Original Research Paper

Volume-9 | Issue-3 | March-2019 | PRINT ISSN - 2249-555X

Paediatrics

EFFECT OF PHOTOTHERAPY ON SERUM CALCIUM LEVEL IN TERM NEONATE WITH HYPERBILIRUBINEMIA AT A TERTIARY CARE HOSPITAL

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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 one of the routine methods for management of hyperbilirubinemia. The aim of this study was to evaluate whether significant change in serum calcium level occurs in term neonates who are undergoing phototherapy and to find out the association between effect of phototherapy on serum calcium level.

Methods: This prospective study was conducted on 100 term neonates (65 males and 35 females) admitted to NICU of Paediatrics Department at Jawahar Lal Nehru Medical College Hospital Bhagalpur with unconjugated hyperbilirubinemia and requiring phototherapy. Total Serum bilirubin levels and serum calcium levels were checked before and after phototherapy. Neonates were assessed for clinical features of hypocalcemia i.e. jitteriness, irritability/excitability, lethargy and convulsions.

Results: After phototherapy, there was hypocalcemia in 33.0% neonates. The difference between pre and post phototherapy serum calcium levels were found to be statistically significant ($p < 0.001$). 3.0% of neonates developed jitteriness among those who had hypocalcemia. Hypocalcemia was more in subjects who received phototherapy for longer duration.

Conclusion: There is significant reduction in serum calcium level after phototherapy but risk of symptomatic hypocalcemia is low in healthy full-term neonates. Careful estimation of calcium status should be done before starting and during phototherapy for neonatal jaundice and close monitoring of neonates for signs of hypocalcemia should be done.

KEYWORDS : Hyperbilirubinemia, Hypocalcemia, Newborns, Phototherapy

INTRODUCTION:

Jaundice is the most common and important abnormal physical problem in the first week of life. Due to immaturity of the bilirubin metabolism approximately 60% of term new borns and 80% of preterms develop jaundice in the first week of life.

Jaundice is mainly due to immaturity in bilirubin metabolism resulting in imbalance between bilirubin production and elimination. Jaundice usually appear after 24 hours i.e between 24-72 hours of age. Due to physiologic immaturity premature babies are at a higher risk of developing hyperbilirubinemia No intervention is required in most cases but 5-10% of them have significant hyperbilirubinemia and use of phototherapy becomes mandatory. Untreated severe unconjugated hyperbilirubinemia is potentially neurotoxic. Among them about 5-10% may require active intervention in terms of phototherapy management which may be mandatory in such cases.

The commonly known side effects of phototherapy are loose stools, hyperthermia, dehydration fluid loss, skin burn, photoretinitis, low platelet count, increased red cell osmotic fragility, bronze baby syndrome, riboflavin deficiency and DNA damage. A lesser known side effect, but potential complication of phototherapy is hypocalcemia.

Neonatal hypocalcemia is defined as total serum calcium concentration of < 7 mg/dl or ionized calcium concentration of < 4mg/dl (<1mol/L). Ionized calcium is important in biochemical processes like blood coagulation, neuromuscular excitability, cell membrane integrity and function, and cellular enzymatic and secretory activity.

The aim of this study was to evaluate whether significant change in serum calcium level occurs in term neonates who are undergoing phototherapy and to find out the association between effect of phototherapy on serum calcium level.

MATERIALAND METHODS:

This study was conducted in Neonatal Intensive Care Unit of Paediatrics Department at Jawahar Lal Nehru Medical College Hospital Bhagalpur, a tertiary care teaching hospital in Eastern Bihar. Ethical approval for the study was obtained from the Institutional Ethical Committee. It was Hospital based prospective study and 100 term neonates were included in the study.

Inclusion criteria:

Full term neonates (37 completed weeks to 41 weeks) with unconjugated hyperbilirubinemia requiring phototherapy.

