

Correlation of Transcutaneous bilirubin and Total serum bilirubin in term and near-term neonate while on phototherapy and 24hrs after its cessation

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Abstract:

Background: This Study investigated the correlation among Transcutaneous Bilirubin (TcB) and Total Serum Bilirubin (TSB) levels in term and near-term neonates during Phototherapy and 24 hours after its cessation.

Methods: A retrospective cohort study was conducted from February 2022 to March 2023, involving a sample size of 230 neonates. TcB and TSB measurements were obtained at baseline, during Phototherapy, and 24 hours after cessation. The correlation between TcB and TSB levels was assessed using statistical analysis.

Results: During Phototherapy ($r = 0.85$, $p < 0.001$) and 24 hours after ($r = 0.79$, $p < 0.001$), there was a statistically significant positive correlation among the mean TcB and TSB levels. This correlation held for newborns who were either full-term or very close to attaining this developmental milestone. In contrast, TcB consistently provided inaccurate estimates of TSB concentrations, especially at higher bilirubin levels.

Conclusion: According to the outcomes of our research, there is a strong correlation among the levels of TcB and TSB in full-term and near-term neonates during Phototherapy and 24 hours after the conclusion of treatment. The measurement of TcB has the potential to be an effective noninvasive method for monitoring bilirubin levels in these neonates; however, it is essential to note that this method may result in a slight underestimation of TSB levels at higher concentrations. These results lend credence to the potential efficacy of TcB in the treatment of jaundice in infants, paving the way for early interventions and decreasing the need for invasive blood samples to diagnose jaundice.

Keywords: Correlation, Transcutaneous bilirubin, Total serum bilirubin, Term and near-term neonates, Phototherapy.

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Introduction

Neonatal jaundice is a common condition induced by an accumulation of bilirubin in a newborn's circulatory system. The liver is responsible for processing and eliminating bilirubin produced by hemolysis [1]. On the other hand, neonates can develop jaundice due to an accumulation of bilirubin due to their immature liver function. Without treatment, newborns with severe neonatal or jaundice that has not been treated run the risk of developing kernicterus. This condition can cause permanent brain injury [2]. Monitoring infant bilirubin levels is essential for diagnosing and treating neonatal jaundice [3]. To determine how much TSB is present in the blood, the "gold standard" has always been the invasive collection

of blood samples [4]. On the other hand, this method can be stressful for the infant and the parents, as it frequently requires extracting blood from the infant, which can be distressing. Recently, alternatives to TSB testing that are noninvasive have become available. The TcB test illustrates this. Total body bilirubin, or TcB, is measured using a portable instrument that detects bilirubin levels in the blood via the epidermis. It is a straightforward technique that does not involve pain or difficulty and eliminates the need for routine blood samples [5,6].

Phototherapy is a principal component of neonatal jaundice treatment [7].

In this procedure, the neonate is exposed to a specific wavelength of light to accelerate the

breakdown of bilirubin into a form that can be excreted. During and after Phototherapy, there is a correlation among the TcB and TSB levels; understanding this relationship can shed light on the validity and precision of TcB measurements compared to TSB ones [8]. This Study aims to contribute to the existing body of knowledge regarding TcB as a noninvasive method for monitoring bilirubin levels in neonates by investigating the relationship between TcB and TSB levels in term and near-term newborns. This Study will focus specifically on time and near-term newborns. The findings have the potential to be implemented in therapeutic contexts because they provide a reliable method for determining the bilirubin level of a newborn and guiding treatment decisions in cases of infant jaundice.

Objective

- To determine if there is a correlation between the levels of TcB and TSB in near and in term infants undergoing phototherapy.
- To evaluate the persistence of the correlation between TcB and TSB levels 24 hours after the cessation of Phototherapy in term and near-term neonates.

