Study of 25 cases of exchange transfusion by reconstituted blood in hemolytic disease of newborn

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Abstract:

This study was aimed to review and establish the practice of exchange transfusion (ET) with reconstituted blood in neonates and to observe fall of bilirubin and its comparison with related studies. Twenty-five neonates diagnosed as hemolytic disease of newborn (HDN) were selected for this study, in which exchange transfusion was carried out as one of the treatments for hyperbilirubinemia. Out of the 25 cases, 15 were of Rhesus (Rh) HDN, while ABO and other blood groups constituted 6 and 4 HDN cases respectively. First, the neonates' and mother's blood samples were subjected to relevant investigations. After that, for neonates having Rh HDN, O Rh negative cells suspended in AB plasma were given, O Rh positive cells suspended in AB plasma were given to ABO HDN; and O positive cells, which were indirect Coomb's cross-matched compatible with neonates' and mother's serum / plasma, suspended in AB plasma were given to the neonates having HDN because of other blood group antibodies. The exchange transfusion (ET) was carried out taking all aseptic precautions by Push-Pull technique with double-volume exchange transfusion method. The average post-exchange fall in serum indirect bilirubin was (52.01%) in all 25 cases, which was found to be more significant than the previous studies. Looking into the superiority of the exchange transfusion in HDN by reconstituted blood, the reconstituted blood can be modified and supplied as per the requirement and conditions.

Key words:

Exchange transfusion, hemolytic disease of newborn, hyperbilirubinemia; reconstituted blood

Hemolytic disease of the newborn (HDN) is characterized by the presence of IgG antibodies in maternal circulation, which causes hemolysis in the fetus by crossing the placenta and sensitizing red cells for destruction by macrophages in the fetal spleen with consequent hyperbilirubinemia.[1] Early detection and treatment of neonatal hyperbilirubinemia is important in prevention of bilirubin-induced encephalopathy.[2] It is classified according to the specificity of causative IgG antibodies like RhD HDN, ABO HDN and HDN due to other blood group antibodies. Exchange transfusion (ET) removes circulating bilirubin, antibodies in plasma and antibody-coated sensitized red blood cells (RBCs), replacing them with RBCs compatible with maternal serum or neonates' serum and providing albumin with new bilirubin site.[3] Whole blood used for exchange transfusion either compatible with neonates' serum or plasma or mother's serum is commonly used.[4] Present study was undertaken by reconstituted blood for exchange transfusion in all three groups (present study only addressing immunogenic causes of HDN), i.e., (i) Rh HDN group, (ii) ABO HDN group and (iii) other-group HDN. The purpose of this study was to establish the role of reconstituted blood for exchange transfusion in neonates.

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Materials and Methods

This study was carried out in 25 cases suffering from HDN in the year 2004-2005 in the blood bank of the Department of Pathology, G.R. Medical College, Gwalior, along with Emergency Blood Bank, Gwalior. Both centers were fully equipped for component blood bank with the facilities of sterilized connecting device, plasma extractor, dielectric tube sealer, laminar air-flow, etc. Reconstituted blood was supplied to HDN cases hospitalized in the Paediatric Department of G.R. Medical College and associated J.A. Group of Hospitals and Kilkari Nursing Home at Gwalior. All the cases of HDN were diagnosed by testing cord blood specimen for ABO group and Rh type, Direct Coomb's Test (DCT), Indirect Coomb's Test (ICT), total and indirect bilirubin and also mother's sample for ABO Rh type and Indirect Coomb's Test.

The cases were divided into the following three groups:

(i) Rh HDN group –when mother is Rh negative and neonate is Rh positive
(ii) ABO HDN group – when mother is O and neonate is A or B group
(iii) HDN due to other blood group (except ABO

and Rh system) – when irregular antibodies are present in mother's serum and corresponding antigen present on neonate's RBCs

Other laboratory investigations carried out were hemoglobin estimation, hematocrit, peripheral smear, reticulocyte count and ABO and Rh status of father, if not done during pregnancy.

The reconstituted blood was prepared in the blood bank by standard method of preparation of component, i.e., centrifugation and separation method by mixing fresh plasma / fresh frozen plasma (FFP) and packed RBCs / leukocyte-poor RBCs / saline-washed RBCs. The fresh plasma is the liquid portion of anticoagulated blood remaining after separation from the cellular component; and fresh frozen plasma is the plasma separated from whole blood, frozen within 6 h of collection and stored at -20°C and below. Leukocyte-poor RBCs were prepared by discarding the buffy coat from the packed cell. Hematocrit was adjusted to 45%.[5] For Rh HDN, O negative cells were suspended in AB plasma;[5] for ABO HDN, O positive packed RBCs were suspended in AB plasma; while in other blood group HDN (i.e., Indirect and Direct Coomb's Test positive neonates by using polyvalent Coombs Sera), O cells ICT cross-matched, compatible with neonates' or mother's serum, were suspended in AB plasma and were supplied for exchange transfusion. Under all aseptic precautions, exchange transfusions were performed through the umbilical vein under antibiotic coverage in the pediatric ward by Push-Pull technique.[6,7] Blood exchange at each cycle varied with the weight, maturity and general condition of the newborn. In the present study, the volume of blood used for exchange transfusion was calculated as 160 ml/kg in term neonates and 180 ml/kg in preterm neonates.[7] On an average, total reconstituted blood in an individual neonate ranged between 200 and 400 ml/per exchange transfusion. Post-exchange blood was collected for estimation of hemoglobin, hematocrit, bilirubin and direct antiglobulin test. Post-exchange indirect bilirubin fall and hemoglobin of neonate were also observed.

