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Electrolyte Changes in the Term Neonates Following Phototherapy in Neonatal Hyperbilirubinemia.

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ABSTRACT

Background: Hyperbilirubinemia is one of the most prevalent problems in neonates. Jaundice is observed during first week of life in approximately 60% of term neonates and 80% of preterm neonates. Phototherapy is the most common therapeutic modality used in the treatment of uncomplicated neonatal hyperbilirubinemia. Objective: To study electrolyte (Ca, Na, K, Cl) changes in the term neonates following phototherapy in neonatal hyperbilirubinemia. **Methods:** This study was performed on 100 term neonates (65 males, 35 females) admitted to the Department of Pediatrics, Bebe Nanki Mother and Child Care Centre, Government Medical College, Amritsar, Punjab with unconjugated hyperbilirubinemia and were managed with phototherapy. These neonates were completely normal on physical examination. Electrolytes were checked at 0 hr (at the time of admission) and after 48 hours of phototherapy or at discontinuation of phototherapy (second sample) whichever was earlier. The first sample was considered as control. **Results:** After phototherapy, among electrolytes (Ca, Na, K ,Cl) there was significant fall in serum calcium (ionized) level. 16 neonates developed hypocalcemia after 48 hr or less of phototherapy and 11 neonates developed hypocalcemia after 48 hr or up to 96 hr of phototherapy. The difference between pre and post phototherapy serum calcium (ionized) levels was found to be statistically significant (p <0.005). Of the 27 term neonates who developed hypocalcemia, 7 (26%) developed jitteriness and none of them developed irritability, seizures and aponea. No statistically significant fall/rise in levels of Na, K, Cl were observed in term neonates after phototherapy. The incidence of potassium, sodium and chloride changes following phototherapy was found to be non-significant irrespective of gestational age, birth weight and duration of phototherapy. **Conclusion:** The study concluded that among electrolytes (Ca, Na, K, Cl), phototherapy induced hypocalcemia is a significant problem. Thus calcium supplementation should be considered.

Keywords: Phototherapy, Hypocalcemia, Electrolytes, Term neonates.

INTRODUCTION

Neonatal hyperbilirubinemia is one of the most prevailing clinical conditions in newborns.[1] It is usually encountered during the first week of life after birth.[2,3] It usually takes 24-72 hrs after birth to become evident clinically.[4] About two third of healthy new born babies are expected to present with idiopathic neonatal jaundice.[5] Jaundice is the yellowish discoloration of sclera and skin in a newborn due to high levels of serum bilirubin.[6] Neonatal icterus first appears on the face followed by discoloration of body and extremities.[7] Premature birth, significant bruising during birth, blood type, breast feeding and sepsis are the main factors responsible for neonatal jaundice.[8,9] Immaturity of the liver in the absence of any other illness results in elevated levels of unconjugated bilirubin leading to physiological jaundice. Visual examination of sclera and subcutaneous tissue should be performed either in day light or in a properly lit room.[10] Any suspicion after clinical examination should be elucidated by assessing transcutaneous bilirubin (TcB) or total serum bilirubin (TSB).[11] The use of visible light for the treatment of neonatal jaundice is called phototherapy.[12] In general, total serum bilirubin level declines with phototherapy.

Aims and Objectives

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To evaluate the electrolyte changes in the term neonates following phototherapy in neonatal hyperbilirubinemia.

MATERIALS AND METHODS

This study was performed in the Department of Pediatrics, Bebe Nanki Mother and Child Care Centre, Government Medical College, Amritsar, Punjab, after taking approval from Ethics Committee. It was hospital based prospective study involving 100 term neonates who did not have problems such as congenital abnormalities, sepsis, dehydration symptoms.. Informed consent was obtained from parents/guardians.

