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Original Research Article

Efficacy of Cord Blood Transfusion in Children with Severe Acute Malnutrition Weighing Six Kilogram or Less

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Abstract

Objective: To establish the efficacy of umbilical cord blood (UCB) as an alternative to adult human blood (AB) and to compare change in haematological parameters after transfusion in children with severe acute malnutrition (SAM).

Study design: It was a prospective interventional study of UCB transfusions given to children with severe acute malnutrition requiring blood. UCB was collected in labour Room, under all aseptic precautions, and pretesting were done in blood bank. SAM children fulfilling inclusion criteria were included. UCB and AB was given as per availability and consent. Post blood analysis was done next day to transfusion, watched for reactions. Outcomes like death, discharge and duration of hospital stay were analysed.

Results: A total of 90 blood transfusion were performed, out of which 40 received UCB and 50 with AB. Mean rise of haemoglobin in UCB transfused patient was 1.40gm/dl.

Conclusion: In SAM children requiring blood transfusion whole UCB is a good and safe alternative of whole AB.

Keywords: Umbilical cord blood; Placental blood; Severe Acute Malnutrition transfusion

Introduction

Paediatric population often require blood transfusion for various indications but there is usually deficiency of available blood because of non-availability of donors, lack of awareness, irrational demand, poor supply chain management system etc. especially in developing countries. In India there is an annual requirement of 1 million units of blood for neonatal care but there is significant gap between demand and supply [1]. Till today, there is no substitute of human blood. Even after all efforts for voluntary blood donation and blood component therapy, there is substantial gap between demand and supply. After birth, placenta is commonly discarded which has 80 ml to 150 ml whole human blood that can be saved, stored and used as replacement of adult whole human blood [2–4]. Anaemia contributes to a wide range of health problems like heart failure, poor cognitive

performance, and macro- and micronutrients deficiency. [2]

Severe anaemia is a major cause of mortality, hospitalisation, and mortality in children with severe acute malnutrition, and it is a common co-morbidity. When compared to severe acute malnutrition (SAM) without anaemia, SAM with anaemia has a 2.62times higher mortality rate [3]. On an average 100 million deliveries occur worldwide from which this blood can be harvested and many lives can be saved [4]. Hence this study was done to asses efficacy of umbilical cord blood (UCB) as an alternative to adult human blood (AB) which can be used to fill this gap.

Methods:

This prospective interventional study was carried out at a level III neonatal care unit of an institutional hospital in central India between Jan 20 to June 2021. The first aim of our study was to evaluate, during the study period, the feasibility of fulfilling transfusion needs of SAM children admitted to the hospital with allogeneic UCB units within the first 24hr of admission. As a secondary objective, we focused on the safety of allogeneic cord blood transfusions. [5] Those parents who were not willing for the procedure, children who had history of blood transfusion prior to admission, clinically diagnosed syndromic patients, with primary haematological disease were excluded from the study. Cord blood was collected in Labour Room, under all aseptic precautions from healthy mothers and healthy placenta in Obstetrics and Gynaecology Department done in citrate phosphate dextrose (CPD; an anti-coagulant and preservative) bags of 100 ml capacity [6]. Healthy mothers were defined as mothers who didn't had any antenatal complications like Preeclampsia, sepsis, foul smelling liquor etc. Placenta was examined after birth by researcher and was looked for any abnormality. If any abnormality was detected then sample collected was discarded. Cord blood was collected from healthy placenta of normal vaginal deliveries. Prior consent of patient or attender was taken. Soon after delivery of baby, delayed cord clamping was done as per NRP protocol, then placenta was delivered out and kept in a sterile tray. Distal end of Cord was swabbed with betadine gauge and cleaned with spirit swab than the cord was held between 2 hands and umbilical vein was pierced by a needle connecting to bag. 80 to 120 ml of cord and placental blood was collected in bag through gravity. All aseptic precautions were taken while collecting sample. If collected blood was less than 60 ml, or positive for infections or immunologically unfit (defined as ABO Haemolytic Disease of new born because of presence of anti AB in serum of the cord blood), then unit was discarded. All necessary pretesting (ABO, RH typing, HIV, Hepatitis B, Hepatitis C, Malaria, Syphilis) was done in blood bank. Fit blood units were stored in institutional blood bank and was transfused to the SAM children weighing less than 6 kg who required blood transfusion, if haemoglobin concentration is less than 4 g/dl or packed–cell volume is less than 12% in the first 24 hours after admission, the child has very severe anaemia.

