

Study of effect of exchange transfusion in pre-term and term infants: A prospective study

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Abstract

Hyperbilirubinemia is usually benign in preterm and term infants. Dangerous hyperbilirubinemia is uncommon but may cause long term neurological impairment. In a resource limited rural setup exchange transfusion is an easy, cheap and convenient way for treatment. Our Study focus to improve the outcome in neonatal Hyperbilirubinemia patients in a rural referral center of Odisha.

Aim: Our present study aims at determining the alternations of various haematological and biochemical parameters after exchange transfusion along with adverse outcomes in pre-term and term infants.

Materials and Methods: Total 106 new-borns blood samples were taken from those who have under gone exchange transfusion for different indications. New-borns are divided into two groups pre-term and term infants.

Results: A significant decrease in serum bilirubin values was observed in both the groups after exchange transfusion. Also a significant decrease in blood platelet and increase in calcium level were also present.

Conclusion: Proper approach and prompt management is needed in case of neonatal-hyperbilirubinemia in a resource limited rural setup.

Keywords: Exchange Transfusion, Hyperbilirubinemia.

Introduction

Normally bilirubin is formed from the metabolism of haeme, a component of red blood cell. Upon premature destruction of red blood cells there is increase in bilirubin concentration. Normally this process is physiological but in presence of certain conditions like autoimmune diseases of new-born bilirubin level may increases pathologically.^{1,2}

Neonatal hyperbilirubinemia with elevation of serum bilirubin levels usually occurs in pre-term and term infants leading to morbidity but usually not life threatening. However, if serum bilirubin levels exceeds a dangerous limit, which varies with various factors like birth weight, gestational age, chronological age and rate of increase in un-conjugated bilirubin concentration, bilirubin may cross blood brain barrier as in neonates blood-brain barrier is not fully developed and bilirubin encephalopathy, kernicterus may occur.³⁻⁵

Severe hyperbilirubinemia occurs when the total serum bilirubin (TSB) concentration is >340 $\mu\text{mol/L}$ at any time during the first 28 days of life and critical hyperbilirubinemia occurs when the Total Serum Bilirubin concentration is >425 $\mu\text{mol/L}$ during the first 28 days of life.¹

Materials and Methods

The present study was done in the Department of Pathology in association with the Department of Paediatrics in Veer Surendra Sai Medical College, Burla from period July 2016 to August 2017. All haematological parameters are measured in Regional Diagnostic Centre of our Medical College. A total of Hundred-six blood samples were analysed including both pre-term and term infants who had under-gone exchange transfusion. The pre-term and term infants were placed in Group A and Group B respectively.

Before Exchange Transfusion: Bilirubin, Hemoglobin, total Leukocyte count, platelets, blood urea and creatinine, serum electrolytes, total serum calcium, serum phosphate, c-reactive protein were measured in the first aliquot of blood drawn from the baby.

Post-Exchange Transfusion: At the end of the procedure the last aliquot of blood drawn from the baby was collected and all the above parameters were re-estimated.

Exchange transfusion was done by standard push-pull method through umbilical route.

Results

Table 1: Details of Group A & B infants studied

Term Infants	Numbers & sex		Birth weight		Gestational age(weeks)
	M	F	Range	No of Infants	
39	25	14	2500-2999	30	
			>3000	9	
Pre-term infants			<1000	0	

67	38	29			
			1000-1499	6	<28 weeks
			1500-1999	36	28-31 weeks
			2000-2499	25	32-36 weeks

Table 2: Distribution of new-borns according to etiology of jaundice

S. No.	Etiology	Group A (n=39)	Group B (n=67)
1.	Rh incompatibility	4	7
2.	ABO incompatibility	15	24
3.	Rh and ABO incompatibility	3	5
4.	Cephalhematoma	1	0
5.	Septicaemia	9	19
6.	Unknown	7	12

Table 3: Changes in haematological and bio-chemical parameters in admitted babies before and after exchange transfusion

Hematological Parameters	Pre-transfusion	Post-transfusion	P-Value
Total bilirubin $\mu\text{mol/L}$ (mean(SD))	494.9(138.2)	182.5(59.3)	<0.001
Direct bilirubin $\mu\text{mol/L}$ (median(range))	24(12.5–28.5)	14.0(10.3–22.04)	0.034
Haemoglobin g/dL (mean(SD))	14.0(3.2)	14.3(1.9)	0.638
White cell count $\times 10^9/\text{L}$ (mean(SD))	11.9(7.2-16.2)	9.8(5.4-12.3)	0.161
Platelets $\times 10^9/\text{L}$ (mean(SD))	225.6(121.1)	135.9(86.7)	<0.001
Urea mmol/L(mean(range))	4.2(3.4)	3.5(2.6)	0.443
Creatinine $\mu\text{mol/L}$ (median(range))	44.5(31.3–59.5)	51(33.0–64.5)	0.211
Sodium mmol/L(median(range))	143.0(138.3–146.0)	142.0(138.1–145.9)	0.312
Potassium mmol/L(median(SD))	4.4(3.7-5.1)	4.3(3.6-4.9)	0.473
Calcium mmol/L(median(SD))	2.5(2.3-2.8)	3.0(2.6-3.3)	<0.001
Magnesium mmol/L(median(SD))	0.91(0.76-0.97)	0.88(0.78-0.95)	0.606
Phosphate mmol/L(mean(range))	2.0(0.5)	2.5(0.5)	0.016
C-reactive protein mg/mL(median(range))	2.9(1.0–9.8)	3.1(1.0–12.1)	0.653

