Section: Pediatrics

JAMP

Research

CO-RELATION OF SERUM ELECTROLYTE CHANGES DURING AND POST PHOTOTHERAPY WITH GESTATIONAL AGE

Arif Husain[1], Kavita Yadav[2], Tahir Husain Ansari[3]

[1]Assistant Professor, Department of Pediatrics, Rohilkhand Medical College and Hospital Bareilly, U.P, India
[2]Senior Resident, Department of Pediatrics, Institute of Child Health Sir Gangaram Hospital, New Delhi, India.
[3]Associate Professor, Department of Ophthalmology, Rohilkhand Medical College and Hospital, Bareilly, U.P., India.

Received : 14/09/2022
Received in revised form : 06/10/2022
Accepted : 18/10/2022

Keywords:
Co-relation, serum electrolyte, phototherapy, gestational age.

Corresponding Author:
Dr. Arif Husain,
Email:arifhussain517@hotmail.com
ORCID: 0000-0002-2918-6123

DOI: 10.47009/jamp.2022.4.5.20

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2022; 4 (5); 91-95

Abstract

Background: In first week of life Neonatal hyperbilirubinemia is a common physical finding, a common cause of concerns to parents and the most common cause of hospital readmission during neonatal period. To study the co-relation of serum electrolyte changes during and post phototherapy with gestational age. **Materials and Methods:** This study was done on admitted at Dept. of Pediatrics, Rohilkhand Medical College and Hospital, Bareilly, U.P. **Result:** we found that 7(15.4%) neonates had hypocalcaemia after phototherapy, None of the neonates developed any clinical features of hypocalcemia and remained asymptomatic. Although, there was difference in mean values of S. magnesium and S. phosphorus, but none of the neonates had decline in levels of these electrolytes before and after phototherapy. Although, there was difference in mean values of S.magnesium and S.phosphorus, but none of the neonates had decline in levels of these electrolytes before and after phototherapy. There was no correlation in incidence of hypomagnesaemia and hypophosphatemia with gestational age. **Conclusion:** The incidence of hypocalcaemia and hypokalaemia was also more in neonates (29.4%, 11.8%) with LBWs as compared to neonates (7.1%, 3.6%) with normal birth weight. There was no correlation in incidence of hypomagnesaemia and hypophosphatemia with birth weight.

INTRODUCTION

Unconjugated hyperbilirubinemia (UHB) is one of the most common problem during the first 2 weeks after birth among premature and term infants.[1] When the rate at which bilirubin is produced exceeds the rate at which bilirubin can be eliminated, the level of bilirubin in the circulation and body increases. Therefore, the relative imbalance of these processes determines the pattern and degree of neonatal hyperbilirubinemia, which vary for a variety of reasons and represent the known risk factors.[2]

Unconjugated bilirubin (UCB) is produced by the degradation of heme, which is derived mainly from the catabolism of erythrocyte hemoglobin. After the production of unconjugated bilirubin, the hydrophobic unconjugated bilirubin gets bound to albumin in the plasma and istransported to liver. In liver, the enzyme bilirubin UDP-glucuronosyltransferase (UGT1A1) conjugates unconjugated bilirubin with glucuronic acid. Relatively hydrophilic bilirubin conjugates, are then excreted into bile and transit biliary tree to the intestines. In the intestinal lumen, the bilirubin conjugates are partly hydrolysed to unconjugated bilirubin, which can be reabsorbed from intestine, reduced to urobilinoids, or excreted with the faeces. The reabsorbed unconjugated bilirubin is then transported to liver via vena porta, where it can be conjugated and excreted via the bile, hence constituting an enterohepatic circulation.[3]

In Unconjugated hyperbilirubinemia, accumulation of unconjugated bilirubin can result from increased production, enhanced enterohepatic circulation or decreased hepatic clearance.

This is the reason for transient neonatal unconjugated hyperbilirubinemia during first postnatal week as is known as physiological jaundice.[3]In unconjugated hyperbilirubinemia, there is potential risk of deposition of unconjugated bilirubin in the central nervous system, which may lead to bilirubin induced neurological dysfunction (BIND), kernicterus and death.[3]

