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Original Research Article

THE EFFECT OF PHOTOTHERAPY ON TOTAL SERUM CALCIUM LEVELS IN NEWBORNS

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ABSTRACT

Background: Neonatal hyperbilirubinemia is the most common morbidity in the first week of life. Around 5-10% of them will be having significant jaundice requiring phototherapy (PT). PT can produce various adverse effects; hypocalcemia is one of the lesser known effects. So, estimation of calcium levels before and after PT should be done in neonates with jaundice. **Materials and Methods**: This was a observational cross sectional study conducted over a period of 10 months among 100 neonates (both term and preterm) in the neonatal intensive care unit of NRI Medical College and General Hospital, Guntur. Total serum calcium levels were measured before and after phototherapy and compared using chi-square test. **Result**: Out of 100 neonates, 75% were term and 25% were preterm. The mean total serum calcium levels before and after PT were 8.92 mg/dL and 8.165 mg/dL, respectively. The reduction was statistically significant with a p-value < 0.0001. Mean total serum calcium levels in preterms before and after PT were 8.32 and 7.1 mg/dL, respectively, with a significant p-value of < 0.0001. The mean total serum calcium levels in term newborns before and after PT were 9.12 and 8.52 mg/dL, respectively (p < 0.0001). A total of 7% of the newborns had hypocalcemia after PT, with 5% exhibiting jitteriness and 2% remaining asymptomatic. Following phototherapy, 20% of preterms and 2.7% of term newborns developed hypocalcemia. Overall, 86% of newborns had lower serum calcium levels after phototherapy, with 14% having the same or higher levels as before. **Conclusion**: This study found a substantial reduction in total serum calcium levels after phototherapy. Although phototherapy reduced total serum calcium levels, only 7% of newborns experienced hypocalcemia. Most common clinical presentation noticed was jitteriness.

INTRODUCTION

Jaundice in newborns develops when bilirubin levels rise above 5 mg/dl. It occurs in 60% of term and 80% of preterm infants.[1] The majority of cases are benign and do not require intervention. About 5-10% of patients have clinically severe jaundice that requires treatment.[2] High bilirubin levels can be harmful to the growing brain and cause neurological damage.[3] Phototherapy is a convenient and accessible treatment option for pathologic unconjugated hyperbilirubinemia in newborns.[4] Phototherapy can cause consequences such as skin rashes, diarrhea, overheat, dehydration, hypocalcemia, retinal degeneration, allergic diseases, hemolysis and bronze baby syndrome, particularly in cholestatic patients.[5] It is theorized that phototherapy leads to suppression of the pineal gland by transcranial illumination, resulting in a fall in melatonin levels and, in turn, lowering corticosterone levels to finally decrease calcium resorption from bones, generating hypocalcemia.[6] Other etiologies being decreased parathormone secretion,[7] and increased excretion of calcium in urine8. Hypocalcemia is characterized as total serum calcium <8 mg/dL or ionized calcium <4.4 mg/dL for term or preterm babies weighing >1.5 kg at birth, and total serum calcium <7 mg/dL or ionized calcium <4 mg/dL for babies weighing <1.5kg.[9] Ionized calcium is essential for various biochemical processes, such as blood clotting, neuromuscular excitability, and cellular enzymatic activity.[10] One study reported a significant decrease in calcium levels in 64% of term and 76% of late preterm infants.[11] Another study found that phototherapy resulted in hypocalcemia in 90% of preterm and 75% of term newborns.[12]

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Hypocalcemia can lead to significant symptoms such as convulsions, apnea, laryngospasm, irritability, and jitteriness.[13] Therefore, phototherapy-induced hypocalcemia can be a major issue. This study aimed to detect hypocalcemia in neonates receiving phototherapy by monitoring serum total calcium level and to identify symptomatic hypocalcemia.

MATERIALS AND METHODS

This was a observational cross sectional study conducted over a period of 10 months (June 2023 to March 2024) conducted in Neonatal intensive care unit of NRI General Hospital and Medical College, Guntur. Ethical approval for this study was taken from the institutional ethics committee. Written informed consent was taken from parents/ legal guardians. Neonates requiring phototherapy for unconjugated hyperbilirubinemia as per AAP nomogram were included. Neonates with co-morbidities like birth asphyxia, septicemia, renal failure; hypocalcemia detected before start of phototherapy; whose mother had history of taking anticonvulsants; who had exchange transfusion and jaundice lasting more than 14 days of life were excluded from the study. Venous blood samples were collected from the neonates included in the study and sent for total bilirubin, direct bilirubin, serum calcium and blood grouping. Total and direct bilirubin is measured by Diazo method (Diazotized sulfanilic test). Calcium is measured by Arsenazo III method. Blood group of newborn analyzed by antisera method. Serum calcium levels were checked before initiation of phototherapy (first sample) and at discontinuation of phototherapy (second sample). The neonates were clinically assessed for features of hypocalcemia i.e. jitteriness, irritability/excitability and convulsions, as well as other complications like rashes, loose stool, fever and dehydration. Hypocalcemia in the neonates was managed with intravenous calcium supplementation.

