

Complication of Phototherapy with Special Reference to its Effect on Serum Calcium in Neonatal Hyperbilirubinemia

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Abstract:

Background and Objectives: Jaundice is common and, in most instances, a benign condition in the newborn. Jaundice is defined as a yellow discoloration of skin, mucous membrane and sclera that is produced by the accumulation of bilirubin in the tissues and interstitial spaces. Prevalence of phototherapy induced hypocalcaemia among neonates. To estimate and compare the serum calcium concentration in neonatal hyperbilirubinemia.

Materials and Methods: Prospective Hospital based Analytical Longitudinal Cohort study. Department of paediatrics, Kurji Holy Family Hospital, Patna, Bihar a tertiary care referral hospital. Study duration of Two years. Kurji Holy Family Hospital is a 300 bedded hospital. It provides 24 hours emergency services, managed by a team of consultants, registrar, DNB students, house surgeons and trained nurses. Apart from these, there is round the clock laboratory, blood bank, Radiological facility, NICU, PICU.

Conclusion: jaundiced neonates who undergone phototherapy the number of neonates developing hypocalcemia i.e. Serum calcium level < 7 mg/dl at 48 hour of phototherapy increase i.e. 78(74.28%). This observation is statistically significant (p-value=0.00).

Keywords: Nicu, Picu, Hypocalcemia, Jaundice.

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Introduction

Jaundice is common and, in most instances, a benign condition in the newborn [1]. Jaundice is defined as a yellow discoloration of skin, mucous membrane and sclera that is produced by the accumulation of bilirubin in the tissues and interstitial spaces. Visible jaundice in the neonates occurs when serum Bilirubin level rises more than 7 mg/dl [2].

Over two – third of neonates develop clinical jaundice during early days of life. Out of all newborn, jaundice is observed during the first three days of life in about 60% of term & 80 % of preterm neonates.[3,5] Jaundice may be physiological or pathological. Physiological jaundice (or icterus neonatorum) is nearly always a benign and is defined as an elevation of serum Bilirubin not more than 12 mg/dl in term & up 15 mg/dl in preterm infants without any specific abnormality of Bilirubin metabolism [5,6] Neonatal jaundice in term babies is considered as pathological if serum Bilirubin level exceeds 12 mg/dl or if jaundice persists beyond 8 days of life. Among preterm babies, serum Bilirubin exceeding 15 mg/dl or jaundice persisting beyond 14 days of life is considered pathological. Hyperbilirubinemia within 24 hours of life is always pathological. Hyperbilirubinemia can be divided in unconjugated Hyperbilirubinemia and conjugated

Hyperbilirubinemia.[2] Main causes of unconjugated hyperbilirubinemia are haemolytic disease i.e. ABO & Rh incompatibility, hereditary spherocytosis, G-6 PD deficiency, neonatal sepsis, drugs, Gilbert syndrome, breast milk jaundice and Crigler – Najjar syndrome, Increased enterohepatic circulation, Hypothyroidism, Cephalohematoma. Conjugated hyperbilirubinemia is mainly due to the defect in excretion of Bilirubin in gastrointestinal tract.[1,7,8]

Bilirubin is generally regarded as a toxic compound when it is in unconjugated form, it accumulates to abnormally high concentration in biological tissues and is thus responsible for the development of kernicterus and results in various neurological sequelae[9,10] Hypocalcemia is also found in neonates subjected to phototherapy, Hypocalcemia is defined as total serum calcium level less than 7 mg/dl and ionised serum calcium level below 4 mg/dl. 50% of total serum calcium occurs as free ionic calcium in the serum and is of greater physiological importance. Hypocalcemia is a lesser known but an important complication which one should anticipate and present in a baby undergoing phototherapy. Amongst the neonates preterm babies are poorly adapted to the cessation of maternal calcium flow

and at birth about 50% of them a calcium crisis, it may be symptomatic or clinically mild and is known as "Early onset hypocalcemia" occurring during first 72 hours of life. Late on set hypocalcemia" is usually symptomatic, usually presenting at the end of first week. It classically occurs in term babies who are fed on high phosphate diet. Romagnoli et al were the first to demonstrate an association between phototherapy and hypocalcemia especially in preterm babies. Since then, many workers have proved this relationship and have suggested that phototherapy inhibits pines secretion of melatonin which normally blocks the effects of cortisol on bone calcium up take. This cortisol, now unchecked, exerts a direct hypocalcemia effect and increases bone up take of calcium as well.

Objectives

Prevalence of phototherapy-induced hypocalcaemia among neonates. To estimate and compare the serum calcium concentration in neonatal hyperbilirubinemia.