Those fulfilling the inclusion criteria were given cord blood as per availability of cross matched blood. Adult blood was taken from the blood bank as per institutional guidelines.

Before transfusion, pre-BT blood sample was drawn for CBC, vitals including temperature, heart rate, respiratory rate, oxygen saturation, random blood sugar were monitored. Vitals were monitored after starting transfusion at the interval of 10 minutes, 30 minutes, 1 hour and 2 hour and at the completion of transfusion. If there was any significant change in vitals, it was noted. Blood was given to all patients at rate of 10ml /kg in 5 hrs with infusion pump. Stop feeding during and

for at least 3 hours after transfusion of blood. Six hours after transfusion post BT CBC was done, while routine monitoring was done till baby was discharged. Then whole cohort was divided in two groups group 1 (UCB) and group 2 (AB) based on the type of blood they received. Then both groups were compared for haematological parameters like haemoglobin, mean corpuscular volume (MCV), packed cell volume (PCV), total red blood cell (TRBC) etc. Rate of change (ROC) of haematological parameters were also compared between two groups. Patients were followed till the time of discharge from hospital. Discharge outcomes like death and duration of hospital stay were compared between two-group. Ethical clearance was taken from institutional ethical committee

Statistical Analysis:

SPSS ver.20 was used to analyse data. Data were examined for normality. We used the chi-square test and Fischer's exact test for categorical variables. Independent student t-test was used for continuous variables, as appropriate. A P value of <0.05 was considered statistically significant and all tests were 2-tailed.

Results:

A total number of 50 Umbilical cord blood units were collected from the healthy placenta of normal deliveries. Out of 50 cord blood units, 40 units were found to be fit for transfusion (6 units were not used during study period) and 10 units were unfit for transfusion. Out of 10 units, 4 units were rejected because of less quantity of blood collected (< 60 ml) & 2 units due technical problems consisted of clots and, 1unit was positive for Hepatitis B and 3 units on immunological grounds (Table no. 1).

Table 1: Characteristics of UCB units processed and released for transfusion

Processed units, n	50
Unsuitable units, n (%)	10(20%)
Positive microbiology test	1
Technical problems	2
Less quantity(<60ml)	4
Immunological	3
Suitable units, n (%)	40(80%)
Mean unit volume ± SD, ml	78±12
Expired units, n (%)	6(12%)

Baseline characteristics of the two groups were comparable.

In the study, total of 90 neonatal blood transfusion performed, out of which 40 received UCB and 50 with AB, the mean volume of blood collected in UCB was 78 ± 12ml.The average rise in haemoglobin in UCB transfused patient was 1.40gm/dl. The mean of rate of change (ROC) in haemoglobin, PCV, TRBC was statistically significant (P-value <0.05) while other haematological Parameters were not statistically significant as compared to AB. There were no

Transfusion related adverse reactions like immunologic, metabolic and infectious complications recorded in both groups receiving blood transfusion. In UCB group, out of 40 children, 39 were successfully discharged, there was one death due to sepsis related complication. Average duration of hospital stay is 16.25 ± 4.6 SD while, in AB group out of 50 neonates, 49 were successfully discharged, there were 1 death. Average duration of hospital stay was 20.64± 6.7 SD (P value 0.5)

Table 2: Baseline characteristics of the two groups were comparable

	UCB	AB
Mean weight (SD)	4.44 (0.47)	4.59(0.42)
Sex ratio (M: F)	2.01:1	1.80:1
Mean Pre BT-Haemoglobin (SD)	3.605	3.488
Blood groups (n) A B AB O	 6 (17.6%) 13 (38.2%) 3 (8.8%) 12 (35.2%)	 5 (8.7%) 26 (45.6%) 4 (7 %) 22 (38.5%)

Table 3: Clinical and hematological findings of enrolled patients

	Cord blood group	Adult blood group	p value
Total transfusions, n	40	50	
Mean Hb before transfusion, (gm/dl)	3.605	3.488	0.005
Mean Hb) after transfusion, (gm/dl)	5.007	4.666	0.005
Mean ΔHb) ROC after transfusion, (gm/dl)	1.40	1.18	.005
Deaths, n	1	1	0.005
Mean Duration of Hospital stay, (days)	16.25	20.64	0.5
Successful Discharge from Hospital	39	49	0.005

Discussion:

