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Original Research Article

Phototherapy and serum blood calcium levels in neonates: is there a need for calcium supplementation?

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ABSTRACT

Background: Phototherapy is the first line of treatment for physiological jaundice. However, it has its own set of complications. Hypocalcaemia is a less frequent but a potential complication of phototherapy. The purpose of this study was to see the effect of 24 hours of phototherapy on the serum blood calcium levels of the newborn after 24 hours of exposure and the need for supplementation in these new born babies.
Methods: A cross sectional observational study was conducted at our institute on 31 newborn babies born between June 2022 to December 2022. All term neonates who developed clinically significant physiological jaundice after 48 hours of life were subjected to double surface phototherapy with LED blue light for 24 hours. These babies were screened for their serum calcium levels by venous blood sampling before the commencement of the phototherapy. The same sampling was repeated after 24 hours of exposure to the phototherapy lights to see the effect on serum calcium levels of the newborn.
Results: Phototherapy was given for 24 hours. Mean serum calcium measured at 48 hours of life prior to phototherapy was 9.25±0.62 mg/ml. Also, mean serum calcium at 24 hours post phototherapy was 8.74±0.38 mg/ml. A highly significant decrease in serum calcium level was seen post phototherapy (p=0.0002). Independent samples t test was used.
Conclusions: In healthy term neonates exposed for only 24 hours of phototherapy decrease in serum calcium levels to some extend was noted however it is unlikely to cause clinically significant hypocalcemia.

Keywords: Phototherapy, Hypocalcemia, Hyperbilirubinemia, Newborn

INTRODUCTION

Physiological jaundice is a benign but most common condition encountered in the first week of life in neonates leading to alarmed physicians and apprehensive parents. Around 60 percent of the term and 80 percent of preterm neonates are diagnosed with this condition on average. However, only 5-10 percent of these neonates need intervention for clinically significant jaundice.[1]

Phototherapy is the first line of treatment for physiological jaundice. However, it has its own set of complications such as loose stools, skin rash, hyperthermia, dehydration, retinal degeneration, bronze baby syndrome, and hypocalcemia.[1,2]

Hypocalcaemia is a less frequent but a potential complication of phototherapy. The purpose of this study was to see the effect of 24 hours of phototherapy on the serum blood calcium levels of the newborn after 24 hours

of exposure and the need for supplementation in these new born babies.

METHODS

Study design and sample size

A cross-sectional observational study was conducted at our institute, urban health center (JJ Group of Hospitals) on 31 newborn babies born between June 2022 to December 2022. These babies were diagnosed with physiological jaundice and were subjected to phototherapy for treatment.

Inclusion criteria

All term neonates who developed physiological jaundice were included.

Exclusion criteria

Patients with gestational age less than 37 weeks; patients with high risk factor in mother or baby; babies requiring phototherapy for more than 24 hours were excluded.

Ethical consideration

Appropriate informed and written consent was taken from the parents. Ethical clearance was taken from the institutional ethical committee dated 15th May 2022, before the start of the study.

Study method

All term neonates who developed clinically significant physiological jaundice after 48 hours of life were subjected to double surface phototherapy with LED blue light for 24 hours (Zeal double surface phototherapy unit, model PT6003, Chhattisgarh).

These babies were screened for their serum calcium levels by venous blood sampling before the commencement of the phototherapy. The same sampling was repeated after 24 hours of exposure to the phototherapy lights to see the effect on the serum calcium levels of the newborn.

All babies were monitored for any phototherapy induced side effects or any clinically significant sign of hypocalcemia.

Statistical analysis

Data was analyzed using software SPSS21 (IBM, Chicago, IL, USA). Categorical variables were presented in number and percentage (%) and continuous variables were presented as mean±SD. Quantitative data was compared using the student's t test. P value of <0.05 was considered statistically significant.

RESULTS

A total of 31 term neonates were included in the study who required phototherapy for clinically significant physiological jaundice. There were 19 male babies (61.2%) and 12 female babies (38.7%). All neonates were less than 5 days of age with a mean duration of jaundice of 1.45±0.53 days. The mean gestational age at the time of birth was 38.39±1.14 weeks and the mean maternal age was 28.45±3.02 years (Table 1).

Table 1: Descriptive statistics of various parameters.

Parameters	Mean±SD	Range
Mother's age (years)	28.45±3.02	22-36
Gestational age (weeks)	38.39±1.14	37-40
Cord blood calcium (mg/ml)	10.12±1	8.5-11.8
Duration of jaundice (days)	1.45±0.53	1-3

Mean maternal age was 28.45 years; mean gestational age of population was 38.39±1.14 weeks with maximum to minimum value is 37 weeks to 40 weeks; mean cord calcium level was 10.12 mg/ml and its range was 8.5 to 11.8 mg/ml; mean duration of jaundice in neonates was 1.45 days.

Table 2: Comparative analysis of pre-phototherapy and post-phototherapy serum calcium levels.

