

## PHOTOTHERAPY OUTCOMES AND BILIRUBIN ASSESSMENT TECHNIQUES IN PRETERM NEONATES: A TERTIARY CARE EXPERIENCE

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### ABSTRACT

**Objective:** Management of neonatal jaundice, particularly in preterm neonates, is a significant challenge in neonatal care, with phototherapy serving as the primary treatment modality. This study evaluates the outcomes of phototherapy and the efficacy of different bilirubin assessment techniques in a tertiary care environment.

**Methods:** A hospital-based prospective observational study was conducted involving 100 preterm neonates. Transcutaneous (TcB) and total serum bilirubin (TSB) levels were measured before, during, and after phototherapy to assess correlations and differences.

**Results:** Statistically significant correlations were found between TcB and TSB post-phototherapy (r-value = 0.8154, p-value<0.0001) and during phototherapy (r-value = 0.6069, p-value<0.0001). However, TcB tended to underestimate bilirubin levels compared to TSB post-phototherapy, with a mean difference of -0.42 mg/dl (p-value = 0.0117).

**Conclusion:** Despite discrepancies with traditional serum bilirubin (TSB) measurements during and after phototherapy, TcB proves to be an effective tool in clinical practice. The findings suggest that with further refinement and adjustment for influencing factors, TcB can serve as an equivalent to serum assessments, reducing the need for invasive procedures in neonatal jaundice management.

**Keywords:** Neonatal jaundice, Phototherapy, Preterm neonates, Transcutaneous bilirubin, Serum bilirubin, Tertiary care

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### INTRODUCTION

Neonatal jaundice is a prevalent condition in preterm neonates, necessitating effective management strategies to prevent severe complications such as bilirubin-induced neurologic dysfunction (BIND). Phototherapy remains the primary treatment modality for reducing high serum bilirubin levels. However, the variation in treatment outcomes, particularly among preterm neonates in a tertiary care setting, prompts a thorough examination of current practices and assessment techniques [1, 2].

Phototherapy functions by converting bilirubin into isomers that are more water-soluble and less toxic, which can be excreted without conjugation in the liver. While this treatment is generally safe and effective, its efficacy can vary significantly based on the intensity of light, the distance from the light source to the infant, and the total body surface area exposed. Additionally, the gestational age and physiological condition of preterm neonates can affect their responsiveness to phototherapy, necessitating adjustments to treatment protocols and careful monitoring of bilirubin levels [3, 4].

The assessment of bilirubin levels in preterm neonates is equally critical. Traditional methods involve serum bilirubin measurements, which, despite their accuracy, are invasive and may pose risks such as infection and anemia due to blood loss from frequent sampling. Recent advancements have seen the introduction of non-invasive techniques, such as transcutaneous bilirubin meters, which offer the advantage of less frequent handling and discomfort for the neonate. However, the accuracy of these devices can be influenced by factors like skin pigmentation, maturity of the infant, and the presence of other neonatal conditions [5-7].

In tertiary care settings, where the range of medical complexity is broader, the effectiveness of phototherapy and the precision of bilirubin measurement techniques must be critically evaluated. This evaluation is crucial not only for improving individual outcomes but

also for enhancing clinical protocols and guidelines in neonatal care units. Furthermore, the heterogeneity of this population, including variations in gestational age, underlying health conditions, and the severity of jaundice, makes standardization of treatment protocols challenging but necessary [8, 9].

This paper aims to explore the outcomes of phototherapy in managing neonatal jaundice among preterm neonates in a tertiary care context. It will assess the efficacy of various bilirubin assessment techniques, both invasive and non-invasive, in guiding treatment decisions and improving clinical outcomes. By analyzing retrospective data and current practices, this study seeks to identify potential areas for improvement in the treatment protocols and to contribute to the broader knowledge base regarding optimal jaundice management strategies in vulnerable preterm populations. Through this investigation, the study will provide insights that could lead to more tailored and effective approaches to managing this common yet complex condition in neonatal care.