Materials and Methods

Prospective Hospital based Analytical Longitudinal Cohort study. Department of paediatrics, Kurji Holy Family Hospital, Patna, Bihar a tertiary care referral hospital. Kurji Holy Family Hospital is a 300 bedded hospital. It provides 24 hours emergency services, managed by a team of consultants, registrar, DNB students, house surgeons and trained nurses. Apart from these, there is round the clock laboratory, blood bank, Radiological facility, NICU, PICU.

All neonates who are delivered in this hospital or outside who come to this hospital for phototherapy and fulfil our inclusion criteria will be studied. The study is planned over a period of 2 year.

Neonates will be divided in two groups.

Group 1: Preterm: Gestational age less than 37 completed weeks.

Group 2: Term: Gestational age 37 to 41 weeks. Gestational age estimated by New Ballard Scoring system.

Ethical committee clearance will be given by the hospital ethical committee. Informed consent will be

taken from the parents and the guardian after explaining the purpose of the study to them.

Inclusion Criteria

All preterm and term neonates of either sex admitted to our hospital for phototherapy.

Exclusion Criteria

- Neonates requiring exchange transfusion.
- Neonates who had developed a complication during the course of phototherapy, eg: septicemia, respiratory distress, renal failure etc.
- If jaundice appear within 24 hours of life.
- Infants of diabetic mother etc.
- Neonates with conjugated hyperbilirubinemia.
- Neonates with birth asphyxia.
- Maternal consumption of anti-consultant.

Our phototherapy unit consists of 6 daylight tubes working at 120- 220 volt with a life of 3000 hours. The neonates were placed naked in cribs, 45 cm away from the phototherapy unit. Their eyes were covered with a bandage and genitalia of neonates were covered by using a diaper. The infant's position was change from time to time. They were removed occasionally for brief periods for the purpose of feeding.

Their temperature were monitored every 12 hourly and were watched for any signs of complication of phototherapy.

The neonates were subjected to the following investigations (whenever indicated):

Blood: Hb (gm%), TLC, DLC, Septic screen, ESR, Blood sugar, General blood picture.

Blood groups: ABO and Rh blood grouping of mother and baby.

Serum bilirubin level (total, conjugated & unconjugated)

SGPT, SGOT, Serum alkaline phosphates

Analysis of data

Data was entered in Microsoft excel sheet. Data will be analysed by using paired 't' test by using SPSS software. Descriptive data are presented as mean, S.D., Standard error of mean. P value less than 0.05 were considered significant.

Results

Table 1: Distribution of Jaundiced Neonates in Group Based On Gestational Age

	Group-1 Preterm	Group-11 Term
No. of Jaundice neonates	105(47.5%)	116(52.5%)
Total	221	

Total 221 jaundiced neonates were included in the study out of which 105 (47.5%) were preterm having gestational age < 37 week, and 116(52.5%) were term having gestational age >37 week.

	Male	Female
No. of Jaundice neonates	137 (62%)	84(36%)
Total	221	

Total 221 jaundiced neonates were included in the study out of which 137 (62%) male and 84 (38%) female.

Comparison of serum calcium in group-1 (preterm) before phototherapy and at 24 hrs of phototherapy

	Serum calcium	At zero hour	At 24 hour
No. of jaundice neonates	>7.mg/dl	105 (100%)	38 (36.2%)
	<7.mg/dl	0 (%)	67(63%)
Total		105	105
Mean		9%	8.07%
S.D.		0.81%	5.94%
P value	0.02		

The cutoff of serum calcium level for hypocalcemia in preterm neonates is < 7.0 mg/dl^(x). The number of preterm jaundiced neonates having serum calcium < 7 mg/dl at zero hour (i.e. before phototherapy) were zero. The number of preterm jaundiced neonates at 24 hours of phototherapy having serum calcium < 7 mg/dl were 67 (63.8%). This observation was statistically significant (p-value <0.02).

Comparison of serum calcium in group-1 (preterm) before phototherapy and at 48 hrs of phototherapy

	Serum calcium	At zero hour	At 24 hour
No. of jaundice neonates	>7.mg/dl	105 (100%)	27 (25.75%)
	<7.mg/dl	0 (%)	78(74.25%)
Total		105	105
Mean		9%	105
S.D.		0.81%	7.1
P value	0.00		0.99

According to present study the graph and table shows jaundiced neonates who undergone phototherapy the number of neonates developing hypocalcemia i.e. Serum calcium level < 7 mg/dl at 48 hour of phototherapy increase. i.e. 78(74.28%). This observation is statistically significant(p-value=0.00)

According to present study the graph and table shows after 24 hours of discontinuation of phototherapy the neonates who develop hypocalcemia during phototherapy 102 (97.2%) regain normal serum calcium level normal and 3 (2.8%) remain hypocalcemic i.e. Serum calcium level <7 mg/dl, whose etiology is unknown and further evaluation of these neonates needs.

