e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2022; 14(7); 983-988

Original Research Article

Phototherapy Induce Hypocalcemia in Neonatal Jaundice: In Tertiary Care Hospital, Patna

Amit Kumar[1], Binod Kumar Singh[2], Saroj Kumar[3]

[1]Senior Resident, Department of Pediatrics, Nalanda Medical College and Hospital, Patna, Bihar, India

[2]Professor & Head, Department of Pediatrics, Nalanda Medical College and Hospital, Patna, Bihar, India

[3]Assistant Professor, Department of Pediatrics, Nalanda Medical College and Hospital, Patna, Bihar, India

Received: 13-05-2022 / Revised: 03-06-2022 / Accepted: 26-06-2022

Corresponding author: Dr. Amit Kumar

Conflict of interest: Nil

Abstract

Background: During the newborn period, neonatal jaundice is a prevalent problem. In the first week of life, jaundice affects preterm and term infants at rates of roughly 80% and 60%, respectively. Approximately 5-10% of them have clinically significant jaundice which requiring phototherapy. Hypocalcemia is potential adverse effect of phototherapy.

Aim &objective: To determine the frequency of hypocalcemia in term neonates with jaundice receiving light emitting diode phototherapy.

Materials and Methods: 84 term newborns with hyperbilirubinemia were the subjects of a prospective observational study at the Nalanda Medical College and Hospital (NMCH), Patna, Bihar, to determine the effects of phototherapy with a light-emitting diode device on total serum calcium. Total serum bilirubin and total serum calcium levels were measured at the beginning and 48 hours after phototherapy, the levels of total serum bilirubin and calcium were measured. All of the neonates included in the study evaluated for the symptom of hypocalcemia, such as jitteriness, irritability/excitement, lethargy, and convulsions.

Results: Our study showed a significant decrease in post-treatment total serum calcium levels compared to per-treatment levels ($p < 0.005$). In 16.67% of the neonates, hypocalcemia (serum calcium 8 mg/dL in term neonates) was observed.

Conclusions: Like traditional blue and white light phototherapy, light-emitting diode phototherapy causes hypocalcemia as a side effect while treating neonatal jaundice.

Keyword: Hypocalcemia, Phototherapy, Jaundice

Introduction

During the newborn period, neonatal jaundice is a prevalent problem. In the first week of life, jaundice affects preterm and term infants at rates of roughly 80% and 60%, respectively [1]. The physiological immaturity of newborns to regulate excessive bilirubin production is the cause of jaundice. Usually between 24 and 72 hours, visible jaundice manifests. Basic patho-physiology of jaundice is same in term and preterm neonates, but premature babies are at a higher risk of developing

jaundice [2]. Most of the time, it is benign and doesn't need any treatment [3]. Newborns may experience neurological damage due to high bilirubin levels that are harmful to the developing central nervous system [4] .Approximately 5-10% of them have clinically significant jaundice which required phototherapy [5]. According to the American Academy of Pediatrics' (AAP) recommended schedule, the number of hours the newborn has been alive after birth and the serum bilirubin level will determine how long phototherapy will last [6].

Phototherapy blunts the rise of bilirubin (unconjugated hyperbilirubinemia) level regardless of the etiology of jaundice [7]. Phototherapy is generally regarded as safe, but certain adverse reactions include loose stools, hyperthermia, dehydration from fluid loss, skin burn, photo retinitis, bronze baby syndrome, mutations, sister chromatid exchange& DNAstrand breaks. Hypocalcemia is a potential side effect of phototherapy that is less well-known [8].

Inverse consequences of phototherapy frequently include hypocalcemia. The definition of hypocalcemia is either total serum calcium less than 8 mg/dL or ionised calcium less than 4.4 mg/dL in term or preterm neonates having a birth weight of more than 1500 g, or total serum calcium less than 7 mg/dL or ionised calcium less than 4 mg/dL in infants with very low birth weights. The major symptoms of hypocalcemia include apnea, reduced feeding, cyanosis, vomiting, laryngospasm, heart failure, tachycardia, prolonged QT interval, tetany, irritability, jitteriness, and seizures [9].

