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Research Article

PREVALENCE OF HYPOCALCEMIA DUE TO PHOTOTHERAPY IN NEWBORNS WITH NEONATAL JAUNDICE IN A TERTIARY CARE CENTER OF SOUTHERN RAJASTHAN

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ABSTRACT

Objective: Neonatal jaundice is a prevalent condition affecting approximately 60–80% of newborns, with phototherapy being a widely utilized treatment. While double surface phototherapy (DSPT) offers enhanced efficacy, it has been associated with adverse effects, notably hypocalcemia. This study aims to determine the prevalence of hypocalcemia induced by DSPT in neonates with jaundice, identify risk factors, and evaluate clinical outcomes.

Methods: This prospective observational study enrolled 200 neonates with jaundice undergoing DSPT in a tertiary neonatal intensive care unit. Baseline data, including gestational age, birth weight, and bilirubin levels, were recorded. Serum calcium levels were measured before initiating DSPT and at 24 and 48-h post-initiation. Statistical analysis was performed to identify risk factors associated with hypocalcemia.

Results: Among 200 neonates, hypocalcemia prevalence increased from 6% at baseline to 38% at 24 h and 52% at 48 h post-DSPT. Symptomatic hypocalcemia occurred in 22% of affected neonates, with 0.9% experiencing seizures. Prematurity (<37 weeks), low birth weight (<2.5 kg), and high bilirubin levels (≥20 mg/dL) were identified as significant risk factors ($p<0.05$). Calcium supplementation normalized serum levels in all cases within 48 h, with no long-term complications observed during follow-up.

Conclusion: DSPT is effective for treating neonatal jaundice but significantly increases hypocalcemia risk. Routine calcium monitoring and preventive supplementation protocols should be considered to minimize adverse outcomes.

Keywords: Neonatal jaundice, Phototherapy-induced hypocalcemia, Double surface phototherapy.

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INTRODUCTION

Neonatal jaundice, characterized by elevated bilirubin levels, affects approximately 60% of term and 80% of preterm neonates within the 1st week of life [1]. It is predominantly caused by increased bilirubin production due to hemolysis and immature liver function. While phototherapy is an effective treatment modality, its adverse effects warrant attention, particularly hypocalcemia.

Hypocalcemia, defined as serum calcium levels below 7.5 mg/dL in term neonates and below 7 mg/dL in preterm neonates, can have serious implications if untreated, including seizures, irritability, and cardiac arrhythmias [2,3]. The exact mechanism linking phototherapy and hypocalcemia remains unclear, although hypotheses include light-induced suppression of pineal melatonin and subsequent parathyroid hormone (PTH) dysregulation. The association between phototherapy and hypocalcemia has been noted for decades but remains an underexplored domain [4,5]. Phototherapy-induced suppression of melatonin may alter calcium homeostasis, while direct effects of light on the parathyroid gland are also suspected [6,7]. Neonates are particularly vulnerable due to their immature calcium regulatory mechanisms. Moreover, the risk factors such as prematurity, low birth weight, and high bilirubin levels contribute to the variability in hypocalcemia prevalence among neonates undergoing phototherapy. Recent advances in phototherapy technology, such as double-surface phototherapy (DSPT), have increased treatment efficacy but may also elevate the risk of adverse effects, including hypocalcemia [8].

Given the clinical significance of hypocalcemia and its potential complications, understanding its prevalence in the context of DSPT is critical. This study aims to assess the prevalence of hypocalcemia among neonates undergoing DSPT for neonatal jaundice, identify associated risk factors, and evaluate clinical outcomes. In addition, the findings aim to contribute to the development of preventive strategies and guidelines for safer phototherapy practices.

METHODS

Study design and setting

This prospective observational study was conducted over 12 months at a tertiary care neonatal intensive care unit of Pacific Medical College and Hospital, Udaipur, Rajasthan. Ethical approval was obtained from the institutional review board, and informed consent was secured from parents.

Inclusion criteria

1. Neonates diagnosed with neonatal jaundice requiring DSPT
2. Gestational age ≥34 weeks
3. Birth weight ≥2 kg.

Exclusion criteria

1. Neonates with congenital anomalies, hypoxic-ischemic encephalopathy, or metabolic disorders
2. Neonates receiving calcium supplementation before phototherapy initiation.

Data collection

A total of 200 neonates meeting the inclusion criteria were enrolled. Baseline data, including gestational age, birth weight, mode of delivery, Apgar scores, and bilirubin levels, were recorded. Serum calcium levels were measured before initiating DSPT and at 24 and 48 h post-initiation.

Phototherapy protocol
DSPT involved placing neonates under two phototherapy units, one above and one below. Irradiance was maintained at 30–45 μW/cm^2/nm. Protective eye shields were used, and neonates were monitored for temperature and hydration.

Outcome measures
Primary outcome
Prevalence of hypocalcemia (serum calcium < 7.5 mg/dL) post-DSPT.

Secondary outcomes
Incidence of symptomatic hypocalcemia, risk factors, and clinical interventions.

Statistical analysis
Data were analyzed using SPSS software. Continuous variables were expressed as mean±SD, while categorical variables were expressed as percentages. Chi-square and t-tests were used to evaluate associations, with $p<0.05$ considered significant.