Phototherapy is use of visible light for the treatment of neonatal hyperbilirubinemia. It is safe, non invasive and effective treatment for neonatal hyperbilirubinemia and also prevents need of exchange transfusion. Hence, it has become as initial line of treatment for neonatal hyperbilirubinemia. The mechanism of phototherapy is by conversion of conjugated bilirubin into water soluble products, by structural photo isomerization and photo oxidation, which get excreted without conjugation by liver.[4] Initiation and duration of phototherapy is defined by a specific range of bilirubin levels, which are based on neonates age and the risk of developing bilirubin neurotoxicity.[5] The decision to start phototherapy is based on AAP guidelines for initiation of phototherapy, which are further based on neonatal age, serum total bilirubin levels, individual risk factors and gestational age.[4] The wavelength of light, intensity of light, distance between light and infant, and body surface area exposed to light, all these factors determine dose and effectiveness of phototherapy. It is seen in controlled trials that more is the surface area exposed, greater is reduction in bilirubin levels. It is usually not necessary to remove neonates' diaper but in cases where bilirubin levels are rising despite of phototherapy and treatment, diaper should be removed until clinically significant decline in serum bilirubin levels.[6] As light can be toxic to immature retina, neonates' eye should always be covered with opaque eye patches.[6] Hence this study was conducted to study the co-relation of serum electrolyte changes during and post phototherapy with gestational age.

MATERIALS AND METHODS

This study was done on admitted at Dept. of Paediatrics, Rohilkhand Medical College and Hospital, Bareilly, U.P. Study period was 1st November 2019 to 31st October 2020. Ethical clearance was obtained from the institutional ethical committee for the present study. Informed consent was taken from the parents study subjects.

Sample Size

Sample size is 45 as per PS 2. (alpha is .05; power is .9; sigma is 11; delta is 16; m is 1)

Inclusion Criteria

- All stable neonates (preterm and term) with unconjugated hyperbilirubinemia requiring phototherapy.

Exclusion Criteria

- Neonates who have birth asphyxia
- Congenital malformation
- Sepsis
- Hypothyroidism
- IUGR
- Infant of diabetic mother
- Mother with history of antiepileptic drug, gestational diabetes, eclampsia.
- Infant born to eclamptic mother receiving $MgSO_4$ therapy.
- Those on IV therapy or already with electrolyte imbalances prior to phototherapy.
- Neonates with conjugated hyperbilirubinemia will also be excluded.
- Prerequisite: Informed parental consent.

Methodology

- All infants meeting the inclusion criterion will be involved in study.
- The eligible neonates will be put under double surface phototherapy with a wavelength of 425-475nm at distance of 25-30 cm away from skin.
- Collection of blood: 2ml of venous blood sample will be collected under aseptic condition in serum separating tube. Blood sample will be centrifuged for 5-7 mins at 3000 rotations per minutes in order to separate the serum.
- Estimation of biochemical parameters:
- Na^+ & K^+ will be determined by Easylite Analyser
- Mg^{2+} will be determined by Calmagite method using ERBA CHEM V semi autoanalyser. Phosphorus will be determined using UV Molybydate method, using ERBA 360 auto analyser. Calcium will be determined using Arsenzo method, using ERBA 360 auto analyser.
- Total and Direct Bilirubin will be determined by using Diazo Method, ERBA 360 auto analyser.
- All the above tests will be done in neonates before staring of phototherapy. These values will be considered as base levels. Phototherapy will be given to neonates and after 12 hours the above parameters will be repeated. Based on response to phototherapy again samples will be taken12 hourly till serum bilirubin level come 2-3 mg/dl below the age-specific levels on the normogram.

Criterion for phototherapy is as per AAP recommendation, 2004.[7]

Statistical Analysis

Levels of various parameters will be expressed in terms of Mean +/_ SD. Statistical analysis will be done using SPSS 23.0 Version and MS Excel. Statistical significance will be analysed using student t test. Co- relation between various parameters and bilirubin levels will be done using Pearson coefficient, P value <0.05 will be considered significant.

RESULTS

Out of 45 neonates, 25(55.60%) were male and 20(44.40%) female. Out of 45 neonates, 17(37.8%) were low-birth-weight and 28(62.2%) were normal birth weight. Mean birth weight of neonates was 2.66 ±0.53 kg. Out of 45 neonates, 16(35.6%) were preterm neonates (<37 weeks) and 29(64.4%) were term neonates (37-42 weeks).Mean Gestation Age (in weeks) of neonates was 36.73 ± 2.50weeks.

