ECRONICON OPEN ACCESS

EC PAEDIATRICS
Research Article

The Effect of Phototherapy on Serum Calcium Levels in Term Neonates

Anum Shumail, Muhammad Khalid Masood*, Riffat Omer, Madiha Iqbal, Sadia Sharif and Fatima Tahira

Department of Paediatrics, Services Institute of Medical Sciences, Lahore, Pakistan

***Corresponding Author:** Muhammad Khalid Masood, Department of Paediatrics, Services Institute of Medical Sciences, Lahore, Pakistan.

Received: April 26, 2020; **Published:** August 29, 2020

Abstract

Introduction: Hyperbilirubinemia is observed during first week of life in approximately 60% of term neonates and 80% of preterm neonates. Phototherapy is one of the routine methods for management of hyperbilirubinemia. Commonly known adverse effects of phototherapy are dehydration, hyperthermia, chills, skin rashes, loose stools, retinal damage, bronze baby syndrome and hypocalcemia.

Objective: The objective of the study was to determine the frequency of hypocalcemia after phototherapy in term neonates with unconjugated hyperbilirubinemia.

Materials and Methods: This descriptive case series study was carried out in Neonatal unit, Services Hospital Lahore from April 26, 2017 to October 25, 2017. After taking written informed consent 170 neonates presenting with hyperbilirubinemia were included in the study. Serum calcium and bilirubin levels were measured on arrival and 48 hours after receiving phototherapy. Hypocalcemia was considered as total serum calcium of < 8 mg/dL. Data was entered on a predesigned proforma and analyzed using SPSS version 16.

Results: Out of 170 cases, 67.65% (n = 115) were between 2 - 7 days of life whereas 32.35% (n = 55) were between 8 - 14 days of life, mean ± SD was calculated as 5.71 ± 3.04 days, 48.23% (n = 82) were male whereas 51.77% (n = 88) were females, frequency of hypocalcemia after phototherapy in term neonates with unconjugated hyperbilirubinemia was calculated as 8.82% (n = 15).

Conclusion: The frequency of hypocalcemia is significant in the jaundiced neonates treated with phototherapy.

Keywords: *Term Neonates; Unconjugated Hyperbilirubinemia; Phototherapy; Hypocalcemia*

Introduction

Neonatal jaundice is one of the most common clinical problems observed during the first week of life affecting approximately 60% of term and 80% of preterm infants [1]. Pathophysiological basis of the jaundice is the same in term and preterm neonates, but premature babies are at a higher risk of developing hyperbilirubinemia. High bilirubin level may cause permanent neurological impairment in neonates [2].

Phototherapy plays very important role in the management of hyperbilirubinemia in neonates. Apart from its good effects of decreasing unconjugated bilirubin levels, it may also lead to undesired effects including skin rash, diarrhea, rise in body temperature, chills, trauma to the eye, nasal obstruction, bronze baby syndrome and DNA damage [3,7,8].

Nonetheless, no change in blood ions or metabolites has been reported except for calcium concentration [4,10]; A drop in serum calcium level has been noticed in patients undergoing phototherapy [4,5,9]. Ionized calcium is essential for may biochemical processes including blood coagulation, cell membrane integrity and function, cellular enzymatic activity and neuromuscular excitability. The exact underlying mechanism by which phototherapy leads to hypocalcaemia is not properly understood yet, but it seems that hypocalcemia is accompanied by a decreased in serum melatonin concentration which in turn is regulated by the pineal gland. Pineal gland is influenced by the diurnal light-dark cycle [6].

This study will help the neonatologists and pediatricians in future to assess the effects of phototherapy on serum calcium levels in a better way and to emphasize the need of serial calcium monitoring in neonates receiving phototherapy.

Objective of the Study

The objective of the study was to determine the frequency of hypocalcemia after phototherapy in term neonates with unconjugated hyperbilirubinemia.

Materials and Methods

This descriptive case series study was carried out in Neonatal Unit of Services Hospital, Lahore from 26 April 2017 to 25 October 2017. A total of 170 term neonates > 37 weeks of both genders with weight > 2.5 kg and presenting with hyperbilirubinemia requiring phototherapy between day 2 and day 14 of life were enrolled. Sample size of 170 cases was estimated using 95% confidence level, margin of error 4% with an expected hypocalcaemia as 7.5%. These neonates were selected by consecutive non-probability sampling after written informed consent by parents. Phototherapy at 425 to 475 nm at distance of 45 cm was given. Serum calcium and bilirubin levels were measured on arrival and 48 hours after receiving phototherapy. Hypocalcemia was considered as total serum calcium of < 8 mg/dL.

Those neonates who had asphyxia, respiratory distress (respiratory rate > 60), sepsis (blood culture positive for any microorganism), congenital anomalies, hyperparathyroidism, hypocalcaemia before start of phototherapy, newborns delivered to diabetic mothers and newborns of mothers taking anticonvulsant drugs were excluded from the study. Calcium supplements were given to neonates who develop hypocalcemia. All the collected data was entered into SPSS version 16. Numerical variables i.e. age, duration of phototherapy treatment, serum calcium level before and after phototherapy were presented by mean ± SD. Categorical variables i.e. gender and hypocalcemia was presented as frequency and percentage. Data was stratified by age, gender and duration of phototherapy. Post-stratification chi square test was applied. P-value < 0.05 taken was significant.