RESULTS

A total of 200 neonates were neonates were included in the study during the study period. Out of 200 neonates, 118 (59%) were male and 82 (41%) were female. The mean gestational age was 37.2±1.3 weeks, and the mean birth weight was 2.8±0.5 kg. DSPT was initiated at a mean bilirubin level of 18.4±2.1 mg/dL. Data have been mentioned in Table 1.

Serum calcium levels were sent at the time of start of phototherapy, at 24 h of initiation of phototherapy, and at the end of 48 h of initiation of phototherapy. Baseline hypocalcemia, i.e., hypocalcemia at the start of phototherapy was noted in 8 (4%) neonates. At 24-h post-DSPT, 38% (76 neonates) developed hypocalcemia. At 48-h post-DSPT, 52% (104 neonates) showed hypocalcemia. The result is shown in Table 2.

Among the neonates with hypocalcemia, 22% (13 neonates) exhibited symptoms, including jitteriness, irritability, and poor feeding. Two neonates (0.9%) experienced seizures, requiring intravenous calcium gluconate.

In our multivariate analysis, we identified prematurity, low birth weight, and high bilirubin levels as risk factors for hypocalcemia. The detailed results are illustrated in Table 3.

Neonates with hypocalcemia were managed with oral or intravenous calcium supplementation. Serum calcium levels normalized within 24–48 h in all cases. No long-term complications were observed during a 3-month follow-up.

Table 1: Demographic and clinical characteristics

S. No.	Characteristic	Value
1	Total Neonates (n)	200
2	Male	118 (59%)
3	Female	82 (41%)
4	Gestational age (mean±SD)	37.2±1.3 weeks
5	Birth Weight (mean±SD)	2800±500 g
6	Bilirubin Level (mean±SD)	18.4±2.1 mg/dL

*Data given in mean±SD

Table 2: Prevalence of hypocalcemia in neonates

S. No.	Timepoint	Hypocalcemia cases (n)
1	At start of phototherapy	8 (4%)
2	At 24-h post-DSPT	28 (14%)
3	At 48-h post-DSPT	58 (29%)

DSPT: Double surface phototherapy

Table 3: Risk factors for hypocalcemia

S. No.	Risk factor	Odds ratio (95% CI)	p value
1	Prematurity (<37 weeks)	2.1 (1.3–3.5)	0.01
2	Low birth weight (<2500 g)	1.8 (1.1–2.9)	0.03
3	High bilirubin levels (>20 mg/dL)	2.5 (1.5–4.2)	0.001

CI: Confidence interval

DISCUSSION

Our study enrolled 200 neonates for the study with neonatal jaundice requiring DSPT as per AAP guidelines [9]. Out of 200 neonates enrolled in the study, 59% were male and 41% were female. In study by Basnet *et al.*, they documented the similar gender distribution [10].

The prevalence of hypocalcemia at the end of 48 h of DSPT was 29% in our study. The observed prevalence of phototherapy-induced hypocalcemia (29%) aligns with previous studies reporting rates between 25 and 55% [11,12]. The prevalence of hypocalcemia in Jain's study [13] was 30% in full-term neonates and in Ehsanipoor's study was 15% [14]. The similar finding of hypocalcemia with phototherapy was observed in a study by Murmu *et al.* [15]. DSPT's higher intensity likely exacerbates calcium depletion compared to single-surface phototherapy. The mechanism may involve melatonin suppression. The blue light decreases pineal melatonin production, which may reduce PTH secretion [7]. The other cause could be calcium redistribution due to phototherapy. Phototherapy may alter calcium distribution across cellular compartments, lowering serum levels.

The high prevalence of hypocalcemia underscores the need for routine monitoring during DSPT, particularly in high-risk neonates. In our study, prematurity, low birth weight, and high level of bilirubin have been found to be significant risk factors for inducing hypocalcemia. Dutta S found prematurity as a significant risk factor for hypocalcemia [16]. Tsang RC in his study found low birth weight as a significant risk factor for hypocalcemia [17]. Chung and Kim suggested that high bilirubin levels induce hypocalcemia [11].

Symptomatic cases require prompt intervention to prevent complications. Preventive strategies, such as prophylactic calcium supplementation, merit further investigation.

Our findings corroborate earlier research but provide novel insights into the risk stratification of DSPT-induced hypocalcemia [6]. For instance, the significant association with bilirubin levels emphasizes the importance of individualized phototherapy thresholds.

Limitations
Our study was a single-center study; hence, it limits the generalizability. Furthermore, our study had short follow-up duration; thus, we could not find the long-term effect on serum calcium levels due to phototherapy. We could not study the potential confounding from unmeasured variables, such as maternal calcium status or feeding practices.

CONCLUSION

DSPT is an effective treatment for neonatal jaundice but poses a significant risk of hypocalcemia. Routine calcium monitoring and risk-based supplementation protocols could mitigate adverse outcomes. Further multicenter studies are warranted to validate these findings and establish evidence-based guidelines.

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CONFLICTS OF INTEREST

The authors assert that they do not possess any conflicts of interest.

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