Research Question

1. What are the correlation between the levels of TcB and TSB in the blood of full-term and near-full-term neonates during phototherapy?
2. Does a correlation between the levels of TcB and TSB 24 hours persist after phototherapy has been completed?
3. Does there exist a difference in TcB and TSB levels between full-term and near-full-term neonates before, during, and after phototherapy?

Literature review

During and after Phototherapy, several studies have looked at the levels of TcB and TSB in newborns. Researchers [9] observed a significant positive association between TcB and TSB levels ($r = 0.85$, $p < 0.001$) in a retrospective cohort study of term newborns receiving Phototherapy. TcB and TSB levels were found to have a moderate connection ($r = 0.67$, $p < 0.001$) in Study by [10], which included preterm infants undergoing Phototherapy. These results support the hypothesis that TcB and TSB levels in newborns increase in tandem with exposure to light during Phototherapy.

Compared to the current Study's goals, the studies above support that are examining the relationship

between TcB and TSB levels in full-term and near-full-term neonates during and after Phototherapy is important. TcB and TSB levels positively correlate in both trials, suggesting that TcB could be a useful noninvasive technique for monitoring bilirubin levels in newborns [11].

Despite the usefulness of the current literature, it is important to note a few caveats. First, there may be inconsistencies in the correlation results due to differences in the devices and methodologies used to assess TcB and TSB levels between investigations. How much gestational age, birth weight, and other coexisting disorders affect the correlation is also unknown. In addition, the results may need to be more generalizable due to the small sample numbers in some research [12].

The evaluated research shows that TcB and TSB levels in neonates are positively correlated during Phototherapy and for 24 hours afterwards. Consistent with the Study's aims, the results highlight TcB's potential as a painless means of tracking bilirubin in full- and near-full-term newborns. Future research with bigger sample sizes and standardized techniques is necessary to evaluate the correlation further and overcome these caveats.

Methods

Study Design and Study Population

The researchers conducted a retrospective cohort analysis between February 2022 and March 2023. Participants were neonates with neonatal jaundice who were either delivered prematurely or at term and receiving Phototherapy. "Full term" refers to infants born between 37 and 42 weeks of gestation, while "near term" refers to infants born between 34 and 36 weeks.

Inclusion and Exclusion Criteria

Infants diagnosed with neonatal jaundice required Phototherapy and were born between 34 and 42 weeks and were eligible to participate in the Study. It was determined that neonates with significant congenital anomalies, a history of hemolytic disease, severe systemic illness, or taking other medications that could affect bilirubin levels would not be included in the Study.

Measurement of TcB and TSB

Using a portable transcutaneous bilirubinometer, readings were obtained. The apparatus was placed on the newborn's forehead or sternum, and the reading was converted to mg/dL. A sample of venous blood was drawn for TSB measurements, which was subsequently analyzed in the

laboratory using a specific method.

Phototherapy Protocol

The established protocols administered neonatal participants Phototherapy. The infants were treated with light of a specific wavelength by phototherapy devices positioned at a constant and predetermined distance. Consideration was given to the newborn's age, the gestational age of the mother, and the bilirubin levels when determining the duration and intensity of Phototherapy.

Data Collection Process

TcB and TSB measurements were recorded at three distinct time points: before, during, and 24 hours after treatment. Before the commencement of Phototherapy, baseline data were collected. During Phototherapy, TcB and TSB readings were taken consistently (once every six hours). TcB and TSB levels were measured twenty-four hours after phototherapy treatment was discontinued. We standardized the timing and frequency of measurements to ensure consistency and accuracy throughout the procedure.

Throughout the investigation, a password-protected database was used to store information regarding the neonates' demographics, health, and TcB and TSB readings. The statistical significance of the relationship between TcB and TSB levels was analysed. The confidentiality of the participant's data was maintained by the rules of ethical conduct and the protocols for obtaining informed consent.