Comparative study was made between these two sample groups to determine the changes in levels of serum calcium. The results were calculated as mean ± standard deviation and compared based on the paired t-test. A p value of < 0.05 were considered statistically significant.

RESULTS

In this study, 100 neonates admitted in NICU for phototherapy were evaluated for hypocalcemia. Among them 25(25%) were preterms and terms were 75 (75%) (Table 1). Male newborns were 55(55%) and 45(45%) were females (Table 2). 31% babies belong to low birth weight category (<2.5kgs) and 69% babies were above 2.5kgs (Table 3). 15% of babies were presented with significant jaundice in first 48 hours, 40% in 72 hours , 30% in 96 hours, 10% in after 96 hours of life (Table 4). Mean total serum bilirubin was 16.04±2.99 mg/dL (Table 5). Mean total serum calcium levels before PT was 8.92±0.36 mg/dL and after PT was 8.165±1.3165 mg/dL, was statistically significant as p value was < 0.0001 (Table 6). Mean total serum calcium levels before PT in preterm babies was 8.32±0.45 mg/dL and in term babies was 9.12±0.32 mg/dL , the difference was statistically significant as p value was < 0.0001 (Table 7). Mean total serum calcium levels post PT in preterm babies was 7.1± 0.52 mg/dL and in term babies was 8.52± 0.47mg/dL , the difference was statistically significant as p value was < 0.0001 (Table 8). Mean total serum calcium values in preterms before and after PT were 8.32 and 7.1 mg/dL , significant decrease in calcium levels post PT (p value < 0.0001) (Table 9). Mean total serum calcium levels in term babies before and after PT were 9.12 and 8.52 mg/dL, significant decrease in serum calcium levels post PT (p value < 0.0001) (Table 10). Total 7% of babies developed hypocalcemia post PT, out of which 5% babies (preterm babies) were symptomatic with jitteriness and 2% (term babies) were asymptomatic (Table 11& 12). So, 5 (20%) babies out of 25 preterms and 2 (2.7%) babies out of 75 term babies developed hypocalcemia post PT (Table 13). In 86% of babies after PT serum calcium levels decreased compared to before PT values and in 14% of babies it was same or more than before phototherapy level.

Table 1: Distribution of study population based on gestational age

Gestational age in weeks	Number of cases	Percentage
28- 37	25	25%
Above 37	75	75%
Total	100	100%

Table 2: Distribution of study population based on gender

Gender	Number of cases	Percentage
Male	55	55%
Female	45	45%
Total	100	100%

Table 3: Weight wise distribution of study population

Birth weight (kilograms)	Number of cases	Percentage
<1.5	1	1%
1.5 - 2.5	30	30%
>2.5	69	69%

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Table 4: Distribution of study group based on age at presentation of significant jaundice

Age in Hours	Number of cases	Percentage
24-48	15	15%
> 48-72	40	40%
>72-96	35	35%
>96	10	10%

Table 5: Mean total serum bilirubin (TSB) levels in study group

Parameter	Mean TSB value (mg/dL)	Standard Deviation (SD)
Before Treatment	16.04	±2.99
After Treatment	9.27	±1.39

Table 6: Mean total serum calcium levels in study group before and after phototherapy

Timepoint	Mean Total serum calcium (mg/dL)	Standard Deviation
Before PT	8.92	± 0.36
After PT	8.165	± 1.3165

Mean difference was -1.205, t - value was -20.137 and p value was < 0.0001 , which was statistically significant.

Table 7: Mean total serum calcium levels based on gestational age before phototherapy

Gestational age in weeks	Number of babies	Mean total serum calcium (mg/dL)	SD
28 - 37 (Preterm)	25	8.32	±0.45
Above 37 (Term)	75	9.12	±0.32

Mean difference was 0.800, t- value was 9.724 and p value was <0.0001, statistically significant

Table 8: Mean total serum calcium levels based on gestational age after phototherapy

Gestational age in weeks	Number of babies	Mean serum calcium (mg/dL)	SD
28-37 (Preterm)	25	7.1	± 0.52
Above 37 (term)	75	8.52	± 0.47

Mean difference was 1.420, t- value was 12.738 and p value was < 0.0001, statistically significant

Table 9: Comparison of Mean total serum calcium levels in preterms (28-37 weeks) before and after PT

Parameter	Mean total serum calcium (mg/dL)	SD	T- value	P value
Before PT	8.32	±0.45	-8.870	< 0.0001 (Significant)
After PT	7.1	± 0.52		

