Original Research Article

The effect of phototherapy on serum calcium levels in a term neonate

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Abstract

Phototherapy, exchange transfusion and pharmacological treatment are the main modalities of treatment. Phototherapy plays a significant role in the treatment of hyperbilirubinemia in neonates. Phototherapy may also lead to undesired side effects including skin rash, diarrhea, rise in body temperature, retinal degenerations, nasal obstruction, bronze baby syndrome etc. Nonetheless, no change in blood It is hypothesized that phototherapy inhibits pineal secretion of melatonin which blocks the effect of cortisol on bone calcium. Assuming the probability of type 1 error as 0.05 and a power of 0.8, paired difference to be detected as 0.2 and expected SD of difference from previous study as 0.8, a sample size of 128 was calculated , assuming loss during follow up a total of 150 cases were included in the study. In our study there was decrease in calcium levels in 77.02% neonates, but significant fall to hypocalcemic range was seen only in 2 cases (1.35%). Out of the 2 hypocalcemic neonates both were symptomatic.

Key Words: Phototherapy, Serum Calcium Levels, Term Neonate.

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INTRODUCTION

Jaundice is an important problem in the neonatal period. High bilirubin levels may be toxic to the developing central nervous system and may cause irreversible neurological impairment even in term newborns. Nearly 60% of term newborns and 80% of preterms become visibly jaundiced in the first week of life. In most of the cases, it is benign and no intervention is required. Approximately 5-10% of them have clinically significant hyperbilirubinemia, in whom the use of phototherapy becomes mandatory.[1] The main reason for neonatal hyperbilirubinemia is liver's immature excretory pathway for bilirubin and is the commonest reason for readmission of neonates in first week of life in current era of postnatal discharge from hospital[2]. Jaundice in newborns is a cause of concern for the parents as well as for the paediatricians[3]. Elevated levels of unconjugated bilirubin can lead to bilirubin encephalopathy and subsequently kernicterus, with devastating, permanent neurodevelopmental handicaps[4]. Conjugated hyperbilirubinemia indicates potentially serious hepatic disorders or systemic illnesses. Hence appropriate management of neonatal hyperbilirubinemia is of paramount importance. Phototherapy, exchange transfusion and pharmacological treatment are the main modalities of treatment. Phototherapy plays a significant role in the treatment of hyperbilirubinemia in neonates. Phototherapy may also lead to undesired side effects including skin rash, diarrhea, rise in body temperature, retinal degenerations, nasal obstruction, bronze baby syndrome etc.[2] Nonetheless, no change in blood It is hypothesized that phototherapy inhibits pineal secretion of melatonin which blocks the effect of cortisol on bone calcium. Unchecked cortisol exerts a direct hypocalcemic effect and increases bone uptake of calcium as well[5]. Calcium is essential for many biochemical processes including blood coagulation, cell membrane integrity and

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function, cellular enzymatic activity and neuromuscular excitability. Hypocalcemia increases cellular permeability to sodium ions and increased cell membrane excitability.The signs are usually non-specific like apnea, seizure, jitteriness, irritability, increased extensor tone, hyperreflexia, and stridor(laryngospasm)[6.] Hence the present study is aimed to evaluate the effect of phototherapy on serum calcium levels in newborns requiring phototherapy according to AAP guidelines.

MATERIAL AND METHODS

Newborns admitted to NICU with hyperbilirubinemia who met the inclusion and exclusion criteria were included in the study. The following newborns were excluded

- Jaundice in first 24 hr of life
- Born to a diabetic mother
- Birth asphyxia
- Neonatal sepsis
- Jaundice lasting more than 14 days
- Babies who had exchange transfusion or were on TPN.

Assuming the probability of type 1 error as 0.05 and a power of 0.8 , paired difference to be detected as 0.2 and expected SD of difference from previous study as 0.8 , a sample size of 128 was calculated , assuming loss during follow up a total of 150 cases were included in the study. Sepsis screening was done if required. In case of symptomatic neonates with convulsions, calcium was repeated before 48hrs and treated with IV calcium gluconate and were excluded from the study. The blood samples were drawn by doctors with aseptic precautions and no squeezed samples were used and the samples were analysed immediately within 15 minutes after drawing blood .

Bilirubin Measurement: Total and direct bilirubin is measured by Diazo method (Diazotized sulfanilic test). *Principle:* Bilirubin reacts with diazotized sulfanilic acid in presence of ethyleneglycol and dimethyl sulfoxide to produce an intensely coloureddiazo dye i.e, azobilirubin. The intensity of colour is proportional to quantity of bilirubin.

Calcium measurement: Calcium is measured by Arsenazo III method.

Principle: ArsenazoIII combines with calcium ions at Ph 6.5 to form colouredchromophore, the absorbance of which is measured at 650 nm and is proportional to calcium concentration.