Exclusion criteria:

New borns

- To a diabetic mother
- With onset of jaundice within 24 hrs of age
- With perinatal asphyxia (Apgar <4 at 1 minute of birth)
- Whose mother had history of taking Anticonvulsants
- Fed with cow's milk
- Who had exchange transfusion
- ABO incompatibility.
- With jaundice lasting more than 14 days of life

Written informed consent was taken from parents/guardians of all eligible subjects in their preferred language. Complete maternal history was taken and maternal risk factors like hypertension, diabetes mellitus, oligohydramnios, anaemia, epilepsy, fever, any rash, any drug intake during pregnany other than iron and folic acid supplementation were ruled out. Complete history and physical examination was carried out in all neonates included in the study. Demographic and clinical variables were recorded. It included birth weight, sex, gestational age, mode of delivery, time of appearance of icterus in hours, maternal blood group and Rh status, baby blood group and Rh status, anthropometric measurements (weight, length and head circumference) of infant at the time of admission and duration of phototherapy. Total serum bilirubin (TSB), serum calcium, serum albumin, G6PD, Direct Coombs Test (DCT), Reticulocyte count and thyroid profile were sent in all cases. TSB and Serum calcium levels before and at the end of phototherapy were recorded. The first sample was considered as control. Hypocalcemia was considered as total serum calcium of <8mg/dl. Neonates were clinically assessed for features of hypocalcemia.

A conventional phototherapy equipment, containing four blue light fluorescent lamps with wavelengths of 410- 470nm, was placed at a distance of 25-35cm from the skin surface of neonates under standard protocol with eyes and genitals completely covered. The irradiance during phototherapy was measured and maintained consistently at 15µW/cm2 /nm at the level of infant's skin.

Statistical analysis: Data were analyzed using computer software, Statistical Package for Social Sciences (SPSS). Descriptive statistical

analysis was done and continuous variables were described as mean and standard deviation and categorical variables in number and percentage. Students paired t test and unpaired t test had been used to assess continuous variables for pair matched samples with 95% confidence limit. p value less than 0.001 was considered statistically significant.

RESULTS:

The study group included 100 neonates. Out of these 65 babies were male (65.0%) and 35 babies were female (35.0%), with mean gestational age of 38.28±0.95 weeks and mean birth weight of 2.71±0.33 kilograms. 61.0% neonates were delivered by normal vaginal delivery and 39.0% by lower segment caesarean section. Mean time of appearance of icterus and duration of phototherapy was 108.60±42.10 hours and 46.48±10.15 respectively (Table 1).

Table 1: Demographic features of newborns.

Variable	Mean and number (%)
Gestational age (weeks)	38.28±0.95
Birth weight (kilograms)	2.71±0.33
Time of appearance of icterus (hours)	108.60±42.10
Duration of phototherapy (hours)	46.48±10.15
Type of delivery	
Normal vaginal delivery	61.0%
Lower segment caesarean section	39.0%

Mean total serum bilirubin levels before and at the end of phototherapy was 18.58±2.58mg/dl and 10.18±3.17mg/dl respectively. Mean serum calcium levels before phototherapy was 9.24±0.78mg/dl and it reduced to 8.43±0.75mg/dl after phototherapy. It was found that there was significant reduction (p<0.001) in mean total serum bilirubin and mean serum calcium levels after phototherapy as compared to pre phototherapy levels (Table 2).

Table 2: Comparison between mean total serum bilirubin and serum calcium levels before and after receiving phototherapy.

Test	Admission time	After phototherapy	P value
Total serum bilirubin (mg/dl)	18.58±2.58	10.18±3.17	<0.001
Total serum calcium (mg/dl)	9.24±0.78	8.43±0.75	<0.001

Serum calcium levels after phototherapy was >8mg/dl in 67.0% of subjects and hypocalcemia i.e. serum calcium levels <8mg/dl was noted in 33.0% of subjects (Table 3, Figure 1).

Table 3: Descriptive data of serum calcium levels post phototherapy

Variable	N=100
Hypocalcemia (<8mg/dl)	33/100 (33.0%)
Normal calcium (>8md/dl)	67/100 (67.0%)