Table 10: Comparison of Mean total serum calcium levels in Term babies (> 37 weeks) before and after PT

Parameter	Mean Total serum calcium (mg/dL)	SD	T-value	P value
Before PT	9.12	±0.32	-9.139	< 0.0001 (Significant)
After PT	8.52	± 0.47		

Table 11: Table depicting number of neonates who developed hypocalcemia post phototherapy

Hypocalcemia	Number of babies	Percentage
Total number of hypocalcemia babies	7/100	7%
Symptomatic hypocalcemia babies	5/100	5%

Table 12: Table depicting signs and symptoms of hypocalcemia

Signs & Symptoms	Number of babies	Percentage
Jitteriness	5/100	5%
Other symptoms	nil	

Table 13: Table depicting Number of babies with hypocalcemia as per their gestational age

Gestational Age in weeks	Total Number of babies	Number of babies with hypocalcemia	Percentage
28 - 37 (preterm)	25	5	20%
Above 37 (term)	75	2	2.7%

Table 14: Comparison of decrease in serum total calcium levels with duration of phototherapy

Duration of PT	Number of babies with increased total calcium	Number of babies with decreased total Calcium	Total
< 48 hours	14	34	48
> 48 hours	0	52	52
Total	14	86	100

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DISCUSSION

Phototherapy is highly effective in preventing and treating hyperbilirubinemia in newborns. Every safe method has side effects, including phototherapy. Romagnoli et al,[14] was the first to suggest the link between hypocalcemia and phototherapy in preterm infants. Hakinson and Hunter,[6] proposed that phototherapy reduces pineal melatonin secretion, hence blocking cortisol's influence on bone calcium. As a result, cortisol promotes calcium uptake in bones and causes hypocalcemia.

In our study, there were 25 preterms and 75 term babies out of 100. In the Ravindranath et al,[15] study, there were 25 preterm and term newborns in each of 50 cases. The Snehalatha et al,[16] analysis found 16 preterms and 59 term babies, nearer to our sample. Out of 30 newborns in the Yadav et al study,[17,15] were preterm and 15 were term. In the Karamifar H et al,[18] study, 91 of the 153 cases were term, while 62 were preterm.

Our study found a mean admission TSB of 16.04 ±2.99 mg/dL, which was similar to Snehalatha at al study of 18.12 ± 1.87 mg/dL and Karamifar H et al study of 18 ±2.4 mg/dL in terms and 16.2 ± 3.0 mg/dL in preterms.

In our investigation, mean total serum calcium values before and after PT were 8.92 ± 0.36 mg/dL and 8.165 ± 1.3165 mg/dL, respectively. The decrease in serum calcium levels was statistically significant and comparable to studies by Rozario CI et al,[19] and Ravindranath et al. In our study, mean serum calcium levels before PT in term and preterm babies were 8.32±0.45 mg/dL and 9.12±0.32 mg/dL, respectively. Preterms had lower values than term babies. Ravindranath et al and Karamifar H et al reported similar findings.

Hypocalcemia was detected in 7% of the total newborns in our study. The percentages were 14.4% in the Karamifar H et al study, 38% in the Ravindranath et al study, and 50% in the Arora et al,[13] study. The difference could be attributed to the intensity and length of PT. Hypocalcemia was seen in 20% of preterms and 2.7% of term newborns in our study. In the Ravindranath et al study, 48% of preterms and 28% of term newborns had hypocalcemia, while in the Karamifar H et al study, 22.6% of preterms and 8.7% of term babies had low calcium levels. Our findings were more consistent with those of Karamifar H et al.

In our study, as well as those of Arora et al, Yadav et al, and Ravindranath et al, the most common clinical presentation of hypocalcemia was jitteriness, particularly in preterm babies.

CONCLUSION

In this study, total serum calcium levels were significantly reduced after phototherapy, particularly in preterms compared to term newborns. Although total serum calcium levels decreased overall after phototherapy, only 7% of newborns experienced hypocalcemia. The most common symptom seen was jitteriness; no baby developed apneas or convulsions.

Limitation: Small sample size and less number of preterm babies. The duration and intensity of phototherapy's relationship to the frequency of hypocalcemia was not examined.

