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AN OVERVIEW OF BLOOD TRANSFUSION PRACTICE IN NEWBORNS

Pathology

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ABSTRACT

Aim and objectives: Blood components which are used in modern day practice include, apart from whole blood, a variety of other products like Packed Red Blood Cells , Platelets, Leucocytes, Plasma, Cryoprecipitate, WBC poor red cells, WBC depleted red cells, washed red cells, Frozen deglycerolized red cells and individual factor concentrates . Blood component therapy is a very common intervention practiced in newborns. The objective of this research was to study the Indications, Pattern of usage of blood component therapy & transfusion reactions encountered in neonatal transfusion practice at Trichy SRM Medical College Hospital and Research Centre, Trichy. **Materials and Methods:** In this cross sectional study, 565 neonates who received various blood component transfusion like packed red blood cells, platelet concentrates, fresh frozen plasma, cryoprecipitate and whole blood in Trichy SRM Medical College Hospital and Research Centre during the period of Jan 2015 – Jan 2020 were followed and studied. Observation and result: Neonatal Blood Component Therapy in 565 neonates, Indications: Neonatal anemia in 51%, Thrombocytopenia in 57%, Others - 25% were observed. Pattern of usage: Platelet concentrate - 45%, Packed Red Blood Cell's - 34%, Fresh Frozen Plasma – 17.5%, whole blood – 2.5% and Cryoprecipitate - 1% been observed. Transfusion reactions were observed in 7.5% of cases. The study was extended to the other parameters like gestational age (term), sex and birth weight of the neonates also. **Conclusion:** There is increased usage of all Blood Component for appropriate indication for the transfusion in neonates during the period of study. Minimal transfusion reactions mainly acute non-infectious transfusion reactions were seen which not interferes the transfusion practice in newborns. Most frequently used component been observed was Platelet concentrates and maximum usage of components were seen in preterm and very low birth weight babies. No blood-sparing protocol would be complete and efficient without the use of an evidence-based transfusion algorithm.

KEYWORDS

Cryoprecipitate, Fresh Frozen Plasma, Packed Red Blood Cells, Platelets, Whole Blood, Transfusion reactions, Anaemia, Febrile non-hemolytic transfusion reactions, Transfusion related acute lung injury.

1. INTRODUCTION

Use of Blood Components ensures added advantages: i] Maximized use of one unit of blood for a number of patients with same unit [1-3]. ii] Shelf life of each component is longer than in whole blood. iii] Better patient care with specific components without danger of overloading/ side effects of other unwarranted components [4-6]. iv] Cost effective blood bank system wherein cost & processing a unit of blood is shared by a number of patients compared to as if given as whole blood to only one [7-10].

Various blood components prepared from one unit of whole blood includes Packed red blood cells, platelet concentrates, fresh frozen plasma and cryoprecipitate. Other sub components prepared depends on specific indications are WBC poor red cells, WBC depleted red cells, washed red cells, frozen deglycerolized red cells, platelet rich plasma, frozen platelets, granulocyte rich plasma, lymphocyte rich plasma, frozen plasma,

cryo removed plasma, factor VIII concentrate, factor IX concentrate, antithrombin-III concentrate, factor XIII concentrate, albumin, intravenous immunoglobulin and Rh immunoglobulin[11].

Guidelines and indications for blood transfusion in neonatal practice

The Guidelines for the transfusion of whole blood and packed bed blood cells (PRBCs) varies according to age, level of sickness and haematocrit is shown in the Table-1 [12].

Table-1: Guidelines for transfusion of PRBCs in neonates

I] Hematocrit <20% with low reticulocyte count with symptoms
ii] Hematocrit <30% and any of the following: a. On <35% oxygen hood b. O2 by nasal cannula. c. On CPAP* and/or on ventilation d. With significant tachycardia or tachypnea (heart rate >180 beats/min or respiratory rate >80 beats /min for 24 hours). e. With significant apnea or bradycardia (>6 episodes in 12 hours or 2 episodes in 24 hours requiring bag and mask ventilation) f. With low weight gain (<10 g/day over 4 days).
iii] Hematocrit <35% and either of the following: a. On >35% oxygen hood. b. On CPAP (Continuous positive airway pressure) ≥6-8 cm of water.
iv] Hematocrit <45% and either of the following: a. On extracorporeal membrane oxygenation. b. With congenital cyanotic heart disease

The Guidelines for transfusion of platelet concentrate in neonates varies according to the platelet value range and shown in the Table-2 [13,14].