In present study entitled "Efficacy of Cord Blood Transfusion in SAM Patients who have Weight Equal to 6 kg or Less Than 6kg", on the whole, 90 total transfusion was done.40 SAM patients receive umbilical cord blood and another 50 SAM patients receive adult blood. Total 50 units of umbilical cord blood collected in which 40 units are fit for transfusion ie. 80% of collected. [6-8] Out of 10units, 5 units (10%) were rejected because of less quantity of blood and another 5 unit (10%) was also unfit because of clot formation and inadequate recovery. In present study we have given total 40 unit of umbilical cord blood transfusion to SAM (Severe acute malnutrition) who fulfil inclusion criteria. [9]

Mean rise in Hb in UCB transfused patients was 1.40±0.37 gm/dL; while in AB group it was 1.18±0.37gm/dL. There was rise in haematocrit, total RBC counts, in SAM patient who received UCB. P value in rise in haemoglobin level in both groups was 0.005 which was statistically significant. In 2015 Maria Bianchi et al [10] in their study collected 128 units of UCB and out which 16 units were discarded; therefore 112 units were suitable for transfusion ie, 87.5% of collected. 5 units were TTI positive, 5 units shows immunological reactions, 6 units have technical problems consisted of clots or inadequate recovery. PCV before transfusion, (%) was 31.6±12.55 in UCB Group & 31.6±3.4 in AB Group while in present study it was 11.575±1.90 and 10.460±1.71 respectively. [11]

Change in PCV in UCB Group was 11.945 while in AB group 13+5 against present study in which it was 3.625 & 3.8. This difference is because of multiple transfusions performed 0-7 days & 31 were more than seven days. In 1999, Bhattacharya et al., for the first time showed the clinical safety and efficacy of cord blood transfusion in more than 1000 patients with severe anaemia. 94 units of UCB was collected and safely transfused to 39 consenting patients of 8 to 72 year.

The rise of haemoglobin within 72 hours of two units of freshly collected cord blood transfusion was 0.5 gm/dl to 1.6 gm/dl. But in present study rise of haemoglobin was 1.40±0.37 gm/dl as compared to adult blood. This result was in agreement with the results of Bhattacharya et al (severe anaemia in malaria).

Hassall et al [7] monitored adverse events and measured haemoglobin levels 24 h and 28 days after transfusion. Overall, the concentration of haemoglobin increased from pretransfusion levels, by a median of 2.6 gm/dL in 24 h after transfusion, and by 5.0 gm/dL around 28 days after transfusion, with only a few severe adverse effects recorded.

Hassall et al in 2003 did a similar study in Ghanian labor ward on 131 children requiring blood transfusion. They transfused umbilical cord blood to these children and observed a 3gm/dL rise of haemoglobin. This result is greater than that observed in present study, which may be due to the fact that they used all the children in the paediatric age group and we used only cases of SAM. [7]

After comparing the results of the present study with some previous similar studies, we concluded that umbilical cord blood can be used as an alternative for treatment of anaemia in severe acute malnutrition patients. No transfusion reactions and adverse effect related to transfusions were recorded among patients, containing fever, haemolysis, allergic reactions or transfusion- related acute lung injury (TRALI) and other reactions. UCB has shown a considerable rise in haemoglobin in these patients.

Limitations:

The present study had several limitations. First, present study had a relatively small number of patients were included. More multicentric studies with larger sample size may prove a better utility of this intervention. Second factors including role of cytokines, cord blood oxygen carrying capacity were not evaluated in the present study. Third, we used whole blood for transfusion in spite of components due unavailability of component separator for small volume of blood. Neonates were followed only till discharge.

Conclusions:

From this study it can be concluded that UCB is a genuine, valuable and safe alternative of AB in routine and emergencies in patients requiring blood transfusion. In present study UCB was better in improving haemoglobin levels as compared to AB. This can form bridge & fill gap between demand and supply of blood in PICU. Further large-scale studies should be done to establish UCB as reliable source for transfusion in neonates.

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Author Contributions

Conception and design: S.B.M and NB Analysis and interpretation: S.B.M and S.V Drafting the manuscript: S.B.M, S.V, and U.P Critical revision of the manuscript: S.B.M, S.V, U.P and P.S. All authors read and approved the final version of the manuscript for submission.

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What This Study Adds?

Umbilical cord blood is a genuine, valuable and safe alternative of whole human blood in routine and emergencies in children requiring blood transfusion due to variety of conditions.

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