Inclusion criteria

1. Term neonates, weighing >2.5 kg
2. Exclusively breast fed
3. Total serum bilirubin(TSB) between 14-20 mg/dl and direct bilirubin <2 mg/dl
4. 3-7 days old

Exclusion criteria

1. Preterm neonates
2. Rh and ABO incompatability
3. Sepsis
4. Birth Asphyxia
5. Congenital malformations
6. Infant of diabetic mother
7. Hemolytic anemia
8. Any new born needing exchange transfusion

Steps

Each case was subjected to detailed history taking and clinical examination. Venous blood samples were collected for TSB, direct bilirubin, electrolytes, blood group, Rh factor, complete blood count and PBF for hemolytic anemia. Electrolytes (Na, K, Cl) were measured by Colorimetric kit & calcium by OCPC method. Total serum bilirubin levels were analyzed by NEO-BIL PLUS bilirubinometer. Phoenix LED phototherapy units were used to deliver phototherapy.

RESULTS

The study included 100 term neonates with mean gestational age 39.15 ± 1.03 weeks and mean weight was 2.86 ± 0.25. None of the babies developed jaundice before first 24 hr of life. All neonates were having TSB between 14-20 mg/dl. Mean duration of phototherapy was 46.19□12.63 hr.

Mean value of serum bilirubin (direct) was 1.62 □ 0.533 mg/dl before the start of phototherapy. Decrease in mean value of serum bilirubin (direct) was statistically significant with p-value 0.037 when given phototherapy up to 48 hr and 0.044 when given phototherapy from 48-96 hr.

Table 1: S. Calcium (Ionized)

S. Calcium (Ionized) (mg/dl)	At the start of phototherapy		Phototherapy given up to 48 hr		Phototherapy given from 48-96 hr	
	No. of patients	% age	No. of patients	% age	No. of patients	% age
3-3.9	1	1.00	16	16.00	11	91.66
4.0-4.9	97	97.00	84	84.00	0	0
>5	2	2.00	0	0	1	8.34
Total	100	100.0	100	100	12	100

Mean value of serum calcium (ionized) before start of phototherapy was 4.41□0.26 mg/dl. Mean value of serum calcium (ionized) was 4.13±0.26 mg/dl when phototherapy was given up to 48 hr and further decreased to 3.71±0.18mg/dl when phototherapy was given from 48-96 hr with statistically significant p-value 0.000.

Out of 100 neonates, 27(27%) neonates developed hypocalcemia after phototherapy. 16 neonates developed hypocalcemia when phototherapy was given up to 48 hr and 11 neonates developed hypocalcemia when phototherapy was given from 48-96 hr.

Table 2: Symptoms of hypocalcemia.

	No. of patients	% age
Jitteriness	07	26
Irritability	0	0
Seizures	0	0
Aponea	0	0
Asymptomatic	20	74

Out of 27 term neonates who developed hypocalcemia, jitteriness was noted in 7 (26%) neonates. None of them developed irritability, seizures and aponea. Out of these, 20(74%) remained asymptomatic. No statistically significant change was noted in levels of other electrolytes (Sodium, Chloride and Potassium) following phototherapy.

Table 3: Conclusive comparison of electrolytes before and after phototherapy.

	Before phototherapy	After phototherapy	Difference	p-value
Serum Bilirubin (Total) (mg/dl)	16.93±1.60	14.94±3.54	1.99	0.000
Serum Bilirubin (Direct) (mg/dl)	1.62±0.533	1.36±0.29	0.26	0.044
Serum Calcium (Total) (mg/dl)	8.91±0.40	8.34±0.28	0.57	0.000
Serum	4.41±0.26	3.71±0.18	0.7	0.00

Calcium (Ionized) (mg/dl)				0
Serum Sodium (mEq/L)	138.48±3.51	138.57±2.98	-0.09	0.914
Serum Potassium (mEq/L)	4.38±0.45	4.35±0.396	0.03	0.810
Serum Chloride(mEq/L)	103.25±4.69	103.81±4.16	-0.56	0.628

DISCUSSION

Neonatal hyperbilirubinemia is a life threatening condition in neonates. Phototherapy is a simple, easily available, most common and widely used form of treatment to reduce indirect bilirubin level in newborns and it is a relatively safe method. In our study, we took a cut value of serum calcium of <7 mg/dL, which is similar to cut of value taken by Karamifer et al,[13] Taheri et al,[14] Arora et al.[15] Our study assessed the change in the electrolytes level at different intervals of time i.e at beginning, up to 48 hr and from 48- 96 hr of phototherapy.

