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ORIGINAL RESEARCH ARTICLE

PHOTOTHERAPY INDUCED HYPOCALCEMIA IN ICTERIC NEWBORNS ATTENDING BIRAT MEDICAL COLLEGE TEACHING HOSPITAL, MORANG, NEPAL

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ABSTRACT

Background: Neonatal jaundice is the single most common abnormal physical finding and the cause of morbidity in the first week of life. It is commonly managed by phototherapy. A lesser known, but a potential complication of phototherapy is hypocalcemia. This study was done to determine the prevalence of phototherapy induced hypocalcemia in icteric newborn and to compare it between preterm and term babies.

Methods: This was a hospital based cross sectional study carried out in the Department of Pediatrics, Birat Medical College Teaching Hospital from 1st September 2020 to 1st March 2021. This study was performed on 201 icteric newborn that were managed with phototherapy. Serum calcium level was estimated both before initiating phototherapy and after 24 hours of phototherapy. All the data were recorded in the structured proforma. Data was analysed using SPSS version 16.

Results: This study was performed on 201 icteric newborn (121 term, 80 preterm). Male babies (n=133; 66.2%) outnumbered the female babies (n=68; 33.8%). The majority of neonates were in the age group of 1-5 days (n=156; 77.6%), with mean age of4.50± 3.39 days.7.9% (16 out of 201) neonates exhibited phototherapy induced hypocalcemia. The prevalence of hypocalcemia in preterm was 10%and term neonates was 6.6%.

Conclusions: Hypocalcemia is a significant problem in icteric newborn treated with phototherapy. Hence there is a need for closed monitoring of serum calcium levels. Also the risk is greater in preterm neonates as compared to the term neonates.

INTRODUCTION

Neonatal jaundice is a common cause of morbidity encountered in the first week of life.[1] Around 5-10% cases have clinically significant jaundice that signifies the use of phototherapy.[2] Neonatal jaundice is usually unconjugated hyperbilirubinemia which when elevated at pathological range is potentially toxic to infants developing brain.[3] Neonatal jaundice has been defined as a condition in which the serum (se.) bilirubin is > 10mg/dl in the preterm and > 12mg/dl in the fullterm babies.[4] The serum total bilirubin (STB) concentration have been defined as nonphysiologic in term newborn if the concentration exceed 5 mg/dl on the 1st day of life, 10 mg/dl in 2nd day, or 12-13 mg/dl. However, STB elevation exceeding 17 mg/dl should be considered as pathological.[3] Neonatal hypocalcemia is defined as total serum calcium concentration of < 7 mg/dl.[2]

The blue lamps with a peak output of 425-475nm at a distance of 18" (45cm) with irradiance of 6-12µw/cm2/ nm.[5] The complications of Phototherapy include skin rash, diarrhea, rise in temperature, dehydration, hypocalcemia, trauma to the eye and bronze baby syndrome.[6]

Reduced melatonin and glucocorticoid secretion leading to an increase in bone calcium uptake, results in phototherapy induced hypocalcemia.[7] Calcium reabsorption in the proximal tubule and loop of henle is sodium-dependent. Thus, natriuresis affects urinary calcium excretion.[8]

Neonatal jaundice and its early outcome study has been done in Nepal.[3] However not done in our setup so this study can be helpful for the clinicians to manage phototherapy induced hypocalcemia so that the complications can be prevented. The main objective of this study was to determine the prevalence of phototherapy induced hypocalcemia in icteric newborn and to compare phototherapy induced hypocalcemia among preterm and term babies.

METHODS

This was a hospital based cross sectional study carried out from 1st September 2020 to 1st March 2021 in the department of Pediatrics, Birat Medical College and Teaching Hospital. Ethical clearance was obtained from the Institutional Review Committee (IRC) of the institute to carry out the study. The

study was conducted on 201 neonates (121 terms and 80 preterms) with the diagnosis of neonatal jaundice and who required phototherapy. Newborn with bilirubin level in pathological range managed with phototherapy. The informed consent was taken from parents of neonates. All consecutive neonates suffering from birth asphyxia, sepsis, respiratory distress, congenital malformation, neonate of diabetic mother and neonate requiring exchange transfusion were excluded. Neonates less than 37 weeks (wks) were termed as preterm and 37 weeks or greater were termed as term.[3] The complete history and thorough physical examination was carried out in all the neonates. Besides routine investigation, total serum calcium levels, before and 24 hours after exposure to phototherapy was estimated. Total serum bilirubin was estimated by Beckman Coulter AU 480 analyzer machine using diazo reagent. Light treatment was provided by a phototherapy unit with four 40 watt blue fluorescent tubes, placed at 40 cm distance from the skin and with the eyes and genitalia covered. The data was recorded in a predesigned proforma.

