TRANSFUSION REQUIREMENTS OF SICK NEONATES IN INTENSIVE CARE UNIT

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ABSTRACT

BACKGROUND

Eighty five percent of babies admitted to hospital care with extremely low birth weight is receiving some type of blood component transfusion. In such a scenario, if the frequency of transfusion is reduced, the associated donor exposure and adverse reactions can be decreased. Risk based estimation of blood usage can identify those infants who are likely to require transfusion. We wanted to describe usage pattern of blood and blood components in the intensive care unit of a speciality centre.

METHODS

The research was descriptive type in nature. The study was performed on neonates with a gestational age less than 37 weeks and/or a birth weight of less than 2500 grams admitted to the Neonatal Intensive Care Unit (NICU) of Sri Avittom Thirunal Hospital (SATH), Government Medical College, Thiruvananthapuram. The sample size was 150. Demographic characteristics and details of transfusion related to mother and baby were collected. SPSS software version 16 was used for statistical analysis.

RESULTS

Among study subjects, 23.3% required one unit of red cells, 36% required two units of PRC, 35.3% required three units and 5.3% required four units during their hospital stay. Among FFP transfused babies, 17.4% received one unit, 32.6% received two units, 34.9% received three units and 15.1% received four units during their hospital stay. On analysis, 42.7% of the neonates received red cells alone and 57.3% of the neonates received both red cells and Fresh Frozen Plasma (FFP). On analysing the usage of platelet concentrate among neonates, 34.6% received one unit of platelet concentrate, 48.1% received two units and 17.3% received three units during their hospital stay. On assessment, 34.7% received platelet concentrate along with red cells while the rest 65.3% received red cells only.

CONCLUSIONS

Multiple transfusions were common among neonates. Majority of infants received multiple components too.

KEY WORDS

Low Birth Weight, Newborn, Transfusion, Red Blood Cell, Platelet, Fresh Frozen Plasma

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BACKGROUND

Among the extremely low birth weight newborns admitted to care centres, 85% needed a transfusion.[1] Almost half of red cell transfusions were given in the first two weeks of life. During that period the neonatal cardio-respiratory illness is most severe and laboratory blood sampling is more performed.[2] Red cell transfusion can reduce the morbidity associated with anaemia especially anaemia of prematurity and maybe lifesaving in neonates with severe blood loss.[3]

In this study the necessity for transfusion of red blood cells were analysed. Thus, the candidates who required more number of blood component transfusion was identified. Risk based estimation of blood usage can identify those infants who are likely to require only one or more transfusion. This helps to identify unnecessary transfusions too.

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METHODS

The research was a descriptive one. 150 neonates were enrolled in study. Sample size was taken based on the convenience of the study. The neonates met an inclusion criteria of gestational age less than 37 weeks and/or birth weight less than 2500 grams. The babies admitted to the Neonatal Intensive Care Unit (NICU) of Sri Avittom Thirunal Hospital (SATH), Government Medical College Thiruvananthapuram was subjects.

SATH has a level III NICU caring for both in-born and out-born infants. Study was done for a period of one and a half years in the Department of Transfusion Medicine, Government Medical College Thiruvananthapuram.

All neonates admitted to NICU were defined as sick neonates. Study population was sick neonates admitted to the NICU who are transfused at least once during their hospital stay. Infants with chromosomal abnormalities, congenital heart disease, other life-threatening congenital abnormalities, death within first 24 hours were excluded from the study.

The maternal and neonatal demographic characteristics were recorded. Other data collected include number of red cells, platelet and plasma transfused.