Results

In the present study, exchange transfusion was done in 25 cases by reconstituted blood. Out of these, in 20 cases (80%) ET has been performed once while 5 cases (20%) required ET twice. The range of bilirubin in all the cases was 22.0-45.0 mg/dl [Table 1]. Among 25 cases, 15 cases were of Rh HDN, in which pretransfusion indirect bilirubin was 22.0-45.0 mg%. In these, maximum cases, i.e., 11 (73.33%), in which indirect bilirubin was <40 mg%, required exchange transfusion only once; and 4 (26.67%) cases, in which pretransfusion indirect bilirubin was ≥40 mg%, required two exchange transfusions. In these cases, exchange transfusion was done with O negative cells suspended in AB plasma. One newborn having neonatal septicemia along with Rh HDN in whom ET by reconstituted blood was performed died due to septicemia and respiratory distress. In the present study, septicemia due to reconstituted blood was not observed. In 6 cases of ABO HDN, range of pre-exchange indirect bilirubin was 22.4-26.8 mg%, and all cases (100%) required single ET by O positive cells suspended in AB plasma. In 4 cases of other-group HDN, range of pre-exchange indirect bilirubin was 22-40 mg%; 3 cases (75%) required once and 1 case (25%) required twice exchange transfusion by O positive cells, ICT cross-matched compatible with neonates' serum suspended in AB plasma. In all the 25 cases of HDN subjected in this study, there was a post-ET fall of 52.01% in indirect serum bilirubin. These results by reconstituted blood can be used further in exchange transfusion in neonates suffering from HDN; these results came out to be better and significant in comparison to previous studies,[8,9] in which the approximate fall of indirect bilirubin was 51.9 and 50% respectively.

Discussion

By using reconstituted blood in this study, we further strengthened the concept and practice of using reconstituted blood in neonates for exchange transfusion. All cases resulted in an approximate fall in indirect bilirubin by 52.01%, which is more than documented literature,[8,9] in which the approximate fall of indirect bilirubin was 51.9 and 50% respectively. Five cases (20%) required ET twice as their range of indirect bilirubin was high (≥40 mg%); out of these, 4 cases were of Rh HDN and one was of other-group HDN. Single- and double-surface phototherapy was given to all the cases before and after the exchange transfusion. An average fall of hemoglobin by 20% was also registered in the initial four cases, probably due to donor blood hemoglobin being lower than that of neonate or due to the inadequate mixing of donor blood during the transfusion so that the supernatant plasma gets infused towards the end of the procedure or may be due to ongoing process of hemolysis.[10,11] Afterwards, the hemoglobin of neonates was maintained by correcting the technical pitfalls in the procedure and adjusting the hematocrit of reconstituted blood to 50 ± 5%.[12]

The concept of reconstituted blood (O cells suspended in AB plasma) for exchange transfusion in HDN is safe and can be used, irrespective of the neonates' and mothers' blood group. We are supplying this reconstituted blood in routine for exchange transfusion. The concept is very easy to understand and simple to follow, and the results are also better than those of group-specific exchange transfusion in babies with HDN. The immunogenic complications and risks are very low. In Rh HDN group, we have chosen O negative cells suspended in AB plasma over group-specific Rh negative cells to avoid the controversy of ABO sub-grouping and because of the presence of weaker ABO antigens in newborns and full-term mothers and easy availability of O negative cells. In

Table 1: Exchange transfusion for hyperbilirubinemia

Cause of Jaundice	No. of cases	Range of pre ET indirect bilirubin (mg%)	ET required		Death	Post ET fall %
			Once	Twice		
Rh HDN	15	22.0-45.0	11 (73.33)	4 (26.67)	1 (6.67)	51.7
ABO HDN	06	22.4-26.8	6 (100)	-	-	54.33
Other group HDN	04	22.0-40.0	3 (75)	1 (25)	-	50
Total	25	22.0-45.0	20 (80)	5 (20)	1 (4)	52.01

ET= Exchange transfusion, HDN= Hemolytic disease of newborn, Figures in parentheses are in percentage

the remaining two groups, utility of reconstituted blood is well established. By use of reconstituted blood, hematocrit is also well adjusted according to the requirements.

Conclusion

Reconstituted blood has superiority over whole blood in exchange transfusion in HDN as it fulfills all the therapeutic indications of exchange transfusion in a better way – viz., removal of bilirubin and antibody-coated RBCs from the neonates' circulation; better and safe survival of transfused RBCs; to establish normal hematocrit after exchange transfusion.

In the present study, results are encouraging as indirect bilirubin fall was 52.01%, survival of transfused RBCs was 100%, removal of sensitized RBCs and circulating mother's antibodies were maximum (double-volume exchange transfusion) and there was enhanced ability to maintain normal hemoglobin after exchange transfusion. Using this concept, there is no controversy in choosing the type of blood for exchange transfusion, as it exists in whole blood exchange transfusion. We therefore conclude that exchange transfusion with reconstituted blood in HDN is a safe and better option if aseptic precautions are maintained during reconstitution of the blood component and also during the exchange transfusion.

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