The data were entered into Microsoft excel. Data analysis was done using SPSS version 16. Frequencies and percentages were used to present the categorical data and mean with standard deviation were reported for continuous data. Paired t-test was applied to compare serum calcium level in newborns before phototherapy and 24 hours after phototherapy. A p-value less than 0.05 were considered as statistically significant.

RESULTS

The present study constituted a total of 201 cases, in which male babies (n=133; 66.2%) outnumbered the female babies (n=68; 33.8%). The majority of neonates were in the age group of 1-5 days (n=156; 77.6%), with mean age of 4.50± 3.39 days. In this study, 121 (60.2%) neonates were term and 80 (39.8%) neonates were preterm (Table 1).

Table 1: Demographic variables of the study population

Variables	Number (%)
Gender	
Male	133 (66.2)
Female	68 (33.8)
Age in days	
1-5 days	156 (77.6)
6-10 days	32 (15.9)
11-15 days	9(4.5)
>15 days	4 (2.0)
Gestation age	
Preterm	80 (39.8)
Term	121 (60.2)

Table 2 showed the percentage of babies with maximum level of serum bilirubin requiring phototherapy. Table 3 showed that majority of preterm (n=56;70%) had serum calcium level in the range of 7-7.9 mg/dl and majority of term neonates (n=69;57%) had serum bilirubin level in the range of 8-8.9 mg/dl before starting phototherapy.

Table 2: Distribution of serum bilirubin level among new born babies

Serum Bilirubin Level(mg/dl)	Frequency (%)
10.0-15.9	71 (35.3)
16.0-19.9	108 (53.7)
>20	22 (10.9)
Total	201 (100)

Table 3: Serum calcium level among new born babies before phototherapy by gestational week

Serum calcium level before phototherapy	Gestational age in week		Total
	<37 week	≥37 week	
7-7.9 mg/dl	56 (70%)	15 (12.4%)	71 (35.3%)
8-8.9 mg/dl	23 (28.8%)	69 (57.0%)	92 (45.8%)
≥9 mg/dl	1 (1.2%)	37 (30.6%)	38 (18.9%)
Total	80 (100%)	121 (100%)	201 (100%)

After exposure to phototherapy, 8 (10%) preterm babies out of 80 cases developed hypocalcemia. Similarly, 8 (6.6%) term babies out of 121 cases developed hypocalcemia after exposure to phototherapy. The risk of phototherapy induced hypocalcemia was more in preterm babies as compared to the term babies (Table 4). In this study, 7.9% (16 out of 201) neonates exhibited phototherapy induced hypocalcemia.

Table 4: Serum calcium level among new born babies after 24 hours of phototherapy by gestational week

Serum Calcium level after phototherapy	Gestational age in week		Total
	<37 week	≥ 37 week	
<7.0 mg/dl	8 (10.0%)	8 (6.6%)	16 (8.0%)
7.0-7.9 mg/dl	61 (76.2%)	36 (29.8%)	97(48.3%)
8.0-8.9 mg/dl	11 (13.8%)	62 (51.2%)	73(36.3%)
≥9.0 mg/dl	0 (0%)	15 (12.4%)	15 (7.5%)
Total	80 (100%)	121 (100%)	201(100%)

The mean±SD for serum calcium level before phototherapy was 7.89±0.38 in preterm and 8.68±0.57 in term newborns. The mean±SD serum calcium level after 24 hours of phototherapy was 7.39±0.53 in preterm and 8.17±0.78 in term newborns. After 24 hours of phototherapy, serum calcium levels significantly lowered in both pre-term (p<0.0001) as well as in term (p<0.0001) babies (Table 5) The prevalence of hypocalcemia was 10% in preterm babies and 6.6% in term babies (Table 5).

Table 5: Comparision of serum calcium level before and 24 hours after phototherapy in newborns

Newborns Status (N)	Before phototherapy	24 hrs after phototherapy	p-value *
	Mean±SD	Mean±SD	
Preterm (80)	7.89±0.38	7.39±0.53	<0.0001
Term (121)	8.68±0.57	8.17±0.78	<0.0001

*Paired samples t test

DISCUSSION

Neonatal jaundice is the single most common abnormal physical finding requiring hospitalization and readmission in the initial week of life. Treatment with phototherapy is an appropriate and safe measure to reduce jaundice in newborn. Even though it is a safe measure, common complications like loose stool, skin rash, hyperthermia and bronze baby syndrome can occur. Less common but potential complication of phototherapy is hypocalcemia.Therefore regular monitoring of serum calcium level require for the newborn receiving phototherapy.