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

Table 1: Comparison of study variables in newborns before and after phototherapy

	Before Phototherapy	After Phototherapy		
Investigation	**Mean ± SD**	**Mean ± SD**	**Mean difference**	**P-Value**
S.Sodium	139.94 ± 1.55	138.69 ± 1.96	1.250	<0.001*
S.Potassium	4.81 ± 0.34	4.20 ± 0.43	0.610	<0.001*
S.Calcium	8.98 ± 0.37	8.25 ± 0.64	0.730	<0.001*
S.Magnesium	2.13 ± 0.11	2.04 ± 0.16	0.090	<0.001*
S.Phosphorus	3.83 ± 0.16	3.42 ± 0.14	0.410	<0.001*

Mean S.Sodium of neonates before phototherapy was 139.94 ± 1.55 and after phototherapy 138.69 ± 1.96.The Mean difference in S.Sodium before and after phototherapy was 1.250 and which was asignificant difference(P-value<0.001).

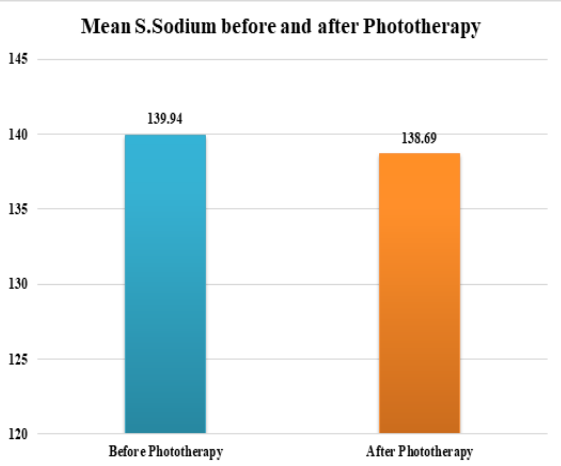

Figure 1: Graph showing Mean S.Sodium level before and after phototherapy.

Mean S.Potassium of neonates before phototherapy was 4.81 ± 0.34 and after phototherapy was 4.20 ± 0.43. The Mean difference in S.Potassium before and after phototherapy was 0.610 which was statistically significant difference (<0.001).

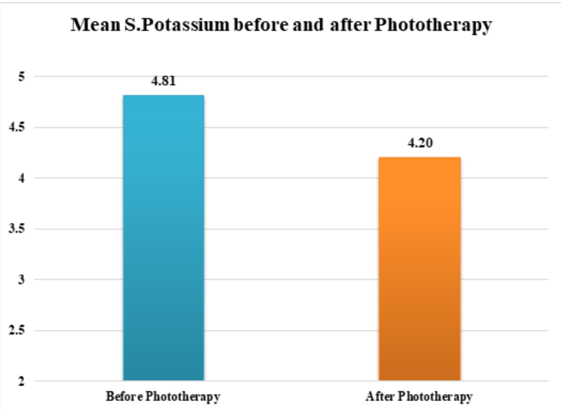

Figure 2: Graph showing mean S.Potassium level before and after phototherapy.

Mean S.Calcium of neonates before phototherapy was 8.98 ± 0.37and after phototherapy was 8.25 ± 0.64. The Mean difference in S.Calcium before and after phototherapy was 0.730. This difference was significant statistically (<0.001).

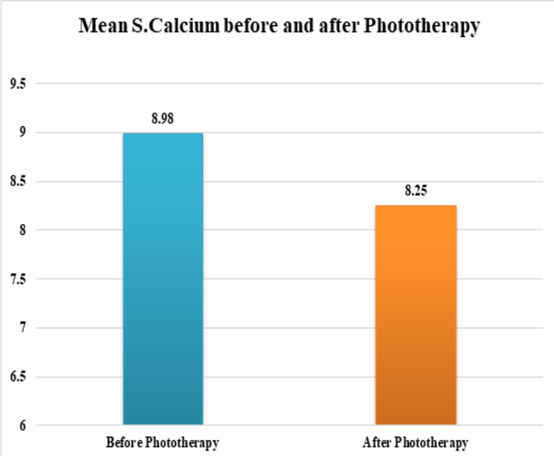

Figure 3: Graph showing S.Calcium level before and after phototherapy.

Mean S.Magnesium of neonates before phototherapy was 2.13 ± 0.11 and after phototherapy was 2.04 ± 0.16. Mean difference in S.Magnesium before and after phototherapy was 0.090 and it was statistically significant with a P-value of<0.001.

Mean S.Phosphorus of neonates before phototherapy was 3.83 ± 0.16 and after phototherapy3.42 ± 0.14. The mean difference in S.Phosphorus before and after phototherapy was 0.410 and it was statistically significant with a P-value <0.001.

