ABSTRACT

Double volume (170 ml/kg body weight) exchange transfusion was done in 52 term infants in the first week of life for neonatal hyperbilirubinemia. The M:F ratio was 1.08:1 and 37 (71.1%) babies were of low birth weight. Causes of jaundice were hemolytic in 46.2% and non-hemolytic in 41.3% cases; in 13.5% babies no cause of jaundice could be found. After exchange transfusion a fall of 14.6% and 47.4% was observed in the hemoglobin and serum bilirubin levels respectively. There was significant (p=0.0414) rise in the mean mid exchange and post-exchange serum sodium levels as compared to pre-exchange values and it was found to be due to higher donor’s serum sodium levels (p=0.007). There was no effect on the serum potassium levels during or after ET.

In general serum calcium levels significantly increased at mid-exchange period (p=0.0029) but post-exchange levels were same as pre-exchange. Donor’s serum calcium level had no effect on the infant’s serum calcium level (p=0.993). There was no change in the serum phosphate and blood urea levels during and after exchange-transfusion. The plasma glucose was significantly raised during and after ET and plasma glucose of the donors had significant effect on the infant’s plasma glucose levels (p=0.043). Similarly plasma osmolality also showed significant increase during and after ET which was due to the effect of donor’s plasma osmolality (p=0.007).

INTRODUCTION

Neonatal hyperbilirubinemia with mild to moderate elevation of serum bilirubin levels is generally considered to be an innocuous state. However, if serum bilirubin levels exceed a dangerous limit, that varies with birth weight, gestational age, chronological age and internal milieu of the body, bilirubin may cross blood brain barrier and bilirubin encephalopathy results. Kernicterus, a pathological description of bilirubin encephalopathy, rarely occurs when serum bilirubin levels are below 18-20 mg% in term infants(1).

Despite advent of phototherapy as a therapeutic modality, exchange transfusion (ET) plays a significant role in the treatment of neonatal hyperbilirubinemia by eliminating serum bilirubin quickly. In ET infant’s blood is exchanged with adult blood by conventional discontinuation technique in 10 ml aliquotes. Total volume of donor’s blood infused is usually double (170 ml/kg body wt) the total blood volume of the infant (85 ml/kg body wt) and it replaces about 87% of the infant’s blood (1). A significant proportion of serum bilirubin is removed from the body which ensures immediate protection against the imminent bilirubin toxicity (2). Although it is considered to be a safe undertaking, many changes take place in various serum biochemical parameters, plasma osmolality and electrolyte profile in the recepient infants which may give rise to post operative complications including death, syncope and serious ECG changes. These changes result due to procedure per se and to infusion of large volume (170 ml/kg body wt) of adult blood that is qualitatively different from that of an infant (2,3,4,5). Many biochemical alterations following ET have not been studied in detail, hence this study.
MATERIALS AND METHODS

The present prospective study was undertaken in the Neonatal Intensive Care Unit, Dept. of Pediatrics and Dept. of Biochemistry. Only term newborn infants of both sexes born at 37 to 41 completed weeks of gestation, calculated from last date of menstrual period of their mothers, in whom double exchange blood transfusion was done in the early neonatal period (age <7 days) by one of us (AJ) according to Cockington's criteria (6), were included in the study. Babies in whom partial exchange transfusion was done earlier or where ET was done with single or 1.5 volume of blood were excluded. In all 52 newborns fulfilled the criteria of inclusion with M:F of 1.08:1.

Complete history of pregnancy and delivery was elicited, birth weight of babies was recorded by electronic weighing scale (Secca, Germany), complete examination of the babies was carried out and breast feeding was offered within two hours of birth. When clinical jaundice was observed and baby fulfilled Cockington's criteria (6) for ET, following parameters were studied:

Before ET: Hemoglobin, blood urea, plasma glucose, serum electrolytes, total serum calcium, serum phosphate and plasma osmolality were measured in the first aliquot of blood drawn from the baby and in the donor's blood.

Mid-ET: All the above parameters in the baby's blood were estimated when 50% of the donor's blood was exchanged.

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

ET was done by standard method through umbilical route (1,2). An aliquot of 10 ml of blood was removed from the infant's body and the same amount of donor's blood was infused. The procedure was carried out with alternate removal of infant's blood and infusion of donor's blood with written record till whole of the donor's blood was transfused. The whole procedure took about 45 to 60 minutes. The donor's blood was collected between 2 to 4 days prior to ET.

Serum electrolytes were estimated by microanalyser (AVL 984-5). Total serum calcium was estimated by autozyme calcium kits and serum phosphate was measured by modified method of Fiske and Subbarow (7). Plasma glucose was done by Glucose-oxidase method using Ranbaxy kits; blood urea was estimated by Netelson method (8). Plasma osmolality was calculated by the following formula (9):

\[ \text{Osmolality (mosm/l) = } 2\text{[Na+] (mEq/l) + [Glucose]18(mg%) + BUN/2.8} \]

The p value and significance for various biochemical parameters was calculated by one way analysis of variance with Tukey and Duncan tests and regression analysis was applied for analyzing effect of donor's blood; the data was processed on SPSS-PC computer version 5.

RESULTS AND DISCUSSION

Out of 52 neonates 71.1% were of low birth weight (<2500 gm). Cause of jaundice was hemolytic in 46.2% cases, with ABO blood group incompatibility accounting for 30.8% and Rh-incompatibility for 13.5% cases. Oxytocin induction/augmentation of labor was responsible for hemolytic jaundice in 1.9% cases only. Nonhemolytic causes of jaundice were septicemia (17.3%), cephalhematoma (3.8%) and low birth weight per se (19.2%) and no cause could be found in 13.5% cases. Most of the babies required ET between 24 to 72 hours of age (71.2%); 4 (7.7%) babies were between 4 and 7 days and one baby was subjected to ET with in 24 hours of birth. There was a fall of 14.6% in the hemoglobin level after ET which was higher in hemolytic cases (17.3%) in comparison to non-hemolytic cases (14.9%). A fall of 47.4% was observed in the serum bilirubin level which was slightly higher in the non-hemolytic cases (48.47% vs 46.1% in hemolytic cases). These observations are in conformity with other workers (1,2,5,13). The results of various parameters analysed are given in tables 1 and 2.