ORIGINAL RESEARCH PAPER

Volume-8 | Issue-4 | April-2019 | PRINT ISSN No 2277 - 8179

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

A STUDY OF EFFECT OF EXCHANGE TRANSFUSION BY WHOLE BLOOD IN NEONATAL HYPERBILIRUBINEMIA AT SMS MEDICAL COLLEGE AND ATTACHED GROUP OF HOSPITALS, JAIPUR

Immunohaematology

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ABSTRACT

Background: Exchange transfusion (ET) is required in hyperbilirubinemic hospitalized neonates.

Aims & Objectives: To study the effect of whole blood exchange transfusion to decrease serum bilirubin and raise haemoglobin in neonatal hyperbilirubinemia

Materials & Methods: The study centre at SMS and associated hospitals. Blood bank is licensed and fully equipped. Fall in serum bilirubin minimum 40 cases were required as sample size of present study.

Results: The rise in mean value of Hb after exchange transfusions was 0.85 gm/dl but when neonate's haemoglobin was less than 12.5 g/dl the rise in mean value of Hb after exchange transfusions was 2.44 gm/dl. The average fall in total serum bilirubin was 47.71 %. The average fall in direct serum bilirubin was 73.51 %. The average fall in indirect serum bilirubin was 52.16%.

Conclusion: While selecting Whole Blood for exchange transfusion it should also be checked for Haemoglobin and haematocrit values and the Whole Blood with higher Haemoglobin and Haematocrit (i.e. with values closer to normal neonatal Hb and Hct) should be preferred for exchange transfusion for better rise in neonatal Hb and Hct after the exchange transfusion. It was more effective in reducing direct bilirubin levels (73.51 %) compared to indirect (52.16%).

KEYWORDS

exchange transfusion, hyperbilirubinemia, Haemoglobin, Haematocrit, Total, Direct and indirect bilirubin.

INTRODUCTION

An exchange transfusion involves removing aliquots of patient blood volume along with simultaneously substituting same amounts with donor blood in order to remove abnormal blood components and circulating toxins whilst maintaining adequate circulating blood volume, primarily done for removing antibodies and excess bilirubin in isoimmune disease. The frequency of exchange transfusion is decreasing secondary to the prevention and improved prenatal management of alloimmune haemolytic disease and improvements in the management of neonatal hyperbilirubinaemia[1].

MATERIAL AND METHODS

- Study Type: Interventional study without control
- Study Design: Longitudinal study
- Study Area: The study was undertaken at SMS hospital, JK Lon Hospital and Mahila Chikitsalya, Jaipur. The tests were performed in Department of Immunohaematology & Transfusion Medicine and laboratories of SMS hospital, J.K.Lon Hospital and Mahila Chikitsalya, Jaipur.
- Study period: Data collection started since approval of plan from research review board of institute till significant sample size was completed.
- Sample size: Sample size was calculated at 95% confidence level assuming standard deviation of 9.7% in fall of serum bilirubin as per references study, at the precision of 3% fall in serum bilirubin minimum 40 cases were required as sample size of present study.

Inclusion Criteria:

1. All neonates with Neonatal Hyperbilirubinemia requiring exchange transfusion and/or if requiring multiple exchange transfusions.[2]
2. Those giving consent for participation in this study.

Exclusion Criteria:

1. Patients who may get benefit by phototherapy and blood transfusion and don't fall in range of exchange transfusion criteria.
2. Major congenital malformations.
3. Those refusing consent for participating in this study.

Information recorded were age, weight and sex of the newborn baby and Volume of blood Transfusion. Investigations conducted in all neonates requiring exchange were total serum bilirubin (TSB), conjugated and unconjugated fractions of TSB, ABO and Rhesus blood group; direct coombs test (DCT), reticulocyte count and peripheral blood smear examination. Glucose-6-phosphate dehydrogenase (G6PD) levels, thyroid profile and sepsis screen were done wherever indicated.

The data were prepared for term / preterm and first/second exchange transfusion from 40 neonates with Hyperbilirubinemia, (but the total was of 46 including 6 cases of second exchange transfusions.)