In our study we have found that incidence of hyponatremia was more in neonates (17.6%) with LBWs (<2.5kg) as compare to neonates (10.7%) with normal birth weight (2.5-4.0kg) which interpret that neonate with LBWs (<2.5kg) are at higher risk for developing hyponatremia after phototherapy. Incidence of hypocalcemia and hypokalemia are also more in neonates (29.4%, 11.8%) with LBWs (<2.5kg) as compared to neonates with normal birth weight (7.1%, 3.6%). There was no correlation in incidence of hypomagnesaemia and hypophosphatemia with birth weight.

Hence, in our study we found that neonates with LBW (<2.5kg) are at high risk of developing electrolytes changes, in comparison with neonates with normal birth weight.

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

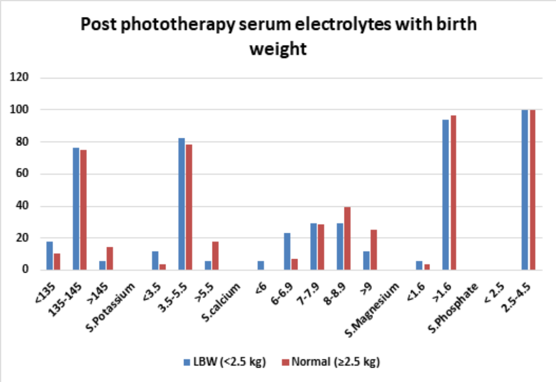

Figure 4: Co-relation of serum electrolytes before and post phototherapy with birth weight

In our study, we found that incidence of hyponatremia was more in pre-term neonates (18.8%) as compared to term neonates (10.3%) which interpret that pre-term neonates are at high risk of developing hyponatremia after phototherapy. Incidence of hypocalcaemia and hypokalaemia are also more in pre-term neonates (31.3%, 12.5%) as compared to term neonates (27.6%, 3.4%). There was no correlation in incidence of hypomagnesaemia and hypophosphatemia with gestational age.

Hence, in our study we found that pre-term neonates are at higher risk for developing electrolytes changes after phototherapy.

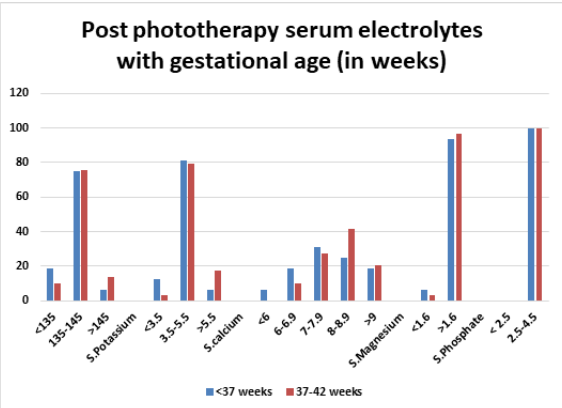

Figure 5: Co-relation of serum electrolytes with gestational age after phototherapy

DISCUSSION

In this study, the mean birth weight of neonates was 2.66+/-0.53 kgs. Mean birth weight of pre-term neonates was 2.20 ±0.35 kg and term neonates was 2.90 ±0.44 kg. In Karamifar et al,[8] the mean birth weight of term and preterm neonate was 2.88+/-0.474 kgs and 2.077+/- 0.316 kgs respectively, 2.224+/-0.340 and 2.980+/- 0.410 kgs in Reddy et al,[9] which is comparable to our study.

Curtis et al,[10] stated that the absorption of water, potassium, sodium and chloride was significantly decreased in neonates undergoing phototherapy, which leads to electrolyte imbalances during phototherapy.

there was significant decline in the mean serum calcium levels which was statistically significant (p –value<0.001). The mean s. calcium levels before phototherapy was 8.98+/- 0.37 and after phototherapy was 8.25+/-0.64.

This was similar to study conducted by Eghbalian et al,[11] where mean s.calcium before phototherapy was 9.85+/-1.23 and after phototherapy was 9.09+/-0.93, Reddy et al9, where mean s.calcium levels before phototherapy was 9.16+/-1.00 and after phototherapy was 8.53+/-1.7, Suneja et al,[12] where mean s. calcium levels before phototherapy was 9.34+/-1.21 and after phototherapy was 8.38+/-1.05 and Gayatri et al,[13] where mean s. calcium levels before phototherapy was 9.02+/-0.993 and after phototherapy was 8.21+/-1.084.