### MATERIALS AND METHODS

#### Study design

This was a hospital-based prospective observational study conducted in the Neonatal Intensive Care Unit (NICU) of the Department of Pediatrics at SDM College of Medical Sciences and Hospital, Sattur, Dharwad.

#### Study area and period

The study was carried out in the NICU from December 2019 to November 2020.

#### Study subjects

The subjects included all preterm neonates born between 30 to 34 w of gestation, delivered either via vaginal delivery or cesarean section, during the study period.

**Inclusion criteria**

- Preterm neonates born between 30 to 34 w of gestation.
- Clinically suspected jaundice.
- Gestational age assessed using the modified Ballard scoring system.

**Exclusion criteria**

- Evidence of hemolytic diseases (positive direct Coombs test, increased reticulocyte count, fall in hemoglobin, or peripheral smear showing signs of hemolysis).
- Major congenital anomalies.
- Hydrops fetalis of any cause.
- Birth asphyxia.
- Jaundice with direct bilirubin component.

**Methods****Informed consent**

Consent was obtained from the parents of the neonates who met the inclusion criteria.

**Ethical committee clearance**

The study received ethical clearance from the appropriate committee at SDM College of Medical Sciences and Hospital.

**Intervention**

Transcutaneous bilirubin (TcB) and total serum bilirubin (TSB) levels were estimated in neonates with clinically suspected jaundice at three different times: before the initiation of phototherapy, during phototherapy, and after stopping phototherapy.

**Methods adopted**

- Neonates were enrolled based on a gestational age between 30 and 34 6/7 was determined by Ballard score.
- Data were collected using a pre-designed proforma after obtaining parental informed consent.
- TSB and TcB samples were paired and collected within 45 min of each other. The TSB samples were analyzed using the Diazo method in the laboratory.
- TcB measurements were performed using a Drager jaundice meter JM 103 on the skin at the sternum, where a photo-opaque patch 2.5 cm in diameter was applied before starting phototherapy to ensure consistent measurement locations.

- Phototherapy decisions (initiation, maintenance, and discontinuation) were based on TSB levels.

**Sample size**

The study included 100 preterm neonates.

**Statistical methods**

Data were analyzed using paired t-tests, correlation coefficients, and scatter plots to assess the relationship and agreement between TcB and TSB measurements.

**RESULTS**

The study conducted comprehensive analyses to evaluate the efficacy and correlation between transcutaneous bilirubin (TcB) and total serum bilirubin (TSB) measurements in preterm neonates undergoing and following phototherapy treatment. The statistical assessments included dependent t-tests and Karl Pearson's correlation coefficients to determine the relationship and agreement between these two bilirubin assessment methods during various stages of phototherapy.

Table 1 comparison of TcB and TSB after stopping phototherapy after cessation of phototherapy, the mean TcB was slightly lower than the mean TSB (7.23 mg/dl vs. 7.65 mg/dl), with a mean difference of -0.42 mg/dl. The standard deviation of this difference was 1.62 mg/dl, reflecting a percentage difference of -5.75%. The dependent t-test resulted in a t-value of -2.5685, which, with a p-value of 0.0117\*, indicates a statistically significant difference between the TcB and TSB measurements after phototherapy had ceased.

Table 2 correlation between TcB and TSB during phototherapy the correlation coefficient between TcB and TSB was 0.6069. This moderate positive correlation was statistically significant, with a t-value of 7.5602 and a p-value of 0.0001\*, suggesting a reliable association between the transcutaneous and serum bilirubin measurements while phototherapy was ongoing.

Table 3 correlation between TcB and TSB after stopping phototherapy; the correlation analysis after stopping phototherapy exhibited a strong positive correlation between TcB and TSB, indicated by a correlation coefficient of 0.8154. The associated t-value of 13.9418 and a p-value of 0.0001\* further affirm the high level of agreement between the two measurement methods post-phototherapy.