Discussion

In the present study, we compare the mean serum calcium concentration of jaundice neonates in both group -1 and group 2.

In group 1 (preterm), the mean serum calcium concentration of jaundiced neonates is at before phototherapy 9.1mg/dl± 0.81, at 24 hours of phototherapy 8.07± 5.94 (p=0.02), at 48 hours of phototherapy 7.1mg/dl±0.99 (p=0.00) and after 24 hours of discontinuation of phototherapy 8.75±0.87 (p=0.00)11. These all are found to be statistically significant (p<0.05). In our present study 63.80%, (67) preterm neonates developed hypocalcemia at 24 hours of phototherapy, 74.28% (78) preterm develop hypocalcemia at 48 hours of phototherapy, at 24 hours after discontinuation phototherapy nearly all hypocalcemic neonates serum calcium level return to

normal, 2.8% (3) of neonates remain hypocalcemic, whose etiology will be further investigated. None of our hypocalcemic neonates became symptomatic.

In group 2 (term), the mean serum calcium concentration of jaundiced neonates is at before phototherapy 9.41±0.80, at 24 hours of phototherapy 8.07±1.02 (p = .00), at 48 hours of phototherapy 7.77± 0.96 (p= .00), after 24 hours of discontinuation of phototherapy 9.03± 0.80 (p= 0.00). These all are found to be statistically significant (p<0.05). In our present study 43.1% (50) of term neonates develop hypocalcemia at 24 of phototherapy, 51.7% (60) of term neonates develop hypocalcemia at 48 hours of phototherapy, 4.3% (5) of term neonates remains hypocalcemic, whose etiology will be further investigated. None of our hypocalcemic neonates became symptomatic. Sethi et al (1993) [12] reported that 90% of preterm neonates and 75% of full-term neonates developed hypocalcemia after being subjected to phototherapy. In the study done by Jain (x) the prevalence of phototherapy induced hypocalcemia was 55% in the preterm neonates and 30% in full term neonates. Romagnoli et al (1979)[13] noted the association of hypocalcemia with phototherapy in premature neonates. 22 out of 42 neonates (52.3%) developed hypocalcemia in the study group; while in controls only 6 out of 49 (12.2%) had hypocalcemia14. The difference was statistically highly significant (p<0.05). Eghbalian F et al (2002) noted the association of hypocalcemia with phototherapy in term babies63 jaundiced term neonates were included in the study and approximately 52% were developed hypocalcemia. Mean ± SD

serum calcium level decreased significantly ($p < 0.001$) from a baseline value of $9.85 \text{ mg/dl} \pm 1.23$ (before phototherapy) to $9.09 \text{ mg/dl} \pm 0.93$ (after phototherapy). [15] Karamifar H et al noted that mean serum calcium level decreased significantly ($p = 0.043$) from a baseline value of $9.53 \text{ mg/dl} \pm 0.92$ (before phototherapy) to $9.3 \text{ mg/dl} \pm 1.111$ (after phototherapy) in term and from $8.73 \text{ mg/dl} \pm 1.38$ (before phototherapy) to $8.4 \text{ mg/dl} \pm 1.71$ (after phototherapy) in preterm babies ($p = 0.039$). 10% of preterm and 2.5% of term babies were developed erythematous rash in the present study. These finding were in consistent with the finding of Drew JH et al (1976) who observed it in 12% of the neonates.

Siegfried EC (1992) has observed a flea-bitten type of transient rash in jaundiced neonates undergoing phototherapy. Phototherapy can lead to watery loose stool as a side effect. 25% of preterm and 10% of the term newborns developed watery loose stool in the present study. Bakken AF (1976) observed transient lactase deficiency during phototherapy and attributed this to the diarrhoea. [16] Berant et al (1983) observed a transient increase in bile salt concentration in colonic contents which could explain the occurrence of diarrhoea. This theory was supported by De Curtis et al (1989) [17] Berant M (1983) observed this complication in 40% of the neonates. [18] Another complication of phototherapy was dehydration. 15% of preterm and 2.5% of term babies developed dehydration in the present study. Dehydration could be attributed to increase heat production by phototherapy lamps and large surface area of the neonates. Moreover, these neonates had developed loose stool during the course of phototherapy.

Conclusion

Jaundiced neonates who undergone phototherapy the number of neonates developing hypocalcemia i.e. Serum calcium level $< 7 \text{ mg/dl}$ at 48 hour of phototherapy increase. i.e. 78(74.28%). This observation is statistically significant ($p\text{-value} = 0.00$).

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