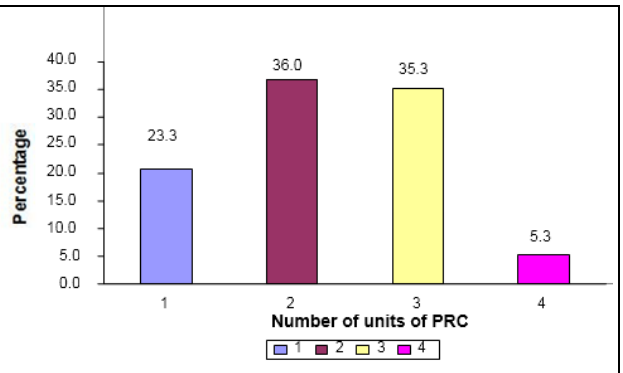

Figure 1. Percentage Distribution of Neonates on the Basis of Number of Red Cell Units Transfused

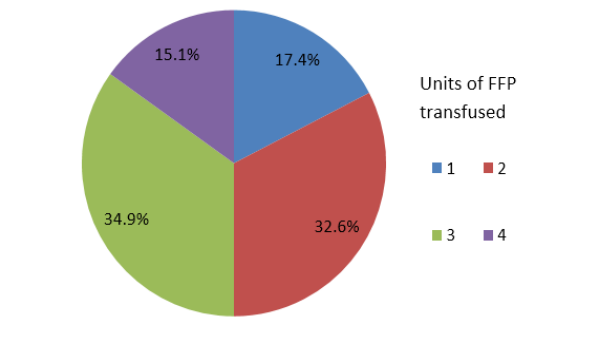

Figure 2. Percentage Distribution of FFP Usage

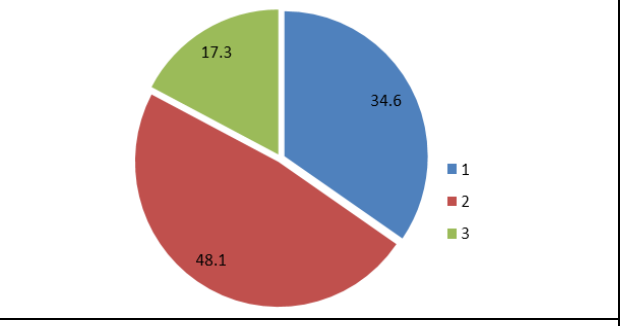

Figure 3. Percentage Distribution of Platelet Usage

Usage of Blood Components	Number of Neonates	Percentage
PRC alone	64	42.7
PRC & FFP	86	57.3

Table 1 Usage of Red Cells Alone/with FFP

Usage of Blood Components	Number of Neonates	Percentage
PRC alone	98	65.3
PRC & PC	52	34.7

Table 2. Usage of Red Cells Alone/with Platelets

Ethics

Human ethical committee, of the institute gave sanction for this research. Counselling was provided for all parents of study subject in detail and consent was obtained. Those who were not willing to consent the study was excluded.

Statistics

SPSS software version 16 was used for analysing the data. Continuous variables were expressed as mean +/- standard deviation. Qualitative data expressed as percentage. Categorical variables were compared using chi square test.

RESULTS

This study was a descriptive study done in 150 neonates admitted in the NICU of Sri Avittom Thirunal Hospital, Government Medical College, Thiruvananthapuram. Transfusion details of those neonates were studied.

On analysis of transfused group, 23.3% required one unit of red cells, 36% required two units of PRC, 35.3% required three units and 5.3% required four units during their hospital stay.

Among FFP transfused babies, 17.4% received one unit, 32.6% received two units, 34.9% received three units and 15.1% received four units during their hospital stay. On analysis, 42.7% of the neonates received red cells alone and 57.3% of the neonates received both red cells and Fresh Frozen Plasma (FFP).

On analysing the usage of platelet concentrate among neonates, 34.6% received one unit of platelet concentrate, 48.1% received two units and 17.3% received three units during their hospital stay. On assessment, 34.7% received platelet concentrate along with red cells while the rest 65.3% received red cells only.