Traditional guidelines suggest exchange transfusion in the following circumstances:

Within 12 hours of birth if

Cord blood bilirubin concentration exceeds 3 to 5 mg/dL for preterm infants, 5 to 7 mg/dL for term infants, or the rate of increase is >0.5 mg/dL/hour.

Severe anemia: haemoglobin 10 g/dl combined with hyperbilirubinemia

After 24 hours of birth if

Total bilirubin concentration >20 mg/dL or a bilirubin increase of >0.5 mg/dL/hour or haemoglobin 10 g/dL combined with hyperbilirubinemia.

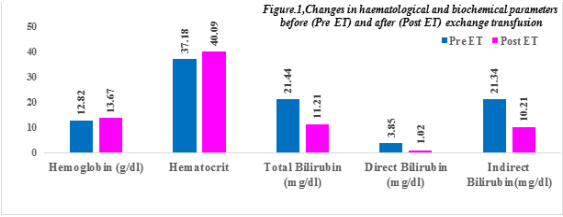
RESULT

The mean values of parameters before and after exchange transfusion were

a) Haemoglobin (g/dl): 12.82±0.50 g/dl and 13.67±0.41g/dl, respectively and P-value were 0.070. The mean difference was non-significant.
b) Haematocrit(%):37.18±1.42 and 40.09±1.20, respectively and P-value mean difference was 0.036 which was significant.
c) Total Bilirubin (mg/dl): 21.44±1.33 and 11.21±0.73 respectively and P-value were <0.001. The mean difference was highly significant.
d) Direct Bilirubin (mg/dl): 3.85±1.17 and 1.02±0.13, respectively and P-value for mean difference were 0.017 which was highly significant.
e) Indirect Bilirubin (mg/dl): 21.34±0.95 and 10.21±0.71 respectively and P-value for mean difference was <0.001 which was highly significant.

Table-1:-Changes in haematological and biochemical parameters before and after exchange transfusion

Variable	*Before transfusion*	*After transfusion*	*P-value*
Haemoglobin (g/dl)	12.82±0.50	13.67±0.41	0.070
Haematocrit (%)	37.18±1.42	40.09±1.20*	0.036
Total bilirubin (mg/dl)	21.44±1.33	11.21±0.73*	<0.001
Direct bilirubin (mg/dl)	3.85±1.17	1.02±0.13*	0.017
Indirect bilirubin (mg/dl)	21.34±0.95	10.21±0.71*	<0.001
*–Denotes significance difference in the Table			



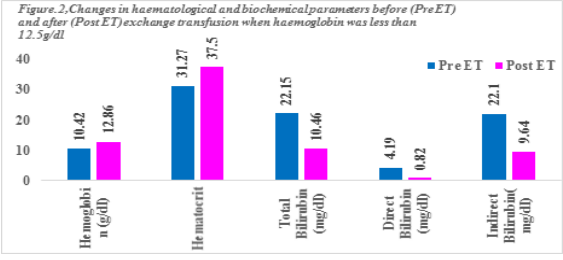
Changes in haematological and biochemical parameters before and after exchange transfusion when neonate's haemoglobin was less than 12.5 g/dl (Table.2 and Figure.2):-

When haemoglobin was less than12.5 g/dl the mean value of parameters before and after exchange transfusion were

a) Haemoglobin (g/dl): 10.42±0.40 and 12.86±0.44 respectively and P-value for mean difference was <0.001 that was highly significant.
b) Haematocrit (%): 31.27±1.31 and 37.50±1.24, respectively and P-value of mean difference was <0.001 suggesting that the mean difference was highly significant.
c) Total Bilirubin (mg/dl): 22.15±1.92 and 10.46±0.95, respectively and P-value of mean difference mean difference was <0.001 which was highly significant.
d) Direct Bilirubin (mg/dl): 4.19±1.70 and 0.82±0.09, respectively and P-value mean difference was 0.06 which was non-significant.
e) Indirect Bilirubin (mg/dl): 22.10±1.39 and 9.64±0.93, respectively and P-value mean difference was <0.001 which was highly significant.