Parameter	Pre-phototherapy 48 hrs of life	Post-phototherapy 24 hr	P value
Serum calcium (mg/ml)	9.25±0.62	8.74±0.38	0.0002*

Independent samples t test was used; p<0.05 is considered to be statistically significant; NS-statistically non-significant; mean serum calcium measured on 48 hours life prior to phototherapy was 9.25±0.62 mg/ml; also, mean serum calcium at 24 hours post phototherapy was 8.74±0.38 mg/ml; a highly significant decrease in serum calcium level was seen post phototherapy (p=0.0002).

Phototherapy was given for 24 hours. Mean serum calcium measured at 48 hours of life prior to phototherapy was 9.25±0.62 mg/ml. Also, mean serum calcium at 24 hours post-phototherapy was 8.74±0.38 mg/ml.

A highly significant decrease in serum calcium level was seen post-phototherapy (p=0.0002) (Table 2). Independent samples t test was used.

DISCUSSION

Physiological neonatal jaundice is the most common condition encountered in new born babies leading to a variable amount of morbidity in the newborns. This condition though relatively benign, if not treated in time

hyperbilirubinemia can lead to kernicterus and cause significant morbidity in the new born in the form of permanent neurological demage.[3,4]

Phototherapy is the first line of treatment in the management of physiological jaundice. Phototherapy causes structural photo isomerization and photo-oxidation of bilirubin into nontoxic form which is then excreted out of the body.[5,6] Though safe, exposure to this LED blue light has its own set of complications of which hypocalcaemia is a lesser known one. The association between phototherapy and hypocalcaemia was first suggested by Romagnoli et al.[1]

In term newborn, hypocalcaemia is defined as total serum calcium of less than 8 mg/dl.[2,7] Clinical signs of hypocalcaemia are nonspecific and include irritability, poor feeding, vomiting, tachycardia, cyanosis, heart failure, prolong QT interval, tetany, jerking, jitteriness, twitching episodes, generalized seizures.[7] Calcium homeostasis in newborns is mainly associated with the peak in calcitonin levels in the first 12 -24 hours of life, while a gradual increase in parathyroid hormone occurs in the first 48 hours of life. While the cord blood calcium is 10-11 mg/dl in newborns, it reaches a physiological nadir of 7.5-8.5 mg/dl by 48 hours of life.[7] Thus any factor that would predispose to a decrease in serum calcium levels can lead to clinically significant hypocalcaemia.

In our study of 31 term neonates with no other high risk factor and normal serum cord blood levels we saw a statistically significant decrease in the serum calcium level after 24 hours of phototherapy (Table 1). This was consistent with the study done by Bahbah et al.[8] They conducted case control study with 50 cases and 25 control which showed a similar decrease in serum calcium level. Similar results were also seen in a study.[1] However in our study we did not have any neonate with clinical signs and symptoms. The purpose of our study was to see the need for supplementation of calcium in these neonates exposed to phototherapy. Since none of the neonates had clinical signs and symptoms of hypocalcaemia nor had serum calcium levels suggestive of severe hypocalcaemia there was no need for supplementation in any of the neonates in our case. This was not consistent with Bahbah et al where they had jitteriness in 14% and convulsion in 10% of the cases with hypocalcemia.[8]

It has been hypothesized that the hypocalcemic effect of phototherapy is due to the inhibition of the pineal gland by transcranial illumination. This results in decreased secretion of melatonin. Melatonin plays a role in inhibiting the secretion of CRH thus impinging on the hypothalamic-pituitary-adrenal axis and regulating the secretion of cortisol. Low melatonin levels cause increased secretion of cortisol thus causing an increase in the calcium uptake by the bones, in turn decreasing the serum calcium levels. It also decreases the absorption of calcium and phosphate ions from the intestine and increases the urinary excretion of the same.[8,9] Hakanson et al conducted a study on young rats by exposing them to white fluorescent light. They reported a similar decrease in serum melatonin levels in these mice which in turn resulted in the drop of serum calcium levels. They also showed that this effect on serum calcium could be prevented by giving exogenous melatonin by covering the occiput or inhibiting corticosterone synthesis.[10]

Ezzeldin et al conducted a study to see if covering the head by a hat could help in preventing the hypocalcaemia effect of phototherapy. They used a dark colour hat covering the entire head. The result was 24.2% without hat had hypocalcaemia whereas 9.7% with hat had hypocalcaemia which was statistically significant with a p value of 0.031.[11] Similar prospective randomised controlled study was conducted by Mohamed et al which showed a significant decrease in the incidence of phototherapy induced hypocalcemia without any decline in the rate of reduction of bilirubin.[12]

Hypocalcemia in infants without any sign and symptoms can be treated with oral calcium supplementation. Supplement having calcium:phosphorus ratio of 2:1 is optimal.[13]

Though the hypocalcaemia was statistically significant in our study we didn't have any clinically significant signs or symptoms in the neonates exposed to 24 hours of phototherapy. Thus therapeutic correction of hypocalcaemia was not warranted in our study nor was prophylactic supplementation needed. However limitation of our study is the small sample size and a single-center study. A larger sample size is needed for more precise and reliable results.

CONCLUSION

In healthy term neonates exposed for only 24 hours of phototherapy it is unlikely to cause clinically significant hypocalcemia. However there is decrease in serum calcium levels to some extend even in these healthy term neonates with just 24 hours of phototherapy. Hence calcium supplementation can be considered in these neonates.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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