DISCUSSION

Studies has proven that multiple RBC transfusions during the first weeks of life was new born infants, especially for those premature ones with birth weight less than 1.3 Kg.[1] Severe respiratory or cardiac diseases has predisposed infants to repeated blood sampling and consequent replacement transfusions During the first 2-3 weeks of life.[2] The haematopoietic system a preterm infant is incompletely developed and poorly adapted to serve the foetus.[3] The erythropoietin (EPO) response is also not good in continuing period, which results in falling RBC values. This further may lead to additional transfusions.[1]

Due physiological factors a decline in circulating RBC volume will be there in first few weeks of infant life.[4] Additionally blood losses due to phlebotomy can lead to anaemia.[3] The haemoglobin value rarely falls below 9 gm/dl in healthy term infants in 10-12 weeks of age. But this is more pronounced in premature infants. The mean haemoglobin concentration falls to approximately 8 gm/dl in infants of 1 to 1.5 Kg birth weight and to 7 gm/dl in infants weighing less than 1 Kg.[5] Decrease in haemoglobin occurs too earlier too.

Neonates have significant physiologic differences from older children and have unique problems related to transfusion. Newborns have better cardio vascular adaptive capacity and withstand volume expansion better than adults.[3] Increased foetal EPO levels are noticed in the presence of placental insufficiency.[6] According to Sally Rudman, there are several factors that can influence the decision for transfusion in neonates. It includes reduced size, physiologic anaemia, blood loss due to phlebotomies, oxygen affinity of foetal haemoglobin, immaturity of immune system, presence of maternal alloantibodies, variations in blood volume with age, shortened red cell survival, decreased erythropoiesis, cardiovascular capacity to adapt changes and immature coagulation factors. Another factor that contributes to neonatal anaemia is the rapid growth early in life that leads to the need for a greatly increased RBC mass.[7]

The bulk iron transport occurs from the mother to foetus after 28 weeks. Likewise, the onset of marked erythropoietic activity of fetal marrow is during the third trimester.

Neonates delivered before 28 weeks of gestation have compromise in both of these mechanisms. [3] Hence, preterm infants of very low birth weight enter extra uterine life with low iron stores and a low volume of circulating red cells.[7] Additionally, repeated blood sampling will contribute heavily to neonatal anaemia.[3]

Hypovolemia is not tolerated in neonates as in older children as left ventricular stroke volume in newborn decreases without an increase in heart rate when > 10 % of blood volume is lost. Newborns must physiologically increase their peripheral vascular resistance with decreasing cardiac output to maintain systemic blood pressure leading to poor tissue perfusion and oxygenation as well as metabolic acidosis.[8] Acute blood loss associated with obstetrical conditions like premature placental separation, vasa previa, umbilical cord accidents, fetomaternal transfusion, twin-twin transfusion and internal haemorrhage leading to hypovolaemic shock which necessitate emergency RBC replacement.[9] In shock due to blood the neonate is usually transfused.[10] Use of fluorocarbons as erythrocyte substitutes cannot be tried in infants because the higher oxygen tension (More than 300 mm Hg) required for the release of O_2 may be devastating for premature neonates.[11] The treatment and outcome of shock in the neonatal period is usually complex. This should be guided by established norms for blood pressure. These norms will vary according to birth weight.[12] Increased foetal EPO levels noticed in case of placental insufficiency.

In neonates, anaemia is often associated with iatrogenic blood loss from laboratory sampling.[13] It is estimated that over 2 to 3 days, about 10 % to 15% of blood volume in seriously ill neonates is removed, just for laboratory tests.[14] Brecher. M. E. et al suggested that phlebotomy losses should be carefully monitored, and replacement be considered when it exceeds 10% of the infants calculated blood volume.[16] After birth, haemoglobin concentration decreases naturally due to physiologic mechanisms. This is a concern when associated with symptoms of anaemia. Wardrop and collegues proposed a calculation of available oxygen from gestational age and haemoglobin level. They demonstrated an association between decreased available oxygen and clinical signs such as difficulty in feeding, tachycardia, tachypnoea, diminished activity and pallor.[5]