Results

A total of 170 cases fulfilling the inclusion/exclusion criteria were enrolled to determine the frequency of hypocalcemia after phototherapy in term neonates with unconjugated hyperbilirubinemia.

Age distribution of the patients shows that 67.65% (n = 115) were between 2 - 7 days of life whereas 32.35% (n = 55) were between 8 - 14 days of life, mean ± SD was calculated as 5.71 ± 3.04 days. Gender distribution shows that 48.23% (n = 82) were male whereas 51.77% (n = 88) were females.

Mean duration of phototherapy was calculated as 4.66 ± 1.25 days, serum calcium level before treatment was recorded as 9.30 ± 0.28 mg/dL and serum calcium level after treatment was 8.79 ± 0.49 mg/dL.

Frequency of hypocalcemia after phototherapy in term neonates with unconjugated hyperbilirubinemia was calculated as 8.82% (n = 15) whereas 91.18% (n = 155) had no hypocalcemia (Table 1). The data was stratified by age, gender and duration of phototherapy. Post-stratification chi square test was applied. P-value < 0.05 taken was significant (Table 2-4).

Hypocalcemia	No. of patients	%
Yes	15	8.82
No	155	91.18
Total	170	100

Table 1: *Frequency of hypocalcemia after phototherapy in term neonates with unconjugated hyperbilirubinemia (n = 170).*

Age (in days)	Hypocalcemia		P value
	Yes	No	
2 - 7	10	105	0.94
8 - 14	5	50	

Table 2: *Stratification for frequency of hypocalcemia with regards to age.*

Gender	Hypocalcemia		P value
	Yes	No	
Male	9	73	0.33
Female	6	82	

Table 3: *Stratification for frequency of hypocalcemia with regards to gender.*

Duration of phototherapy	Hypocalcemia		P value
	Yes	No	
1 - 3 days	6	26	0.02
> 3 days	9	129	

Table 4: *Stratification for frequency of hypocalcemia with regards to duration of phototherapy.*

Discussion

Jaundice in the newborn is one of the most frequent reasons for admission in neonatal unit. Every year, roughly 1.1 million babies develops severe neonatal jaundice and the vast majority reside in sub-Saharan Africa and South Asia [10]. Phototherapy is one of the safest way to reduce hyperbilirubinemia. One of the side effects of phototherapy is hypocalcemia.

The reason to conduct this study was to add to the medical literature about the effect of phototherapy on serum calcium levels as there is no sufficient data present. Romagnoli [11] was the first to suggest the association of hypocalcaemia and phototherapy in preterm neonates. Hakinson [12] and Hunter [13] hypothesized that phototherapy inhibits pineal secretion of melatonin which blocks the effect of cortisol on bone calcium. So, cortisol increases bone uptake of calcium and induces hypocalcaemia. Kim [14] suggested decreased secretion of parathyroid hormone (PTH) as the cause of hypocalcemia. In Hooman's study the urinary calcium excretion was significantly higher in phototherapy group [15].

In our study out of 170 cases, 67.65% (n = 115) were between 2 - 7 days of life whereas 32.35% (n = 55) were between 8 - 14 days of life, mean ± SD was calculated as 5.71 ± 3.04 days, 48.23% (n = 82) were male whereas 51.77% (n = 88) were females, frequency of hypocalcemia after phototherapy in term neonates with unconjugated hyperbilirubinemia was calculated as 8.82% (n = 15).

We compared our results with a study conducted in Iran on the effect of phototherapy in serum calcium level in term neonates evaluated that out of total (198), fifteen neonates (7.5%) developed hypocalcemia. After 48 hours of phototherapy, there were significant differences between serum calcium levels from baseline values of 9.46 ± 0.8 mg/dL to 9.12 ± 0.83 mg/dL ($p < 0.5$). None of the neonates who developed hypocalcemia after phototherapy were clinically symptomatic [16]. In a study conducted in India 22 out of 55 term neonates who had hypocalcemia, 13 were symptomatic. Out of them, 7 developed jitteriness, 6 were lethargic and none of them developed convulsions [7].