Phototherapy induced electrolyte changes:

The present study reported a decrease in serum calcium (ionized) value in 27 (27%) term neonates. This incidence of hypocalcemia after phototherapy was in consonance with results of studies of Goyal S et al,[16] and Jain SK et al,[17] who reported hypocalcemia in 35% and 30% of term neonates respectively. Mean value of serum calcium (ionized) before start of phototherapy was 4.41□0.26mg/dl. Mean value of serum calcium (ionized) was 4.13±0.26mg/dl when phototherapy was given up to 48 hr and further decreased to 3.71±0.18mg/dl when phototherapy was given from 48-96 hr with statistically significant p-value 0.000.

Before the start of phototherapy, the number of neonates having serum calcium (total) levels between 7-9 mg/dl and >9 mg/dl was 70 and 30 respectively. None of them had serum calcium (total) below 7mg/dl. Mean value of serum calcium (total) before the start of phototherapy was 8.91□0.40mg/dl. A significant fall was noted in serum calcium (total) with mean value of 8.50±0.37mg/dl and 8.34±0.28mg/dl respectively when phototherapy was given up to 48 hr and from 48-96 hrs. This value was in correlation with studies done by Bahbah et al18 (8.58±0.76) and Singh et al19 (8.42±1.19)

Khan M et al,[20] in their study showed 28 out of 123 neonates developed hypocalcemia, while in present study 27 out of 100 neonates developed hypocalcemia.

As compared to present study, incidence of hypocalcemia was almost double in the study done by Rajesh et al,[21] in which 50 neonates were studied. Out of these 80% of preterm and 66.6% of term babies developed hypocalcaemia post phototherapy.

Manoj GM et al,[22] reported higher prevalence of hypocalcemia.

In the present study, out of 27 term neonates who developed hypocalcemia, jitteriness was noted in 07 (26%) neonates, which is in consonance with the study conducted by Rastogi D et al,[23] in which jitteriness was the only symptom due to hypocalcemia. None of them developed irritability, seizures and aponea while 74% remained asymptomatic. Tehrani et al,[14] Rozario CI et al,[24] and Reddy et al in their studies stated that none of the hypocalcemic neonates were clinically symptomatic.

Prabhakar N et al,[25] in their study involving symptomatic cases of hypocalcemia, 23% were found to be lethargic, 39% had jitteriness and 38% were irritable. But in the present study, jitteriness was the only symptom due to hypocalcemia. None of the babies had lethargy or irritability.

Inhibition of pineal gland via trans cranial illumination results in hypocalcemia following phototherapy, which results in decrease of melatonin secretion which in turn blocks the effect of cortisol on bone calcium. Cortisol has a direct hypocalcemic effect and increases bone uptake of calcium and leads to hypocalcemia.

Beresford D, Conolly G26 concluded that hypernatremia can occur in neonates during phototherapy due to inadequate feeding and increased insensible water losses due to phototherapy.Curtis et al27reported diarrhoea in neonates with hyperbilirubinemia who underwent phototherapy. The study showed that absorption of sodium, chloride and potassium was significantly impaired in the patients receiving phototherapy. In the present study, no change was found in the levels of serum sodium, serum potassium and serum chloride. Also there was no significant association between reduction in serum calcium (ionized) level and other parameters like weight, age at time of admission, feeding method, gestational age and sex in the present study.

CONCLUSION

Our study concluded that electrolyte changes especially hypocalcemia is a significant problem following phototherapy in neonates which is a commonly used treatment modality for neonatal hyperbilirubinemia. On the basis of present study it is recommended that, even though the prevalence of hypocalcemia is less, there is significant decrease in serum calcium level in term neonates undergoing phototherapy, So it is advisable to observe serum calcium level in neonates treated with phototherapy for 48 hr or more and calcium supplementation should be considered.

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