Table 4 mother's blood group distribution: the distribution of the mother's blood groups among the neonates was diverse, with B positive (33%), A positive (24%), and O positive (28%) being the most common. Less frequent were AB positive (9%), B negative (3%), A negative (2%), and O negative (1%). This distribution provides an overview of the genetic background potentially influencing neonatal jaundice and its management outcomes.

**Table 1: Comparison of TCB and TSB after stopping PT by dependent T-test**

Variables	Mean TcB	SD TcB	Mean TSB	SD TSB	Mean Diff.	SD Diff.	% of difference	T-value	P-value
After PT	7.23	2.41	7.65	2.78	-0.42	1.62	-5.75	-2.5685	0.0117*

**Table 2: Correlation between TCB and TSB during PT using Karl Pearson's correlation coefficient**

Variables	Correlation between TcB during PT with TSB during PT	r-value	t-value	p-value
During phototherapy	Correlation coefficient	0.6069	7.5602	0.0001*

**Table 3: Correlation between TCB and TSB after stopping PT using Karl Pearson's correlation coefficient**

Variables	Correlation between TcB after stopping PT with TSB after stopping PT	r-value	t-value	p-value
After phototherapy	Correlation coefficient	0.8154	13.9418	0.0001*

Table 4: Mother's blood group

Mother blood group	No of neonates	% of neonates
A negative	2	2.00%
A positive	24	24.00%
AB positive	9	9.00%
B negative	3	3.00%
B positive	33	33.00%
O negative	1	1.00%
O positive	28	28.00%

## DISCUSSION

The study's findings provide essential insights into the efficacy of phototherapy and bilirubin assessment techniques in preterm neonates within a tertiary care setting. The significant correlations and differences observed between transcutaneous bilirubin (TcB) and total serum bilirubin (TSB) measurements highlight critical considerations in the management of neonatal jaundice [10].

The strong positive correlation between TcB and TSB post-phototherapy (r-value = 0.8154) emphasizes that while TcB offers a less invasive monitoring alternative, its alignment with TSB readings remains crucial, especially after stopping phototherapy. This correlation underscores the potential of TcB to reliably reflect bilirubin levels when invasive procedures pose a risk or are logistically challenging. However, the negative mean difference observed post-phototherapy (mean diff = -0.42) indicates a systematic underestimation by TcB compared to TSB. This finding is clinically significant, as it could influence the decision-making process regarding the discontinuation of phototherapy [11, 12].

The study also highlights the variability in TcB readings during phototherapy, with a moderate correlation (r-value = 0.6069) suggesting that factors such as phototherapy light effects and changes in skin properties could affect TcB accuracy. These results indicate the necessity for cautious interpretation of TcB measurements during active phototherapy and suggest a potential calibration or adjustment need in TcB devices to enhance their accuracy under varied treatment conditions [13, 14].

Moreover, the diverse distribution of maternal blood groups presents an additional layer of complexity in managing neonatal jaundice. Genetic factors linked to blood type could influence bilirubin metabolism and phototherapy response, suggesting that personalized treatment approaches might be beneficial.

## CONCLUSION

This study supports the effectiveness of TcB as a reliable and non-invasive alternative for monitoring bilirubin levels in preterm neonates. While there are discrepancies with TSB measurements, especially during and after phototherapy, these differences are manageable and do not diminish the utility of TcB in clinical practice. By integrating TcB, healthcare providers can reduce the need for invasive blood draws without compromising care quality. Future research should aim to refine TcB techniques, considering identified factors affecting discrepancies, to further validate its equivalence to serum bilirubin assessments and broaden its applicability in neonatal jaundice management.

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Nil

## AUTHORS CONTRIBUTIONS

All authors have contributed equally

## CONFLICT OF INTERESTS

Declared none

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