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REFERENCES

1. Mitra S, Rennie J. Neonatal jaundice: aetiology, diagnosis and treatment. Br J Hosp Med (Lond). 2017 Dec 2;78(12):699-704. doi: 10.12968/hmed.2017.78.12.699. PMID: 29240507.
2. Bhutani VK, Stark AR, Lazzeroni LC, Poland R, Gourley GR, Kazmierczak S et al. Initial Clinical Testing Evaluation and Risk Assessment for Universal Screening for Hyperbilirubinemia Study Group. Predischarge screening for severe neonatal hyperbilirubinemia identifies infants who need phototherapy. J Pediatr. 2013 Mar;162(3):477-482.e1. doi: 10.1016/j.jpeds.2012.08.022. Epub 2012 Oct 5. PMID: 23043681.
3. Usman F, Diala UM, Shapiro SM, Baptiste Le Pichon J, Slusher TM. Acute bilirubin encephalopathy and its progression to kernicterus: current perspectives. Research and Reports in Neonatology. 2018 Mar 7:33-44.
4. Beal JA. American Academy of Pediatrics' Updated Clinical Guidelines for Managing Neonatal Hyperbilirubinemia. MCN Am J Matern Child Nurs. 2023 Jan-Feb 01;48(1):49. doi: 10.1097/NMC.0000000000000874. PMID: 36469895
5. Wang J, Guo G, Li A, Cai WQ, Wang X. Challenges of phototherapy for neonatal hyperbilirubinemia (Review). Exp Ther Med. 2021 Mar;21(3):231. doi: 10.3892/etm.2021.9662. Epub 2021 Jan 20. PMID: 33613704; PMCID: PMC7859475.
6. Hunter KM. Hypocalcemia. In: Cloherty JP, Eichenwald CE, Stark AR, editors. Manual of Neonatal Care. 5th ed. Philadelphia: Lippincott Wiliams & Wilkins; 2004:579–588.
7. Kim SH, Park JH. Effect of phototherapy on bone metabolism in newborn rats. J Korean Soc Neonatal. 2001;8(2):206–210.
8. Hooman N, Honarpisheh A. The effect of phototherapy on urinary calcium excretion in newborns. Pediatr Nephrol. 2005;20(9):1363–1364.
9. .Oden J., Bourgeois M. Neonatal endocrinology. The Indian Journal of Pediatrics. 2000;67(3):217–223. doi: 10.1007/BF02723667
10. Jain A, Agarwal R, Sankar MJ, Deorari A, Paul VK. Hypocalcemia in the newborn. Indian J Pediatr. 2010 Oct;77(10):1123-8. doi: 10.1007/s12098-010-0176-0. Epub 2010 Aug 25. PMID: 20737250.
11. Gangu Dhilli Ravindranath , Ruthala Bhargav , Putrevu Jagannadh Karthik.INCIDENCE OF HYPOCALCEMIA IN NEONATES WITH UNCONJUGATED HYPERBILURUBINEMIA AFTER INTIATION OF PHOTOTHERAPY.Int J Acad Med Pharm 2023; 5 (1); 582-585.DOI: 10.47009/jamp.2023.5.1.120
12. Sethi H, Saili A, Dutta AK: Phototherapy induced hypocalcemia. Indian Pediatr 1993; 30(12): 1403-6
13. Arora S, Narang GS, Singh G. Serum calcium levels in preterm and term neonates on phototherapy. J of Nepal Paediatr Soc. 2014;34(1):24-8
14. Romagnoli C, Polidori G, Cataldi L, Tortorlo SG, Segni G: Phototherapy induced hypocalcaemia. The Journal of Pediatrics, 1979; 94(5):813-816.
15. Gangu Dhilli Ravindranath, Ruthala Bhargav, Putrevu Jagannadh Karthik1. INCIDENCE OF HYPOCALCEMIA IN NEONATES WITH UNCONJUGATED HYPERBILURUBINEMIA AFTER INTIATION OF PHOTOTHERAPY. Int J Acad Med Pharm 2023; 5 (1); 582-585. Int J Acad Med Pharm 2023; 5 (1); 582-585

ISSN (O): 2687-5365; ISSN (P): 2753-6556

16. Kumari Snehlata, Dibya Jyoti, Manoj Kumar Singh, Bhupendra Narain. Phototherapy-Induced Hypocalcemia in Neonatal Hyperbilirubinemia: Correlation with Phototherapy Duration. International Journal of Current Pharmaceutical Review and Research 2024; 16(11); 253-258.
17. 17.Rajesh Kumar Yadav, R.S. Sethi, Anuj S. Sethi, Lalit Kumar, Om Shankar Chaurasia. The Evaluation of Effect of Phototherapy on Serum Calcium Level.People's Journal of Scientific Research. Vol. 5(2), July 2012.
18. 18.H. Karamifar,* N. Pishva,** GH. Amirhakimi*.Prevalence of Phototherapy-Induced Hypocalcemia.Iran J Med Sci 2002; 27(4):166-168.
19. Cyril Ignatious Rozario, Preethi S. Pillai*, Ranamol T.Effect of phototherapy on serum calcium level in term newborns.Int J Contemp Pediatr. 2017 Nov;4(6):1975-1979. DOI: http://dx.doi.org/10.18203/2349-3291.ijcp20174180.

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