Table-2:-*Changes in haematological and biochemical parameters before and after exchange transfusion when neonate's haemoglobin was less than 12.5g/dl (Table.2and figure. 2):-*

Variable	*Before transfusion*	*After transfusion*	*P-value*
Hb (g/dl)	15.63±0.42	14.54±0.63	0.035
Haematocrit (%)	41.72±2.12	42.79±1.90*	0.641
Total bilirubin (mg/dl)	19.82±1.89	11.92±1.04	<0.001
Direct bilirubin (mg/dl)	4.20±1.70	1.23±0.24*	0.079
Indirect bilirubin (mg/dl)	20.14±1.16	10.73±0.99	<0.001
*–Denotes significance difference in the Table			



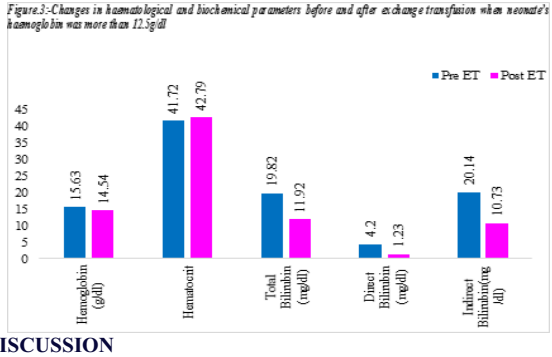
Changes in haematological and biochemical parameters before and after exchange transfusion when neonate's haemoglobin was more than 12.5 g/dl (Table.3 and Figure.3):-

When haemoglobin was more than 12.5 g/dl, the mean value of parameters before and after exchange transfusions of blood were

a) Haemoglobin (g/dl): 15.63±0.42 and 14.54±0.63 g/dl, respectively and P-value of mean difference 0.035 which was significant.
b) Haematocrit (%): 41.72±2.12 and 42.79±1.90, respectively and P-value mean difference was 0.641 which was non-significant.
c) Total Bilirubin (mg/dl): 19.82±1.89 and 11.92±1.04, respectively and P-value of mean difference was <0.001 which was highly significant.
d) Direct Bilirubin (mg/dl): 4.20±1.70 and 1.23±0.24, respectively and P-value of mean difference were 0.079 which was non-significant.
e) Indirect Bilirubin (mg/dl): 20.14±1.16 and 10.73±0.99, respectively and P-value of mean difference was <0.001 which was highly significant.

Table-3:-Changes in haematological and biochemical parameters before and after exchange transfusion when neonate's haemoglobin was more than 12.5g/dl

Variable	*Before transfusion*	*After transfusion*	*P-value*
Hb (g/dl)	10.42±0.40	12.86±0.44*	<0.001
Haematocrit (%)	31.27±1.31	37.50±1.24*	<0.001
Total bilirubin (mg/dl)	22.15±1.92	10.46±0.95*	<0.001
Direct bilirubin (mg/dl)	4.19±1.70	0.82±0.09	0.06
Indirect bilirubin(mg/dl)	22.10±1.39	9.64±0.93*	<0.001
*–Denotes significance difference in the Table			



DISCUSSION

The mean values of Hb before and after exchange transfusions of blood were 12.82±0.50 g/dl and 13.67±0.41 g/dl, respectively and the rise in mean value of Hb after exchange transfusions was 0.85 gm/dl and P-value was 0.070. The mean difference was non-significant, which is not comparable with the study done by Sharma, *et al* (2013)[3] in which pre transfusion mean Hb was 12.46g /dl, post transfusion mean HB was 16.17 g /dl, average increase in post transfusion Hb was 3.71 g /dl and the study done by Serdar, *et al* (2006)[4] where average haemoglobin was 10.64±1.34 g/dl.

2. But When neonates haemoglobin was less than 12.5 g/dl the rise in mean value of Hb after exchange transfusions was 2.44 gm/dl and P-value mean difference was <0.001 which was highly significant. Moreover when neonate's haemoglobin was more than 12.5 gm/dl, there was **fall** (rather than rise) in mean value of Hb after exchange transfusions by 1.09 gm/dl and P-values mean difference was 0.035 which was significant. Suggesting that while selecting Whole Blood for exchange transfusion it should also be checked for Haemoglobin (Hb) values and the Whole Blood with higher Haemoglobin (i.e. with values closer to normal neonatal Hb) should be preferred for exchange transfusion for better rise in neonatal Hb after the exchange transfusion.