Table-2: Guidelines for transfusion of Platelets in neonates

i] Platelet count less than 30,000/cubic mm: transfuse all neonates, even if asymptomatic.
ii] Platelet count 30,000 to 50,000/cubic mm: consider transfusion a. Sick or bleeding newborns b. Newborns weighing less than 1000 gm or less than 1 week of age c. Previous major bleeding tendency (Intraventricular Hemorrhage grade 3-4) d. Newborns with concurrent coagulopathy e. Requiring surgery or exchange transfusion
iii] Platelet count more than 50,000 to 99,000/cubic mm: transfuse only if actively bleeding.

The indications for the use of Fresh Frozen Plasma (FFP) in neonates are congenital coagulopathies, and acquired coagulopathies includes vitamin K deficiency; disseminated intravascular coagulation (DIC), liver disease associated with liver failure, anticoagulant reversal and massive transfusion with DIC [15].

Cryoprecipitate is precipitated specific plasma proteins derived from the fresh frozen plasma. The indications for cryoprecipitate for the conditions include haemophilia A, von-Willebrand disease , congenital or acquired fibrinogen deficiency, acquired factor viii deficiency as in disseminated intravascular coagulation or massive transfusion and factor xiii deficiency [16].

Transfusion reactions

The blood transfusion reactions are classified as hemolytic transfusion

reactions and non hemolytic transfusion reactions [17-21]. Hemolytic transfusion reactions are further classified as acute and delayed. Acute hemolytic transfusion reactions are the reactions appear in first 24 hours of transfusion. Acute hemolytic transfusion reactions has immune and non immune type of reactions. Delayed hemolytic transfusion reactions manifests between 2 hours and 28 day after a transfusion [22-27].

Non hemolytic transfusion reactions further classified as systemic reactions and cardio – respiratory reactions. Systemic transfusion reaction includes Febrile non-hemolytic transfusion reactions (FNHTR), allergic reactions, post transfusion purpura, transfusion associated graft versus host disease (TA-GVHD) [28-30]. Cardio respiratory transfusion reaction includes transfusion related acute lung injury (TRALI), TACO, TAD and transfusion associated hypotension (TAH) . Other non-infectious transfusion reaction includes hemosiderosis, hyperkalemia, hypocalcemia, hypomagnesaemia, air embolism and other unclassifiable reactions [31-33].

2. Materials and Methods

Blood component data's were collected retrospectively at the department of Pathology and transfusion medicine, Trichy SRM Medical College Hospital and Research Centre, Trichy from Jan 2015 to Jan 2020. Details were recorded, analyzed and compared with the clinical data of neonates to find out the necessary indications for which the components been used. Sample size includes 565 neonates. Categorical variables was expressed in percentages, pie chart and bar diagram. Student T test was applied for calculating statistical significance when data followed nominal distribution. Mann whitney test applied when data followed non nominal distribution.

Nominal categorical data between the group was compared using Chi-square test or fisher's exact test as appropriate. P<0.05 was taken to indicate a statistical significant difference. All the neonates who received blood transfusion at Trichy SRM Medical college hospital during the time of study period were included in the study. Neonates with risk of non transfusion related infections and those who were not received blood transfusion during the study period.

3. Observation and result

The pattern of usage of blood component transfusion in neonates during out study period as shown in the Table-3. The component which was used more in the neonatology group transfusion was platelet concentrates which were shown in the pie chart Fig.1. The transfusion distribution studied and observed among 565 neonates shown in Fig.2

Table-3: Pattern of blood component usage noted in neonatal transfusion during the study period

Parameters	Blood component transfusion
Number of Units	878 units Whole blood - 23 (2.5%) PRBC - 299 (34%) Platelet concentrate - 392 (45%) FFP - 154 (17.5%) Cryoprecipitate - 10 (1%)
Number of Neonates received blood transfusion during the study period	565 babies
Gender distribution among 565 neonates: Male Female	356 babies - 63% 209 babies - 37%
Term age among 565 neonates: Full term Preterm Late Preterm Very Preterm Extreme Preterm	175 babies - 31% 390 babies – 69% 180 babies - 32% 125 babies - 22% 85 babies - 15%
Birth weight among 565 neonates: Normal Low Birth Weight Very Low Birth Weight	85 babies - 15% 208 babies - 37% 272 babies - 48%
Transfusion Reactions among 565 neonates: Yes No	17 babies – 3% I] TRALI – 1 (0.2%) ii] FNHTR - 15 (2.6%) iii] Immune mediated Haemolysis – 1 (0.2%) 548 babies - 97%