Discussion

Neonatal jaundice leading to severe hyperbilirubinemia still remains a major problem in our Western Odisha. An exchange transfusion soon after birth is indicated if:

1. Cord bilirubin is ≥ 5 mg/dl
2. Cord Hb is ≤ 10 g/dl, PCV <30.
3. Previous sibling history and positive direct coomb test.

Subsequent exchange transfusion is indicated if:

1. Bilirubin ≥ 10 mg/dl within 24 hours of age.
2. Bilirubin ≥ 15 mg/dl between 25-48 hours of age.
3. Bilirubin ≥ 20 mg/dl after 48 hours of age.
4. Rate of rise of bilirubin is ≥ 0.5 mg/dl/hr.

In exchange Transfusions infant's blood is exchanged with adult blood by conventional push-pull technique in 10 ml aliquots. Total volume of donor's blood infused is usually 80 ml/kg body weight in a single volume of exchange transfusion, it replaces about 60% of the infant's blood volume and in double volume exchange transfusion 170 ml/kg body weight, where it replaces 85% of the blood volume.¹⁰ A significant proportion of serum bilirubin is removed from the body which ensures immediate protection against the

imminent bilirubin toxicity.^{6,11} Phototherapy is an effective way of decreasing the bilirubin level in neonates, by converting un-conjugated bilirubin into isomers like lumirubin that are water soluble and can be excreted in the urine.^{7,12} Exchange transfusion however, is considered to be the most effective and quickest method to lower the bilirubin level in infants at high risk of kernicterus.^{13,14} An ET is indicated when hyperbilirubinemia remains at dangerous levels despite intensive phototherapy and is particularly useful when there is excessive haemolysis.^{13,15} In the present study, most babies with hyperbilirubinemia were male, breastfed, and delivered vaginally.²

The present study highlights the fact that there are two populations of new-born babies who undergo exchange transfusion, premature and sick babies who remain in hospital after birth and well term babies who are discharged after birth. The prevention of severe hyper-bilirubinemia is different for these two groups. For all babies, it is important to know the mother's blood group and to screen babies for jaundice in the first 48 hours after birth.

In the present study, out of 106 new-borns, 63% (67) were low birth weight. In group A, 77% new-borns had their birth weights in the range of 2500-2999 grams, while only 23% were >3000 grams. All new-borns in group A were term (37-41 weeks). In group B, maximum 53.73% new-borns had their birth weight in the range of 1500-1999 grams and 37.31% in the range of 2000-2499 grams.

Increased incidence of neonatal hyperbilirubinemia in preterm and low birth weight babies can be explained on the basis of hepatic immaturity.¹⁵

Our study found that maximum number of new-borns who were exchanged for jaundice had ABO incompatibility i.e. 38.46% in group A and 35.82% in group B. In the present study second-most common cause for exchange in new born is sepsis i.e. 23.07% in group A and 28.35% in group B, which directly reflects lack of proper education and poor health services in villages of western Odisha. Only a single case of Cephalhematoma was documented. In 17.92% cases the aetiology of jaundice could not be determined. In the present study we found that there is a significant decrease in serum bilirubin levels post-exchange transfusion. Though phototherapy is very much popular in the management of neonatal jaundice but to avoid the risk of bilirubin encephalopathy exchange transfusion is the method of choice.¹⁶ In our study post exchange transfusion Thrombocytopenia is a major adverse event.¹⁷

In the present study mean Post Exchange total calcium level was significantly higher than the pre-exchange total calcium level ($p < 0.001$). This transient rise of total calcium level was associated with routine use of intravenous administration of 10% calcium gluconate after each 100 ml of blood exchange in order to counteract any fall in serum ionized calcium levels.¹⁸ Such fall occurs due to calcium chelating properties of citrate which is present in high concentration in the donor's blood where it is used as an anticoagulant.^{17,18} Calcium level came within the normal range after 24 hours of transfusion.

Among rest of the parameters haemoglobin and total leucocyte count shows a little improvement after exchange transfusions.

Conclusion

Neonatal Hyper-bilirubinemia is still a one of the major health hazards in neonates but should largely be preventable if health care personnel's give emphasis on prompt management as per the recommendations. We recommend to give emphasis on the importance of universal, systematic assessment towards the risk factors of severe hyperbilirubinemia, close follow-up, and prompt intervention, when necessary. Careful monitoring of the risk factors involved a systematic approach to the detection and follow-up of neonatal jaundice cases with appropriate laboratory investigations, along with judicious exchange

transfusion when indicated, are the best approach to avoid complications in a rural setup.

Conflict of Interest: None.

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