According to Hakinson and Hunter phototherapy prevents the pineal gland from secreting melatonin, which counteracts cortisol's influence on bone calcium. Cortisol causes hypocalcemia by causing an increase in the absorption of calcium by the bones [10, 11]. Utilizing traditional blue and white phototherapy equipment, previous research was conducted to ascertain the change in serum calcium levels during treatment for newborn jaundice. A more recent kind of light source, the light-emitting diode (LED), produces very little heat, is portable, and is power-efficient [14]. We wanted to know how neonates treated with light-emitting diode (LED) phototherapy, affect serum calcium levels before and after the treatment. Due to the potential problems of hypocalcemia, the relationship between hypocalcemia and phototherapy is a significant factor to take into account. The purpose of this study was to address the burden of hypocalcemia in term neonates receiving phototherapy.

Materials and Methods

Prospective observational study was conducted at Neonatal intensive care unit (NICU) of Nalanda Medical College & Hospital (NMCH), Patna, Bihar from July 2018 to December 2018. The study comprised 84 term neonates in total with jaundice.They were requiring phototherapy for at least two day and had a normal serum calcium level before initiating phototherapy. Their Parents or guardians gave informed consent. Exclusion criteria were neonates with jaundice requiring exchange transfusion, birth asphyxia, sepsis, respiratory distress and infants of diabetic mother. Additionally, approval from the institutional ethical review committee was obtained. Non-probability sampling was the sampling technique.

On every patient, a history and clinical examination were conducted. The modified Ballard scoring method was used to determine gestational age.

Birth-Weight (Kg), Age (days), duration of jaundice and duration of phototherapy in days were recorded. Serum calcium level and total serum bilirubin (TSB) was measured before starting LED phototherapy and after 48 hours of

continuous phototherapy. Data was collected. Using Statistical Package for the Social Sciences (SPSS) version 25, data was entered and analysed.

The descriptive statistical data were represented as mean (Standard Deviation) for continuous variables and frequencies (percentage) for categorical variables. Paired t-test was used to compare the serum calcium and total serum bilirubin levels before and 48 hours after phototherapy A p-value of ≤ 0.05, was taken as statistically significant.

Result

Present research evaluated the hypocalcemia in 84 term neonates who were admitted to NICU for jaundice and treated with LED phototherapy. There were 47 (55.95%) male and 37 (44.05%) female. On admission for phototherapy, the study participants' mean birth weight was 2.97 ± 0.22 kg, their mean gestational age was 39.10 ± 1.29 weeks, and their mean age at birth was 2.61 ± 0 .14 days. 1.950 ± 0.96 was the overall mean time for phototherapy (Table 1).

Among 84 term neonates included in this study, 14 neonates(16.67%) developed hypocalcemia (serum calcium <8 mg/dl) 48 hour after phototherapy mean serum calcium level was 7.6 ± 0.24 ,all neonates who developed hypocalcemia were asymptomatic. The other 70 neonates (83.33%) had normal serum calcium. mean serum calcium level was 8.74 ± 0.46. None of the hypocalcemia neonates in our study showed any clinical manifestations

Table 1: Distribution of descriptive data of the neonates (N=84)

Parameter	Mean ± SD	S. E	95%CI
Gestational age(wk)	39.101±0.29	0.14	38.82-39.38
Age(days)	2.61 ± 0.14	0.12	2.39-2.89
Birth weight(kg)	2.97± 0.22	0.16	1.67 - 2.45
Duration of phototherapy(days)	1.95± 0.96	0.10	1.7 4– 2.16
Duration of jaundice(days)	2.2 ± 0.84	0.09	2.01-2.38
Serum Ca at start of phototherapy	9.2 ± 0. 50	0.05	9.14-9.35
Serum Ca at 48 hr of phototherapy	8.5 0 ± 0.59	0.06	8.55- 8.65
TSB at start of phototherapy	17.76 ± 2.0	0.21	17.32-18.19
TSB at 48 hr of phototherapy	12.22 ± 2.33	0.25	11.71-12.73

Table 2: Comparison of mean total serum bilirubin(TSB) before and 48hour after phototherapy

TSB	Mean	Standard Deviation
Pre phototherapy	17.76	2.0
Post phototherapy	12.22	2.33

Statistical result: t-value: 49.96 df:83 p-value <.0005

The difference in mean TSB level was normally distributed as found by the visual inspection of the Q-Q plot. In our study that there is significant decreased in the mean TSB level after 48 hour of phototherapy. The difference in mean TSB was 0.441 (95%CI: 5.316 - 575).The reduction in total serum bilirubin level after phototherapy was statistically significant (p<0.005) when compared to that before phototherapy.