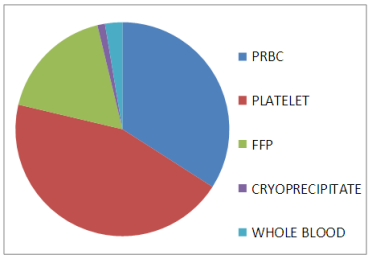

Figure-1: Pattern of usage of Blood Components during the study period

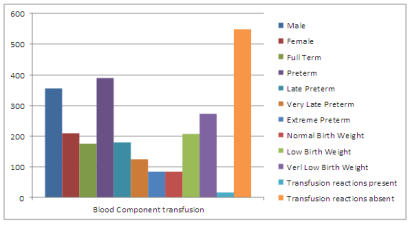

Figure-2: Distribution of blood component transfusion in neonates during the study peri

The common indications for Packed Red Blood Cells that we transfused in 290 out of 565 neonates been observed during our study period were tabulated in the Table-4. The common indications for Platelet concentrate that we transfused in 322 out of 565 neonates were tabulated in the Table-5. The common indications for Fresh Frozen Plasma that we observed in neonatal transfusion - 140 out of 565 neonates were tabulated in the Table-6. The common indications for Cryoprecipitate transfusion been observed among 7 out of 565 neonates were tabulated in the Table-7. The whole blood transfusion distribution been indicated commonly in 15 out of 565 neonates were tabulated in the Table-8.

Table-4: Indications for Packed Red Blood Cells transfusion in neonates during our study period

Indication	No. of babies 290/565 (51%)
Hematocrit <20% with low reticulocyte	70 (24%)
Hematocrit <30% with significant tachycardia / bradycardia	150 (52%)
Hematocrit <35%	59 (20%)
Hematocrit <45% -With Congenital heart disease -Non specific	11 (4%) 04 07

Table-5: Indications for Platelet concentrate transfusion in neonates during our study period

Indication	No. of babies 322/565 (57%)
Platelet count less than 30,000/cubic mm	110 (34%)
Platelet count 30,000 to 50,000/cubic mm with congenital heart diseases, sepsis and hemolysis and bleeding manifestations	187 (58%)
Platelet count more than 50,000 to 99,000/cubic mm	25 (8%)

Table-6: Indications for Fresh Frozen Plasma transfusion in neonates during our study period

Indication	No. of babies 140/565 (25%)
Sepsis	99 (71%)

Disseminated intravascular coagulation	6 (4%)
Pulmonary Haemorrhage	1 (0.5%)
Respiratory distress	2 (1.5%)
Other bleeding diathesis/ liver pathology	32 (23%)

Table-7: Indications for Cryoprecipitate transfusion in neonates during our study period

INDICATION	No. of babies 7/565 (1.2%)
von Willebrand disease	03 (43%)
Factor VIII Deficiency	04 (57%)

Table-8: Indications for the Whole blood transfusion in neonates during our study period

Indication	Number of babies 15 / 565 babies (2.6%)
Anemia	08 (53%)
Exchange transfusion	02 (13%)
Surgery	03 (21%)
Sepsis	02 (13%)
Total	15

4. DISCUSSION

The Pattern of usage of Blood Components in neonatal transfusion from Jan 2015 – Jan 2020 showed frequency of usage of Platelets > Packed Red Blood Cells > Fresh Frozen Plasma > Cryoprecipitate in that order. The most frequently used component was Platelet concentrate - 392 units (45%). Second most frequently used component was Packed Red Blood Cells - 299 units (34%) followed by Fresh Frozen Plasma - 154 units (17.5%) and Cryoprecipitate - 10 units (1%). The most common transfusion reactions in neonates been observed during our study period were Febrile Non Haemolytic Transfusion Reactions (FNHTR) - 15 neonates (2.6%), Transfusion Related Acute Lung Injury (TRALI) – 1 (0.2%), and immune mediated haemolysis – 1 (0.2%) are comparable to all other works Table-3. The transfusion pattern according to sex distribution among 565 neonates include 356 male babies (63%) and 209 female babies (37%) been observed. Preterm babies received more rapid transfusions – 390 (69%). Late preterm includes 180 babies (32%), very late preterm includes 125 babies (22%) and extreme preterm includes 85 babies (15%). The most common birth weight group of neonates who received more transfusions includes – very low birth weight (272 babies – 48%). Low birth weight babies comprises 208 (37%) and neonates with normal birth weight include 85 babies (15%) Table -3.
Neonatal thrombocytopenia could be early (<72 hrs) or late (>72 hrs). Early type could be due to placental insufficiency (Pre-eclampsic toxaemia, Intra Uterine Growth Retardation, diabetes), asphyxia, perinatal infection, maternal autoimmune (Idiopathic Thrombocytopenic Purpura, Systemic Lupus Erythematosus) and severe haemolytic disease of newborn. Late manifestations could result from congenital infections (Cytomegalovirus, toxoplasma, rubella and maternal autoimmunity (idiopathic thrombocytopenic purpura, systemic lupus erythematosus). Most frequently used component was platelet concentrates - 392 units (45%) which been transfused to 322 out of 565 neonates who received transfusion during the period of the study. Platelet concentrate transfusion most often indicated in the neonates with platelet counts of 30,000 to 50,000/ cu.mm with congenital heart diseases, sepsis, hemolysis and bleeding manifestations – 187 babies (58%). 110 neonates (34%) received platelet concentrate transfusion with Platelet count < 30,000. Number of neonates with platelet count between 50,000 – 99,000/ cu.mm who received transfusion were 25 (8%) been observed Table-4.