Both calcium and bilirubin were measured by a semi automatedanalyser ERBA Chem 7. The sample were analysed immediately within 15 minutes after drawing blood.

RESULTS

Table 1: Comparison of mean serum calcium before and after pt by wilcoxon matched test (n =148)

Time point	Mean	SD	Mean Diff.	SD Diff.	% of change	Z-value	p-value
Before treatment	9.42	0.52	0.33	0.40	3.48	8.563	0.000
After treatment	9.12	0.67				2	1

The mean ± SD of calcium was 9.42 ± 0.52mg/dl and 9.12 ± 0.67 mg/dl before and after phototherapy respectively and the p value was significant (< 0.05).

Table 2: Variation in calcium levels afte r phototherapy (n =148)

Type of variation	No of neonates	(%)
Decreased	114	77 .02%
Increased	29	19 .59%
Same	5	3.37 %

In our study there was decrease in calcium levels in 77.02% neonates, but significant fall to hypocalcemic range was seen only in 2 cases (1.35%). Out of the 2 hypocalcemic neonates both were symptomatic.

Table 3: Comparison of decrease in calcium with age of presentation (n =148)

		Decrease		Total
		Yes	No	
AGE	< 3 DAYS	44	19	63
	>3DAYS	70	15	85
	Total	**114**	**34**	**148**

The chi-square statistics is 3.2009, with p value being 0.0735, i.e. not significant. The decrease in calcium was not related to age of the newborn.

Table 4: Comparison of decrease in calcium with sex of neonates (n=148)

		Decrease		Total
		Yes	No	
Sex	Males	62	19	81
	Females	52	15	67
	Total	**114**	**34**	**148**

The chi-square statistics is 0.0237, with p value being 0.87, i.e. not significant. The decrease in calcium was not related to sex of the newborn.

Table 5: Signs and symptoms of hypocalcemia (n=2)

Symptoms	No of cases	(%)
Irritability	2	100 %
Jitteriness	1	50%

In our study most common symptoms suggestive of hypocalcemia is irritability with both hypocalcemic neonates being irritable (100%) and one having jitteriness (50%). There were no other symptoms like lethargy, apnea etc. Two children with convulsions were treated with IV calcium were excluded from study.

DISCUSSION

In our study, we found that only 1.35% (2) cases to be hypocalcemic after phototherapy. In contrast to our study , the incidence of hypocalcemia in term neonates was more in other studies like 7%(10) in Taheri *et al*[7] , 9%(9) in Gheshmi *et al*[8] , 66.7%(16) in Prabhakar *et al*[9] . Even in studies with both preterm and term study groups , the incidence of hypocalcemia was more in both groups in studies like Karamifar et[10] al 8.7% and 22.6% in term and preterm respectively , 66.6% and 80 % in term and preterm in Yadav *et al*[11], 56% and 43 % in Arora *et al*[12] in term and preterm respectively .The higher incidence of hypocalcemia in all these studies can be attributed to the hypocalcemia cut off value of < 8mg/dl in term neonates in contrast to our study where we took cut off for hypocalcemia to be 7 mg /dl in term neonates .Only in Yadav *et al* [11], hypocalcemia prevalence was high inspite of cut off being 7 mg/dl, this could be explained because of smaller sample size in Yadav *et al*. The incidence of hypocalcemia or the fall in serum calcium levels after phototherapy was not affected by sex , weight , age of the neonate. The mean serum calcium before and after phototherapy in our study was 9.42±0.52 and 9.12±0.67 respectively and the difference was significant with p value being < 0.0001 which was similar to other studies like Eghbalian *et al*[13] where the mean calcium was 9.85±1.23 and 9.09 ± 0.93 with before and after phototherapy with significant p value, even in studies like Karamifar *et al*[10] and Taheri *et al*[7] there was significant fall in serum calcium values with p value being < 0.05. In our study, out of 2 hypocalcemic neonates both were having irritability (100%), 1 (50%) had jitteriness. Irritability could be mostly due to phototherapy per se. Symptomatic hypocalcemia was observed in Yadav *et al* [11], Jain *et al*[14] and Arora *et al*[12]. In Jain *et al*[14] among the hypocalcemic term neonates 50 % had jitteriness and 16.7% irritable .In Yadav *et al* [11], among the hypocalcemic term neonates 8 became symptomatic , 3 (30%) had jitteriness,2 (20%) irritability and 3 (30%) had lethargy but no convulsion. In Arora *et al*[12], symptomatic hypocalcemia like jitteriness was seen in 3 (10%) term babies and lethargy in 1 (4%) neonates.

CONCLUSION

The study shows that neonates under phototherapy are at higher risk of fall in serum calcium levels occasionally even to hypocalemic range. So, babies should be closely monitored for changes in calcium and should be managed accordingly.

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