Table 3: Comparison of mean serum Calcium before and 48hour after phototherapy

Serum Calcium	Mean	Standard Deviation
Pre phototherapy	9.2	0.5
Post phototherapy	8.5	0.59

Statistical result: t-value: 17.82 df :83 p-value <0.0005

The difference in mean serum calcium level was approximately normally distributed as found by the visual inspection of the Q-Q plot. In our study that there is significant decreased in the mean serum calcium level 48 hour after photo therapy. The difference in mean serum calcium was 0.155 (95% CI : 0.770 – 0.615).The reduction in serum total calcium level after phototherapy was statistically significant ($p<0.005$) when compared to that before phototherapy.

Discussion

According to Cremer R. et al. phototherapy is an important method of therapy for neonatal jaundice. Jaundice is a significant contributor to NICU admissions. However, even risk-free procedures had drawbacks, such as phototherapy. Hypocalcemia is one of these complications [13].

It has long been known that phototherapy is effective in treating newborn hyperbilirubinemia. The first study to link hypocalcemia with phototherapy for preterm newborns was Romagnoli et al (1979) [14]. According to Hakinson [11] and Hunter [12] phototherapy prevents the pineal gland from secreting melatonin, which counteracts the effect of cortisol on bone calcium. Cortisol causes hypocalcemia by causing an increase in bone calcium absorption. Kim proposed that hypocalcemia may result from decreased parathormone secretion [15].

In our study's serum calcium level was 8.5 ± 0.59 mg/dL after 48 hours phototherapy, which is comparable to the findings of Bahbah et al. (8.58± 0.76) [16].

We found that 16.67% of term infants had phototherapy-induced hypocalcemia, which was similar to studies done by Karamifar et al. and Ehsanipour et al, in which the incidence of hypocalcemia was 15 and 14.4%, respectively, after 48 hours of phototherapy [17,18]. In comparison to our study, Alizadeh-Taheri et al. and Tehrani et al. reported phototherapy-induced hypocalcemia in 7 percent, 7.5 percent, of newborns, respectively which is lesser when compared to our study (16.67%) [19,20].

When compared to our study, Shrivastav et al., and Sethi et al., exhibited hypocalcemia in 30 percent and 75 percent, respectively [21,22] Rajesh et al. and Bahbah et al. found hypocalcemia in 26 percent of neonates.which are greater than those in our study [24,19].

Our study's findings, which are in accordance with those of Tehrani et al. and Reddy et al., revealed that none of the hypocalcemia neonates in our study showed any clinical manifestations [20,24]. In a study by Bahbah et al., 14 percent of hypocalcemic neonates experienced jitteriness and 10 percent experienced convulsions; however, in a study by Rajesh et al., 38 percent experienced jitteriness and none of the participants had convulsions [16,23,25].

Conclusion

Similar to traditional blue and white light phototherapy, light-emitting diode phototherapy has the potential to cause hypocalcemia as a side effect while treating neonatal jaundice.

Our study concludes that 16.67% of neonates developed hypocalcemia after phototherapy. The range of hypocalcemia varied from very low levels to just borderline decrease in total serum calcium. This in turn can have clinical impact and adds to the morbidity. The main limitations of our study were the exclusion of preterm neonates and the estimation of total serum calcium.