In our study, we co-related hypocalcemia following phototherapy with gestational age and found that preterm neonates are at higher risk of developing hypocalcemia as compared to term neonates. 18.8% of preterm neonates developed hypocalcemia as compared to 10.3% of term neonates. These results were similar to studies other studies Karamifar et al Reddy et al Gayatri et a1 but differed from Arora S et al.[8,9,13,14]

In our study, co-relation of hypocalcemia following phototherapy was done with birth weight and it was found that low-birth-weight neonates (31.3%) are at a higher risk of developing hypocalcemia as compared to normal birth weight neonates (27.6%). This was similar to studies conducted by Reddy et al9 (36.2% in low-birth-weight and 6.2% in normal birth weight) and Gayatri et al (26.25% in low-birth-weight and 7.94% in normal birth weight).[13]

In our study, we found that following phototherapy there was significant decline in serum potassium levels which was stastitically significant with p-value <0.001. The mean serum potassium levels before phototherapy were 4.81+/- 0.34 and after phototherapy were 4.20+/- 0.43.

This was similar to study by Suneja et al,[12] where mean potassium levels before phototherapy were 6.095+/-1.4 and after phototherapy were 5.28+/-1.08 and Gayatri et al,[13] where mean potassium levels before phototherapywere 5.01+/- 0.683 and after phototherapy were 4.63+/-0.666. In Reddy et al,[9] there was no decline in serum potassium levels, before and after phototherapy and our results were not in consonance with their study.

The neonates who developed hypokalemia following phototherapy did not show any features clinically and remained asymptomatic.

Therefore, from our study it is evident that neonates undergoing phototherapy, especially preterm and low birth weight neonates are at higher risk of developing electrolyte changes post phototherapy.

CONCLUSION

It was concluded that there was no correlation in incidence of hypomagnesaemia and hypophosphatemia with gestational age. Hence, in our study we found that pre-term and low birth weight neonates are at higher risk of developing electrolytes changes after phototherapy and they should be closely monitored for electrolyte imbalances.

REFERENCES

1. Amin SB, Smith T, Timler G. Developmental influence of unconjugated hyperbilirubinemia and neurobehavioral disorders. Pediatr Res. 2019;85(2):191-197. doi: 10.1038/s41390-018-0216-4.
2. Stevenson DK, Dennery PA, Hintz SR. Understanding newborn jaundice. J Perinatol. 2001;21 Suppl 1:S21-4; discussion S35-9. doi: 10.1038/sj.jp.7210628.
3. Cuperus FJ, Hafkamp AM, Hulzebos CV, Verkade HJ. Pharmacological therapies for unconjugated hyperbilirubinemia. Curr Pharm Des. 2009;15(25):2927-38. doi: 10.2174/138161209789058219.
4. Xiong T, Tang J, Mu DZ. Side effects of phototherapy for neonatal hyperbilirubinemia. Zhongguo Dang Dai Er Ke Za Zhi. 2012;14(5):396-400.
5. Bhutani VK, Wong RJ. Bilirubin neurotoxicity in preterm infants: risk and prevention. J Clin Neonatol. 2013;2(2):61-9. doi: 10.4103/2249-4847.116402.
6. Maisels MJ, McDonagh AF. Phototherapy for neonatal jaundice. N Engl J Med. 2008;358(9):920-8. doi: 10.1056/NEJMct0708376.
7. Sethi H, Saili A, Dutta AK. Phototherapy induced hypocalcemia. Indian Pediatr. 1993;30(12):1403-6.
8. Karamifar H, Pishva N, Amirhakimi GH. Prevalence of phototherapy-induced hypocalcemia. Iran J Med Sci. 2015;27:166-8.
9. Reddy AT, Bai KV, Shankar SU. Electrolyte changes following phototherapy in neonatal hyperbilirubinemia. Indian J Sci Res. 2015;4:752-8.
10. De Curtis M, Guandalini S, Fasano A, Saitta F, Ciccimarra F. Diarrhoea in jaundiced neonates treated with phototherapy: role of intestinal secretion. Arch Dis Child. 1989;64(8):1161-4. doi: 10.1136/adc.64.8.1161.
11. Eghbalian F, Monsef A. Phototherapy-induced hypocalcemia in icteric newborns. Iran J Med Sci. 2002;27:169-71.
12. Suneja S, Kumawat R, Saxena RA. Effect of phototherapy on various biochemical parameters in neonatal hyprbilirubinaemia: A clinical insight. Indian J Neonatal Med Res. 2018;6:13-8.
13. Wang J, Guo G, Li A, Cai WQ, Wang X. Challenges of phototherapy for neonatal hyperbilirubinemia (Review). Exp Ther Med. 2021;21(3):231. doi: 10.3892/etm.2021.9662.
14. Arora S, Narang GS, Singh G. Serum calcium levels in preterm and term neonates on phototherapy. J Nepal Paediatr Soc. 2014;34:24-8.