A relation between haemoglobin level and neonatal apnoea has been suggested.[15] Transfusion in preterm babies with a haematocrit of 0.25 to 0.28 has resulted in decrease of duration of periodic breathing, the number of respiratory pauses up to 20 seconds and the number of episodes of bradycardia by 25% from baseline.[16] Oxygen delivery remained good when the haemoglobin concentration is lowest in pre-term infants at age 7-8 weeks.[17] As recommended, red cells are transfused, if the infant has cardio respiratory problems, feeds poorly or fails to gain weight.[18] Transfusions starting at 2 weeks of age to raise the haemoglobin level from 85 to 114 g/l have been associated with decreased consumption of oxygen. This will result in decrease in energy expenditure which can further improve weight gain in neonates.[19] It is a usual practice to maintain the haemoglobin level above 130 g/L (haematocrit 0.40) in neonates with respiratory distress.[20] Cord haemoglobin values do not significantly change during the last trimester of pregnancy.[21] Burmen and Morris have suggested that a difference in cord blood haemoglobin may exist between male and female infants born prematurely.[22]

Red cell transfusions are planned to maintain the haematocrit at a level considered best for the clinical condition of infant.[23] Most RBC transfusions given to infants are small in volume. The usual dose is 10 to 15 ml/kg and are repeated as necessitated. Phillips HM and Holland concluded that in neonates with severe respiratory disease especially with ventilator support, needs a haematocrit at or greater than 40%.[24] Ramasethu J, Luban and co-workers proposed that red cell transfusions has to be given to treat disturbances of cardio pulmonary rhythm because a low haematocrit contributes to tachypnoea, dyspnoea, apnoea, tachycardia or bradycardia.[25]

Practicing restrictive guidelines versus liberal guidelines for neonates is still confusing.[26] Bell and co-workers found that restrictive practice increases apnoea, intra ventricular bleeding, and brain leucomalacia in infants. But Kirpalani et al found no differences between infants in the restrictive versus liberal groups.[27] Variability in transfusion practices has been described in neonates among different institutions and places.[28] Bednarek and colleagues compared transfusion frequency and volume of blood in a six-site prospective study. They found that several sites differed significantly in mean birth weight, illness severity, number of transfusions, pre transfusion haematocrit, phlebotomy losses etc.[29] Transfusion dosages should be calculated using the blood volume of the child.[30] The typical transfusing dose is 10-15 ml/kg body weight. In children, the transfusion of 3 ml of packed cells per Kg body weight raises haemoglobin by 1 gm/dl.[3] In infants less than 4 months of age with haematocrit <20%, low reticulocyte count and symptomatic anaemia, RBC transfusions have to be given.[31] FFP used for treatment of DIC, factor deficiency, therapeutic plasma exchange, reversal of warfarin in emergency situations etc.

Transfusion needs of low birth weight infants vary considerably.[32] Some of these infants will receive multiple small volume transfusions.

The pattern of usage of PRC in our center showed that 23.3% of neonates received single unit transfusion, 36% two units, 53% three units and 8% more than 3 units.

The usage pattern of FFP was also assessed in our study. 86% in the case group received FFP transfusions. Maximum number of neonates needed two or more units. In our center, the commonest indication for FFP was coagulation factor deficiency secondary to gastro intestinal bleeding. According to the recommendations recently published regarding the usage of FFP in neonates, a dose of 10-20 ml/kg will raise the level of coagulation factors by approximately 20%.[33] FFP is not indicated for volume expansion or wound healing.[34]

Platelet counts less than 100 x 10^9/ L is significantly related to clinical risks for premature neonates.[35] In our research, we assessed the pattern of usage of platelet concentrates in neonates. A total of 34.7% of the case group received platelet concentrates. Out of this, 34.6% received 1 unit, 48% 2 units and 17.3% 3 units of platelet concentrate.

On analysing the blood usage pattern in our center, we noticed that most of the neonates needed transfusions early in life. PRC was used in all the neonates in the study group. FFP was used in 86% and platelet concentrate was used in 34% of the case group.

CONCLUSIONS

Multiple transfusions were common among neonates. Majority of infants received multiple components too.

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