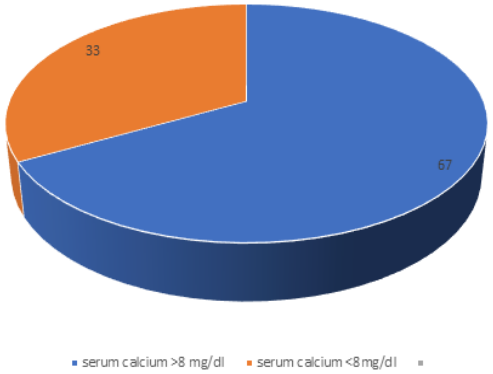
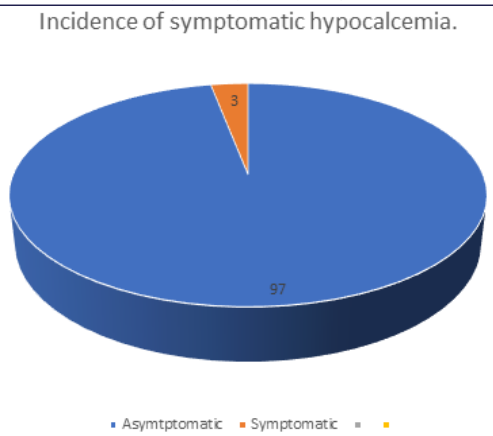


Figure 1: Incidence of hypocalcemia in term neonates after phototherapy

Out of 33 subjects who had hypocalcemia, only one subject (3.03%) was symptomatic and developed jitteriness. Rest of the subjects (96.97%) were asymptomatic (Table 4).

Table 4: Descriptive data of symptoms among hypocalcemic cases post phototherapy

Variable	N=33
Symptomatic (jiterriness)	1/33 (3 %)
Asymptomatic	32/33(97%)



Also, incidence of hypocalcemia was more in neonates who received phototherapy for 48hours (72.72%) as compared to neonates who received phototherapy for 24 hours (27.28%) (Table 5, Figure 2).

Table 5: Incidence of hypocalcemia based on the duration of phototherapy.

	Hypocalcemia	Percentage
24 hours	9	27.28 %
48 hours	24	72.72 %
Total	33	100%

DISCUSSION:

Phototherapy is an appropriate and commonly used measure to reduce indirect bilirubin level in newborns. Romagnoli et al was the first to suggest the association of hypocalcemia in newborn following phototherapy. The mechanism of hypocalcemic effect of phototherapy was reported by inhibition of pineal gland via transcranial illumination, resulting in decline of melatonin secretion which blocks the effect of cortisol on bone calcium. Cortisol has a direct hypocalcemic effect and increases bone uptake of calcium and induces hypocalcemia.

In this study, there was a significant decrease in serum calcium levels after 48 hours of phototherapy (p <0.001). The mean serum calcium in this study after phototherapy was 8.43±0.75 mg/dl. This was in correlation with studies done by Bahbah et al (8.58±0.76) and Singh et al (8.42±1.19).

In an Iranian study, 7.5% neonates developed hypocalcemia after receiving phototherapy. In our study, hypocalcemia was observed in 33.0% of neonates after phototherapy. Shrivastva et al, also observed hypocalcemic effect of phototherapy in 30.0% of term neonates. Sethi et al, observed hypocalcemia in 75% of term neonates after phototherapy.

None of the hypocalcemic neonates were clinically symptomatic in studies by Tehrani et al and Reddy et al. In our study, symptomatic hypocalcemia was observed in 3.0 % of neonates which was similar to studies by Yadav et al and Sethi et al who also observed symptomatic hypocalcemia in term neoantes. Bahbah et al, observed jitteriness in 14% and convulsions represented 10% of hypocalcemic cases.

In a study by Reddy et al, the incidence of hypocalcemia was 18.8% when duration of phototherapy was >48 hours as compared to duration <48 hours (10.9%). Out of total 33 cases of hypocalcemia in our study, incidence of hypocalcemia was more in neonates who received phototherapy for 48 hours (72.72%) as compared to neonates who received phototherapy for 24 hours (27.28%).

CONCLUSION:

There is significant reduction in serum calcium level after phototherapy but risk of symptomatic hypocalcemia is low in healthy full-term neonates. Careful estimation of calcium status should be done before starting and during phototherapy for neonatal jaundice and close monitoring of neonates for signs of hypocalcemia should be done. Calcium supplementation can be considered as prophylaxis in neonates undergoing phototherapy.

ACKNOWLEDGEMENTS

Authors would like to acknowledge the parents of all babies who took part in this study.

Funding: No funding sources
Conflict of interest: None declared

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