In this study, there were 133 (66.2%) males and 68 (33.8%) females which was similar to the study done by Khan et al where 77 (62.6%) males and 46 (37.4%) female were seen.[1] This may be due to major concern of parents towards male baby.

In this study, the mean age of the neonates at the time of birth was 4.50±3.39 days which matches with the study done by Khan et al (8.35±6.74 days) and Karamifar et al (5.69±2.6 days).[1,7]

Majority of cases were in the age group of 1-5 days (n=156;77.6%) with only few neonates above 15 days (n=4;2%).This may be due appearance of jaundice in first week of life.

In the context of gestational age, 121 cases (60.2%) were term and 80 neonates (39.8%) were preterm which was similar to the study done by Arora et al (term 54%, preterm 46%) and Karamifar et al (term n=91;59.3% and preterm n=62;40.5%) where term neonates outnumbered preterm neonates. [5,7] This may be due to higher rate of term delivery.

The prevalence of phototherapy induced hypocalcemia in neonate was 16(8%). This matches the study by Karamifar et al, Ehsanpoor et al, Fatemeh et al and Alizade et al where the incidence of hypocalcemia was 8.7%, 15%, 7.5% and 7% respectively.[7,9,10,11] Much higher incidence of hypocalcemia was observed in the study done by Yadav et al and Sethi et al with the percentage being 66.6% and 75%.[2,12]

The difference between our and their study was that they had measured the ionized calcium levels rather than serum calcium levels as in ours. Similarly, higher incidence of hypocalcemia can be due to the role of fluorescent tubes used. In our study, we used blue light phototherapy and as Gutcher and coworkers reported in their study that blue and green light did not lead to hypocalcemia in their rats compared to day light phototherapy.[13]

Similarly, while comparing the serum calcium level in term and preterm neonates after receiving phototherapy, it was found that 8(10%) preterm neonates and 8 (6.6%) term neonates developed phototherapy induced hypocalcemia. This matches the study by karamifar et al where 22.6% preterm and 8.7% term neonates developed hypocalcemia after exposure to phototherapy.[7] The higher incidence of phototherapy induced hypocalcemia in preterm neonates inour study, may be due to higher penetration of light in preterm neonates. In contrast much higher incidence of hypocalcemia was observed by Yadav et al, Sethi et al, Jain et al with the percentage of pretermbeing 80%, 90%, 55% and term babies being 66%, 75%, 30% respectively.[2,12,14]

The difference between this study and the study by Jain B K et al, is due to they considered serum calcium level <8 mg/dl as hypocalcemia so they have got a higher prevalence of hypocalcemia.[14]

In this study, the mean±SD serum calcium level before phototherapy was 7.89±0.38 in preterm and 8.68±0.57 in term newborns. The mean±SD serum calcium level after 24 hours of phototherapy was 7.39±0.53 in preterm and 8.17±0.78 in term newborns. Similar finding was observed in a study conducted by Karamifar et al where the mean±SD serum calcium level before phototherapy was 8.73±1.38 in preterm and 9.53±0.92 in term newborns and the mean±SD serum calcium level after 24 hours of phototherapy was 8.40±1.71 in preterm and 9.30±1.11 in term newborns.[7] Slight increase in value in Karamifar et al study can be due to the range of serum calcium level to be considered as hypocalcemia. In our study, for both preterm and term, serum calcium level <7 mg/dl was considered hypocalcemia while in Karamifar et al study, serum calcium level <7 mg/dl in preterm and <7.5mg/dl in term babies were considered hypocalcemia. Neonates requiring phototherapy are at a higher risk of developing hypocalcemia. Therefore, it is suggested that serum calcium level should be monitored regularly in neonates requiring phototherapy and if necessary hypocalcemia should be managed properly.

An important limitation to our study is the small number of patients, our study reflects data from one center only and may not represent that of other centers across the country. Hence, multicenter trials would be necessary to determine the prevalence of phototherapy induced hypocalcemia in icteric newborns.

CONCLUSION

Hypocalcemia is a significant problem in icteric newborn treated with phototherapy. Hence, there is a need for closed monitoring of serum calcium levels in those neonates. Also, the risk is greater in preterm neonates as compared to the term neonates.

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FINANCIAL DISCLOSURE: None

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