Reference

1. Kliegman RM: Jaundice and hyperbilirubinemia in the newborn. Nelson Textbook of Pediatrics, 20th ed. Stanton BF, St. Geme III, JW,

Schor NF, Behrman, RE (ed): Elsevier, Philadephia; 2015. 871-5.
2. Walsh S, Murphy J. Neonatal jaundice are we over-treating? Iran Med J. 2010; 103(1):28–29.
3. Dijk P, de Vries T, de Beer J. Guideline' Prevention, diagnosis and treatment of hyperbilirubinemia in the neonate with a gestational age of 35 or more weeks' Nederlands Tijdschrift Voor Geneeskunde. 2009; 153:93.
4. Kaplan M, Bromiker R, Hammerman C. Severe neonatal hyperbilirubinemia and kernicterus: are these still problems in the third millennium? Neonatology. 2011;100 (4):354–362.
5. Hansen TWR. Twists and turns in phototherapy for neonatal jaundice. Acta Paediatrica. 2010;99 (8):1117–1118.
6. Management of Hyperbilirubinemia in the Newborn Infant 35 or More Weeks of Gestation.Pediatrics. 2004; 114:297-316.
7. Maisels MJ, Kring E. Rebound in serum bilirubin level following intensive phototherapy. Arch Pediatr Adolescent Med. 2002;156(7):669–672.
8. Cloherty JP, Eichenwald EC, Hansen AR, Stark AR. Manual of neonatal care. Lippincott Williams & Wilkins; 2011.
9. Vuralli D: Clinical approach to hypocalcemia in newborn period and infancy: who should be treated?. Int J Pediatr. 2019; 2019:4318075.
10. Hakanson DO, Bergstrom WH: Phototherapy induced hypocalcemia in newborn rats. Prevention by Melatonin. Science, 1981;214(4522):807-809.
11. Hunter KM: Hypocalcaemia. In: Manual of Neonatal Care. JP Cloherty, EC Eichenwald, AR Stark (Eds.); 5th Edn.; Lippincott Williams & Wilkins, Philadelphia. 2004;579-588.
12. Kumar P, Chawla D, Deorari A: Light-emitting diode phototherapy for unconjugated hyperbilirubinaemia in neonates. Cochrane Database Syst Rev. 2011, CD007969.
13. Cremer R, Perryman PW, Richards DH. Influence of light on the hyperbilirubinaemia of infants. Lancet 1958; 1: 1094–7.
14. Romagnoli C, Polidore G, Cataldi L, et al. Phototherapy- induced hypocalce mia. J Pediatr. 1979;94(5):815–6.
15. Kim SH, Park JH. Effect of phototherapy on bone metabolism in newborn rats. J Korean Soc Neonatal. 2001;8(2):206–10.
16. Bahbah MH, El Nemr FM, El Zayat RS, Khalid Aziz EA: Effect of phototherapy on serum calcium level in neonatal jaundice. Menoufia Med J. 2015,28:426-30.
17. Karamifar H, pishva N, Amirhakimi GH: Prevalence of phototherapy-induced hypocalcemia. Iran J Med Sci. 2002, 27:166-8.
18. Ehsanipour F, Khosravi N, Jalali S. The Effect of Hat on Phototherapy-Induced Hypocalcemia in Icteric Newborns. Razi J Med Sci. 2008;15 (58):25–29.
19. Alizadeh-Taheri P, Sajjadian N, Eivazzadeh B: Prevalence of phototherapy induced hypocalcemia in term neonate. Iran J Pediatr. 2013, 23: 710-1.
20. Tehrani FH, Sabet Z, Kavehmanesh Z, MIrzaei M: The effect of phototherapy on serum calcium level in full term neonates. J Basic Clinical Pathophysio l. 2014, 10:57-60.
21. Shrivastava J, Singh A: Phototherapy Induced Hypocalcemia in Neonates. Scholars Journal of Applied Medical Sciences. 2015, 3:2931-3.
22. Sethi H, Saili A, Dutta AK: Phototherapy induced hypocalcemia. Indian Pediatr. 1993; 30:1403-6.
23. Rajesh KC, Kanodia P: Phototherapy induced hypocalcaemia in neonates with jaundice. Journal of Nepalgunj Medical College. 2020.

24. Reddy AT, Bai KV, Shankar SU: Electrolyte Changes Following Phototherapy in Neonatal Hyperbilirub inemia. Inter J Sci Res. 2015,4:752-8.
25. Ahmed D. H., Chowdhury M., & Saha L. Plasma Triglyceride levels Increase the Risk for Recurrent Cardiovascular Disease Independent of High-Density Lipoprotein Cholesterol Level. Journal of Medical Research and Health Sciences, 2021;4(9): 1476–1482.