3. The Haematocrit mean value before and after exchange transfusions of blood were 37.18±1.42% and 40.09±1.20%, respectively and the Haematocrit (%) means value of rise after exchange transfusions of blood was 2.98 and P-value means difference was 0.036 which was significant but non-congruous with observation of Audu *et al,* (2017)[5] examined the haematocrit in babies who underwent double volume exchange transfusion for severe hyperbilirubinaemia with compatible fresh whole blood. Mean donor haematocrit was 41.2 (4.3) % with a range of 34.0% to 53.0%. Pre EBT haematocrit 39.8(9.0) % was similar to the post ET haematocrit 39.1(3.7) %, P=0.983, Serdar, *et al* (2006)[4] delineated that the average haematocrit, value of 47%±3,3in children of exchange transfusion.

4. And Congruous with Seddigheh and Gharehbaghi (2010)[6] mentioned that the mean pre-ECT haematocrit of exchange transfused patients with whole blood and reconstituted blood was compatible. Although the mean post-ECT haematocrit in the reconstituted group was higher (39.74 +/- 5.65 versus 38.21 +/- 3.59), this difference was not significant (p is 0.15). They concluded that ECT with either reconstituted or fresh whole blood was an efficient and safe method for

reducing hyperbilirubinaemia. In present study, we had used fresh whole blood for ETC.

5. The mean value of Total Bilirubin before and after exchange transfusions of blood were 21.44±1.33 mg/dl and 11.21±0.73 mg/dl respectively. The average fall in total serum bilirubin is 47.71 % and P-value was <0.001. The mean difference was highly significant. The pre exchange values were less than those observed by Seddigheh and Gharehbaghi (2010)[6] that the mean total serum bilirubin before ECT was 29.59±6.88 mg/dl, Heydarian and Majdi (2010)[7] recorded Mean serum bilirubin levels as 28.7 mg/dl (SD. 9.2), Hakan *et al* (2014)[8] observed the mean peak total bilirubin levels as 25.8 ± 6.6 mg/dl. Sabzehei *et al* (2015)[9] found that the mean maximum total serum bilirubin levels were 27.76 ±7.28 mg / dL. Mostefa (2016)[10] found that for 132 total neonates, the mean initial TSB was24.34 mg/dl (SD 5.13). Singla, et *al* (2017) [11] mean of pre-exchange TSB level was 27.1 ± 10 mg/dl. This was reported to be 30 mg/dl by Bhat et al. (2011) [12] and 25.9 ± 7.5 mg/dl by Badiee (2007) [13] and 28.1 ± 6.4 by Davutoğlu et al (2010).[14] In our study we had included preterms too, in whom the exchange transfusion is done at lower total bilirubin values, compared to term neonates.

6. The mean Direct Bilirubin values before and after exchange transfusions of blood were 3.85±1.17 mg/dl and 1.02±0.13 mg/dl, respectively. The average fall in direct serum bilirubin was 73.51 % and P-value for mean difference was 0.017 which was highly significant.

7. The mean value of Indirect Bilirubin before and after exchange transfusions of blood were 21.34±0.95 mg/dl and 10.21±0.71 mg/dl respectively. The average fall in indirect serum bilirubin is 52. 16% and P-value for mean difference was <0.001 which was highly significant. This is slightly better than most of the other studies in which fall in indirect serum bilirubin was, 52.01%, 51.9% and 52% respectively as recorded by Sharma, et al, (2007)[15] and Mujumdar (2015)[10] and Bansal (2016) [16]but antithetical to 54.6% by Sharma, *et al* (2013).[3]

It was **concluded** from the present study on neonates with Hyperbilirubinemia undergoing double volume exchange transfusion (DVET), that while selecting Whole Blood for exchange transfusion it should also be checked for Haemoglobin and haematocrit values and the Whole Blood with higher Haemoglobin and Haematocrit (i.e. with values closer to normal neonatal Hb and Hct) should be preferred for exchange transfusion for better rise in neonatal Hb and Hct after the exchange transfusion. Exchange transfusion results in significant decrease in total, indirect and direct billirubin leading to speedy recovery towards normal bilirubin values. It was more effective in reducing direct bilirubin levels (73.51 %) compared to indirect (52.16%).

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