A Thirupathi Reddy and others evaluated the electrolyte changes in neonates receiving phototherapy for neonatal hyperbilirubinemia; they recorded that out of 252 neonates that were managed with phototherapy, Male: Female ratio was 1.45:1. Incidence of low birth weight babies was 23% and preterm was 20.2%. Mean birth weight and gestational age was 2.84 ± 0.51 kg and 38.44 ± 1.98 weeks respectively. Mean duration of phototherapy was 37.65 ± 11.06hrs. The incidence of post phototherapy hypocalcaemia was found to be 13.1% ($p = 0.013$) which was more in LBW babies (36.2%, $p < 0.001$) and preterm neonates (41.2%, $p < 0.001$) than in normal weight babies (6.2%) and term neonates (6.2%) and 18.8% when duration of phototherapy was > 48hrs ($p < 0.001$). The incidence of hyponatremia post phototherapy found to be 6% which was more in LBW babies (17.2%, $p < 0.001$) and preterm neonates (17.6%, $p < 0.001$) than in normal weight babies (2.6%) and term neonates (3.1%) and 17.4% when duration of phototherapy was > 48hrs ($p < 0.001$). Even the decline in mean serum calcium and sodium values found to be statistically significant. None of the hypocalcemic neonates were symptomatic clinically. The incidence of potassium and chloride changes following phototherapy was found to be non-significant irrespective of gestational age, birth weight and duration of phototherapy; they concluded that neonates undergoing phototherapy are at higher risk of electrolyte changes. This risk is greater in premature and LBW babies and hence this group of babies should be closely monitored for changes in electrolytes and should be managed accordingly [17].

Khan M and others determined the frequency of hypocalcemia in term neonates with jaundice receiving phototherapy and concluded that the frequency of hypocalcemia is significant in the jaundiced neonates treated with phototherapy [18]. One needs to be vigilant in dealing neonates in this context while serial monitoring for hypocalcemia and its complications should be considered in institutional policy and research priority.

As, local data available on this subject is limited, this study is helpful for the neonatologists and pediatricians in future to assess the effects of phototherapy on serum calcium levels in a better way.

Conclusion

We concluded that the frequency of hypocalcemia is significant in the jaundiced neonates treated with phototherapy. We should be aware when dealing neonates in this context and serial monitoring for hypocalcemia and its complications should be considered in institutional policy and research priority.

Bibliography

1. Rennie J., *et al.* "Neonatal jaundice: summary of NICE guidance". *British Medical Journal* 340.3 (2010): C2409.

2. RK Y., *et al.* "The evalutation of the effect of phototherapy on serum calcium level". *People's Journal of Scientific Research* 2 (2012): 1-4.

3. Jain A., *et al.* "Hypocalcemia in Newborn". *The Indian Journal of Pediatrics* 77.10 (2010): 1123-1128.

4. PI Kumari S SJ AS. "Electorlyte changes in Neonates > 35 weeks gestation Receiveing Phototherapy for jaundice Prospective Study conducted at Tertiary care Centre". *Journal of Evidence Based Medicine and Healthcare* 2.8 (2015): 963-969.

5. Xiong T., *et al.* "The side effects of phototherapy for neonatal jaundice: what do we Know? What should we do?" *European Journal of Pediatrcis* 170.10 (2011): 1247-1255.

6. ZK. "The effect of phototherapy on serum calcium level in Full-term neonates". *Journal of Basic and Clinical Pathophysiology* 2014 2.2 (2016): 57-60.

7. T Dmr K. "The effect of phototherapy on serum lionized calcium levels in Neonates with unconjugated Hyper Bilirubinemia". *Journal of Evidence-Based Medicine and Healthcare* 201517.2 (2016): 57-60.

8. Arora S., *et al.* "Serum Calcium Levels in Preterm and Term Neonates on Phototherapy". *Journal of Nepal Paediatric Society* 34.1 (2014).

9. Monsef AEghbalian F. "Does conventional phototherapy have any effect on platelet count in full term neonates with indirect hyperbiliruinemia?" *Heatl* 03.12 (2011): 709-711.

10. Shaked MD., *et al.* "Evaluation of jaundice caused by unconjugated hyperbilirubinemia in children (2016).

11. Romagnoli C., *et al.* "Phototherapy- induced hypocalcemia". *The Journal of Pediatrics* 94.5 (1979): 815-816.

12. Hakanson D., *et al.* "Calcemic responses to photic and pharmacologic manipulation of serum melatonin". *Pediatric Research* 22.4 (1987): 414-416.

13. Hunter KM. "Hypocalcemia". In: Cloherty JP, Eichenwald CE, Stark AR, editors. Manual of Neonatal Care. 5th edition. Philadelphia: Lippincott Williams and Wilkins (2004): 579-588.

14. Kim SH and Park JH. "Effect of phototherapy on bone metabolism in newborn rats". *Journal of the Korean Society of Neonatology* 8.2 (2001): 206-210.

15. Hooman N and Honarpisheh A. "The effect of phototherapy on urinary calcium excretion in newborns". *Pediatric Nephrology* 20.9 (2005): 1363-1364.

16. J OM B. "Neonatal endocrinology". *The Indian Journal of Pediatrics* 2000.67.3 (2016): 217-223.

17. Reddy AT., *et al.* "Electrolyte Changes Following Phototherapy in Neonatal Hyperbilirubinemia". *International Journal of Science and Research (IJSR)* (2013): 2319-7064.

18. Khan M., *et al.* "Hypocalcemia in jaundiced neonates receiving phototherapy". *Pakistan Journal of Medical Sciences* 32.6 (2016): 1449-1452.

Volume 9 Issue 9 September 2020