Phlebotomy loses due to frequent blood sampling and expected decline in haematocrit in neonates during first week could have contributed to lower levels. Leukodepleted Packed Red Blood Cells with additive are the product of choice. Irradiation and prolonged storage increases K+ and diminishes 2,3 DPG levels, hence in exchange / massive / intrauterine transfusions < 5days old irradiated Packed Red Blood Cells are transfused within 24 hours. Post transfusion hypoglycaemia may ensure due to stimulation of insulin secretion. Packed Red Blood Cells 299 units (34%) were the second most frequently used blood component been observed for 290 out of 565 neonatal transfusion. Its been indicated in neonates with haematocrit range of < 30% with significant tachycardia or bradycardia – 150 neonates (52%). 70 neonates (24%) with haematocrit < 20% and low reticulocyte count , 59 neonates (20%) with haematocrit < 35 % and 11 neonates with haematocrit < 45% received more packed red blood cells transfusion Table-5.

Third most frequently used component in neonatal transfusion been observed was Fresh Frozen Plasma 154 units (17.5%). Fresh Frozen Plasma been used for 140 among 565 neonates. Most common indication been observed was sepsis – 99 neonates (71%), bleeding diathesis with associated liver pathology 32 neonates (23%). Other indications for fresh frozen plasma transfusion in neonates been observed were Disseminated Intravascular Coagulation, pulmonary haemorrhage and respiratory distress Table-6.

Least frequently used component was Cryoprecipitate 10 units (1%). Out of total 7 neonates 3 were von Willebrand disease and 4 neonates been indicated cryoprecipitate transfusion for haemophilia A (factor VIII deficiency). Indications for use of cryoprecipitate include hypofibrinogenemia/ dysfibrinogenemia, haemophilia A (when factor VIII concentration not available) and von Willebrand disease with active bleeding when not responding to DDAVP (1-deamino-8-D-arginine vasopressin) Table-7.

The usage of whole blood for transfusion in neonates been reduced much to prevent volume overload and other transfusion reactions. 23 units of whole blood used for 15 (2.6%) out of 565 neonates for anaemia – 8 neonates (53%) and surgical incidences – 3 neonates (21%) been observed during the study period Table-8.

5. Summary & Conclusion

Neonates, more often premature babies often need blood transfusions. Relatively large number are transfused with possibility of passive transfer of antibodies. Therefore individual component transfusion is preferable compared to whole blood. Because of lack of isohemagglutinins in neonates, immature immune system with risk of TAGVHD and considering their long life expectancy, possibility of sensitization to HLA antigens the long term consequences of which remains significant. Use of only required components is prudent. This also ensures economy of the donor blood in a limited donor programme. Citrate, K+, volume and temperature regulation needs special requirements. Testing of maternal serum for antibodies is strongly advocated. Leukodepleted / Irradiated PRBC's must be used for extreme premature babies and for exchange / massive transfusion in neonates.

6. Future Scope

The highest achievement in this new modern era in the field of Transfusion medicine is the separation of one unit of blood into its various components for the transfusion. So that more Blood component transfusion must be encouraged than the whole blood transfusion, to minimise avoidable transfusion reactions, allogeneic sensitization, volume overload and to use one unit of blood to save many lives. So further extension of this study to the patients of all age groups who got admitted in various departments and receiving various blood component transfusions is recommended in order to know the pattern of usage and the common indications of the blood components among all age groups and to increase the preparation and storage of the blood components which is used more and to minimise immediate as well as long term sequelae of transfusions. This simple cross sectional study can be done in all the institutions to know the common indications, transfusion reactions that encountered, pattern of usage of blood components of Blood transfusion in various geographical areas and to promote economy of voluntarily donated blood to save many lives with one unit of blood.

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