 (15%) FFP,4 (10%) PC,2(5%) whole blood, whereas, 6 (15%) received combination of RCC, PC and FFP , 5(12.5%) RCC and FFP transfusion .

Most frequently utilized blood component was PRBC (37.5%) of the cases. Followed by FFP in (15%) and Platelet Concentrate (10%). Only (5%) received whole blood, reflecting a limited preference for this component.

Table 2: Correlation Of Frequency Of Component Transfusion With Gestational Age Of Neonates

Gestational Age Wise Component Usage	Red Cell Transfusion	Platelet Transfusion	FFP Transfusion	Whole Blood Transfusion
Extreme Preterm (<28 weeks)	2	5	4	0
Preterm (28 - 37 weeks)	16	9	77	0
Term (38 - 42 weeks)	20	9	18	4
Post Term (≥42 weeks)	0	0	0	0
Spearman's P	1.00	0.866	0.500	0.866
P Value	0.000	0.333	0.667	0.333

Out of all blood components, only correlation between PRBC transfusions and gestational age is statistically significant ($p<0.05$), suggesting that older gestational age is associated with higher PRBC use. There was no significant correlation between birth weight and blood components as ($p>0.05$)

Regarding , Correlation between Apgar score and blood components, it was observed that though $p<0.05$(actual $p=0.041$) it was not strongly significant.

Assessment of appropriateness, regarding implementation of guidelines and protocols of blood components ,it was observed that , in 63.2% cases PRBC. ,73.9% platelets ,96% FFP was transfused appropriately ,whereas ,36,8% of PRBC.,26.1% platelets ,4% FFP the guidelines were not followed appropriately.

Table 3: Errors Documented During Blood Component Transfusion In Neonates

Errors	Yes		No.	
	No.	Percentage	No.	Percentage
Consent For Transfusion	106	64.6%	58	35.4%
Documentation Completeness	119	72.6%	45	27.4%
Sample: Label incomplete / Incorrect	6	3.7%	158	96.3%
Sample: Hemolyzed	12	7.3%	152	92.7%
Verification of Patient	164	100.0%	0	0.0%
Verification of Blood Product	164	100.0%	0	0.0%
Blood Group Compatibility	164	100.0%	0	0.0%
Wastage of Blood Products	2	1.2%	162	98.8%

Above table depicts percentage of errors that occurred during blood component transfusions during the study.

DISCUSSION:

Present study sheds light on the patterns, indications, appropriateness of blood and blood component transfusions ,errors during transfusion in neonates admitted to the NICU of a tertiary care hospital. The study analyzed clinical variables such as gestational age, birth weight, and APGAR scores in relation to transfusion practices. In this study of 40 neonates total 5786 ml volume of blood ,with mean 39.69 ml. Out of this , 1180 ml of PRBC with mean 31.13 ml, 660 ml of Platelets with mean 28.7 ml, 2846 ml of FFP, with mean 29 ml and total 1100 ml of whole blood was with mean 275 ml was transfused during the study. Out of 40 neonates ,20 neonates (50%) in this study were preterm. Dogra et al[11] reported that 83.6% of transfused neonates were preterm, with many receiving FFP and platelet transfusions. Similarly, Amrutiya et al[12] found that preterm neonates formed the bulk of transfusion recipients, particularly in the first week of life. 70% of neonates had a birth weight below 2500g,. This is similar to Amrutiya et al[12] , where 73.2% of neonates were low birth weight, Dogra et al[11] also reported that 61.2% of transfused neonates were VLBW, Similarly, Parashar et al[13] observed transfusion requirements increasing with decreasing birth weight. This findings suggests that there is an inverse relationship between neonatal birth weight and blood transfusion requirement. In this study asphyxiated newborns (Apgar score <7) required 47 transfusions out of 164 transfusions ,whereas those without asphyxia required more transfusions this may be due to inclusion of low birth weight and premature neonates in this group also some neonates where Apgar score was not known. This is in contrary to finding of Kaur A et al[14], where a significant proportion of transfused neonates had APGAR scores under 7. Parashar et al[13] and Dogra et al[11] also correlated low initial APGAR scores with increased transfusion needs. Majority of neonates in this study had respiratory distress ,prematurity and low birth weight as indication for admission and 128 out of 164 transfusions were received in this category. Others reported sepsis , Amrutiya et al[12], thrombocytopenia and D.I.C. in preterm Dogra et al[11], Sepsis ,low birth weight & respiratory distress in Parashar et al[13] studies. In studies by Amrutiya et al[12], Parashar et al[13], Gupta et al[15] including this study , most of the transfusions were required in the first week of life. Fresh frozen plasma (60.4%) was most common blood component utilized out of all components , D.I.C. and coagulopathy being the most common reason. Multiple components (PRBC, FFP. and PC) were utilized in 27.5% of cases. Considering appropriateness (Following indications & guidelines) of transfusion , in this study in 63.2% of PRBC. , 73.9% of platelets and 96% of FFP. was transfused appropriately. In case of PRBC clinical basis or judgment ,critical condition of patients was reported as indication of transfusions baring guidelines. Parashar et al[13], documented only 36.4% appropriate RCC use and 63.6% inappropriate use. Gupta et al[15] highlighted similar gaps. Parashar et al[13] reported 58.25% of platelet use appropriately, where, as Dogra et al[11] observed that up to 40% of their platelet transfusions occurred at counts above recommended thresholds (≥50,000/µL). In study of Parashar et al[13], 76.4% of FFP transfusions were inappropriate, often due to absent INR or no bleeding context. Dogra et al[11] too documented INR >2 as a consistent threshold, and found that many transfusions occurred without these criteria, suggesting misuse. Considering errors which were observed with blood component transfusion, it was noted that proper written consent was not taken, although authorized consent form for blood component was filled but inappropriately , in some cases verbal or implied consent was taken ,whereas ,emergency was stated in some conditions and proper consent was forgotten. Errors occurred during sample labeling and samples, which were hemolyzed but error was rectified with communication of Blood bank staff. No error was observed in verifying and identifying patient's ,blood group ,blood products and monitoring during and after transfusion. Minimal wastage of blood product (1.2%) was noted. No adverse reaction was observed during the study. In the U.S. CDC NHSN Hemovigilance Module Ortiz et al[16] observed that, most frequent errors included, sample labeling and incomplete records. Dogra et al[11] reported only minor documentation errors, suggesting well-trained NICU personnel. In contrast, Parashar et al[13] observed documentation and requisition errors in over 40% of cases, underlining systemic lapses in busy tertiary setups.

CONCLUSION:

Blood component transfusions form an integral and important part of neonatal management in N.I.C.U. Prematurity and low birth weight along with neonatal diseases require more frequent blood component transfusions. Maximum frequency of transfusions were required, particularly during first week of life . Deficiencies were observed in following guidelines for transfusion and documentation. Errors, though occurred ,were rectified with due intervention at appropriate steps. Timely audit of blood transfusions in coordination with blood bank may avoid errors . Scrutiny and reinforcement of appropriate documentations must be done.

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