Results

Table 1: Summary of the result

	Photo therapy	Baseline	24 Hours Later Cessation
TcB (mg/dL)	8.7	10.2	7.9
TSB (mg/dL)	9.0	10.5	8.2
Standard Deviation	1.8	2.1	1.6

Interpretation

Before, during, and 24 hours after Phototherapy, there was a correlation between the levels of TcB and TSB in full-term and near-full-term neonates. According to these findings, determining the TcB can effectively monitor bilirubin levels in neonates receiving treatment for jaundice that does not require invasive procedures. Due to the high degree of concordance between TcB and TSB levels, there is strong evidence that TcB may be beneficial in treating infant jaundice. Importantly, TcB assays tended to underestimate TSB levels in the presence of higher bilirubin concentrations. When bilirubin levels are

Demographic Characteristics

The average gestational age of the 230-term and near-term infants who participated in the Study was 38 weeks. Within the scope of the investigation, the sample consisted of an equal number of males and females.

Mean and Standard Deviation of TcB and TSB Measurements

TcB and TSB levels were initially quite elevated, with respective mean values of 10.2 and 10.5 mg/dL and standard deviations of 2.1 and 2.3 mg/dL.

During Phototherapy, the average level of TcB was 8.7 mg/dL (standard deviation = 1.8), and the intermediate level of TSB was 9.0 mg/dL (standard deviation = 2.0). When Phototherapy was discontinued for 24 hours, the median levels of TcB and TSB were 7.9 and 8.2 mg/dL, respectively (standard deviation = 1.6 and 1.8, respectively).

Correlation Analysis Between TcB and TSB Levels

There was a statistically significant positive correlation between the levels of TcB and TSB during Phototherapy ($r = 0.85$, $p < 0.001$). The concentration of TSB increased simultaneously with the concentration of TcB, according to these data. There was a significant positive correlation between TcB and TSB levels ($r = 0.79$, $p < 0.001$), which persisted 24 hours after Phototherapy was discontinued. Using the p-value, the statistical significance of this association was determined.

elevated, it is essential to consider the clinical environment and use TSB methods for precise evaluation, as demonstrated by this finding. This research provides a noninvasive alternative to TSB tests for monitoring the bilirubin levels of neonates, which has significant implications for clinical practice.

Readings of TcB can allow for timely interventions, thereby reducing the need for invasive blood samples and making the experience less traumatic for neonates.

Discussion

This Study's results corroborate previous research

on the connection TSB between and TcB in newborns following Phototherapy.

TcB measures can correctly estimate TSB levels in term and near-term neonates, as evidenced by the substantial positive association observed

during Phototherapy and 24 hours after its termination. This confirms the value of TcB as a noninvasive approach for monitoring bilirubin levels in newborns, as shown in earlier investigations.

Table 2: Comparison with the existing studies

Study	Participants	Methodology	Main Findings
Current Study	Term and near-term neonates undergoing Phototherapy	Retrospective cohort study	As there is a significant correlation among TSB and TcB levels during Phototherapy and 24 hours after its termination, TcB can be utilized as a noninvasive method for monitoring bilirubin levels in neonates. This is because TcB and TSB levels are positively correlated.
[13]	Term neonates	Randomised controlled trial	During phototherapy, a significant correlation among the levels of TcB and TSB, lending credence to idea that TcB may one day serve as a reliable indicator of bilirubin levels.
[14]	Preterm neonates	Retrospective Study	The levels TSB of and TcB in preterm neonates receiving phototherapy were found to be moderately correlated. This finding suggests that TcB measurements may be useful in this population.
[15]	Term and preterm neonates	Retrospective observational Study	During phototherapy, there is a consistent correlation between TcB and TSB levels in both preterm and full-term neonates. TcB is a noninvasive technique for monitoring newborns' bilirubin levels.

This Study provides additional evidence to support the hypothesis that neonates receiving Phototherapy correlate with TcB and TSB levels. Like Studies, the current investigation discovered a strong positive correlation between the two variables. These studies indicate that TcB measurements can effectively predict TSB levels in newborns, irrespective of gestational age. Both studies indicate a modest correlation among TSB and TcB levels; however, they focus on preterm neonates, whereas the present study focuses on term and near-term infants. This suggests that TcB measurements may be advantageous for preterm infants undergoing

Strengths and Limitations

The retrospective cohort design of the Study is a strength because it enabled the evaluation of the relationship between TSB and TcB levels and the collection of data at multiple time points. The findings are more credible because of the large sample size, which consisted of 230 neonates, the findings are more reasonable.

In addition, the hyper-specific focus of the research on term and near-term neonates who received Phototherapy led to the discovery of vitally important new information about this population.

Nevertheless, several restrictions must be considered. Because only a single model of handheld transcutaneous bilirubinometer was used in this study, it is possible that the apparatus influenced the results. To advance future research, it would be advantageous to compare the precision and dependability of multiple devices.

Phototherapy. It has been demonstrated that the levels of TcB and TSB in babies undergoing Phototherapy are associated, based on the consistency of data across a significant number of clinical trials. These findings support the use of TcB as a noninvasive method for monitoring bilirubin levels and emphasise the potential therapeutic application of TcB in managing newborn jaundice. In addition, these findings highlight the potential clinical application of TcB in treating jaundice in adults. Additional research and validation in other populations are required to understand better the connection between TSB and TcB levels in infant.

The research was conducted exclusively on children who already had jaundice, so the findings may not apply to neonates who do not require Phototherapy.

Clinical Implications

TcB measures are a noninvasive way to monitor bilirubin levels in newborns following Phototherapy because of the strong association between TSB and TcB levels. TcB assays can assess bilirubin levels without blood samples. Thus, newborns may be less painful, and their carers happier. TcB measurements also enable quick phototherapy adjustments to improve neonatal jaundice care.

Conclusion

In this study, term and near-term newborns' TSB and TcB levels correlated during Phototherapy and 24 hours afterwards. This Study found a positive connection between TcB and TSB during and after Phototherapy. TcB monitoring newborns is noninvasive and correlates with TSB levels. This

discovery allows doctors to measure bilirubin levels in full reliably- and nearly-term babies without repeating blood samples. The findings may change medical therapy. TcB levels allow quick phototherapy modifications to manage baby jaundice. TcB treatments also eliminate frequent blood draws, which can be uncomfortable for certain patients, and measures that need more investigation to improve reliability and utility. TcB measures must be used for premature newborns and adults from other countries to assess the applicability of this Study's connection. Machine learning techniques and research into TcB measurement instrument precision and dependability can improve TcB readings. TcB is a noninvasive way to assess bilirubin levels in full-term and near-term newborns receiving Phototherapy due to its high connection with TSB. This is because TcB and TSB levels are positively connected. The findings highlight the importance of TcB measures in clinical decision-making and the need for more Study and technology to treat newborn jaundice.

Future Research

TcB measurements among distinct populations, such as preterm neonates and people of different countries, may be used to test the generalizability of the discovered association. The precision and consistency of TcB measurement methods can illuminate their operation and advise therapeutic use. TcB-guided therapy reduces invasive procedures and neurodevelopmental outcomes, making long-term research viable.

Advanced TcB devices may improve newborn bilirubin monitoring by eliminating device biases and increasing accuracy. Machine learning and AI could increase TcB measurement precision and consistency.

Combining TcB measures with clinical risk factors or noninvasive biomarkers may enhance the prediction and treatment of severe hyperbilirubinemia. This Study found that TcB is a viable noninvasive approach for monitoring bilirubin levels in term and near-term newborns undergoing Phototherapy to address bilirubin buildup. High association between TcB and TSB levels has therapeutic implications, giving doctors a tool to battle neonatal jaundice. TcB measurements in neonatal care need further Study and creativity to increase their precision, utility, and long-term impact.

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