



## To Compare Transcutaneous Bilirubin Measurement With Serum Bilirubin In Neonates With Physiological Jaundice.

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### Abstract:

**Background:** Neonatal jaundice remains an important neonatal issue. It is one of the most common symptoms found in newborn babies. A common procedure for the diagnosis of hyperbilirubinemia is the total investigation of total serum bilirubin (TSB); however, this procedure is invasive for neonates. For two decades, transcutaneous bilirubin (TCB) was used as a non-invasive and painless method to assess bilirubin. The potential toxicity of bilirubin is acute bilirubin encephalopathy or kernicterus, which is associated with significant morbidity and mortality.

**Aim & Objective:** To correlate transcutaneous bilirubin levels to total serum bilirubin in healthy neonates with jaundice. To determine the utility of transcutaneous bilirubin meter in the management of physiological jaundice.

**Methods:** THIS Cross-sectional observational study was done with healthy Babies delivered and admitted to the inpatient postnatal ward of the department of pediatrics in Vydehi Institute of Medical Sciences And Research Center, Bangalore, during the study period (January 2015 – May 2016). 300 Samples collected during the study period will be considered for the study, satisfying inclusion and exclusion criteria. The gestational age of the baby will be assessed according to the Expanded Ballard Score within 24hrs of birth. Babies in the postnatal ward satisfying the inclusion and exclusion criteria will be identified. Transcutaneous bilirubin meter on the forehead and sternum on the newborn will be done within 10 minutes of blood collection for serum bilirubin determination, which will be done at around 72 hours as a pre-discharge screening

**Results:** There seems to be a close correlation between Transcutaneous bilirubin measurement and Total serum bilirubin measurement. The Mean +/- SD for the serum bilirubin is 12.19 +/-3.52. The mean +/-SD for transcutaneous bilirubin for the forehead and sternum was 10.33 +/- 3.34, and 12.40 +/- 3.44 respectively. The correlation of coefficient of the sternum as a site of measurement in this study has the highest correlation of 0.90 (p<0.001) compared to the forehead with the serum bilirubin levels.

**Conclusion:** The study demonstrates clearly that there is a good correlation between the QTcB measurement and TSB measurement using the Transcutaneous Jaundice meter MJB20 as per the study the correlation of the sternum is more to the serum bilirubin levels compared to the forehead as per the site is considered. Transcutaneous bilirubinometry can be effectively used as a screening tool to record the pre-discharge bilirubin levels and it is also effective in taking a quick decision regarding the decision of phototherapy and the stay..

**Keywords:** Hyperbilirubinemia, Newborn, Transcutaneous bilirubinometry, Total serum bilirubin

## Introduction:

Neonatal jaundice remains an important neonatal issue. It is one of the most common symptoms found in newborn babies. The potential toxicity of bilirubin is acute bilirubin encephalopathy or kernicterus, which is associated with significant morbidity and mortality. Unconjugated bilirubin has been noted to cross the blood-brain barrier, causing encephalopathy in the immediate period, and potential for causing long term choreo-athetoid cerebral palsy and other complications. [1] Managing bilirubin encephalopathy with the use of phototherapy and exchange transfusion are the mainstays in prevention which have been subjects of rigorous investigation over the last 60-70 years. The visual judgment of jaundice is not objective.[2] On the other hand estimation of total serum bilirubin levels in the clinical laboratory necessitates the collection of multiple blood samples from the healthy neonates. This collection of blood samples is traumatic and painful for neonates and parents. Suboptimal collection technique may result in specimen hemolysis that interferes with serum bilirubin measurement, also there is significant inter-laboratory and intra laboratory variability. To reduce the agony due to blood sampling, a transcutaneous bilirubin meter can be used judiciously. [3] The transcutaneous bilirubin meter readings are immediate and non-invasive. A transcutaneous bilirubin meter depends upon several factors such as gestational age, skin, color, race, ethnicity, phototherapy, and degree of jaundice. Despite a lot of advancements in transcutaneous technology, a lot of debate persists regarding its efficacy in detecting neonatal jaundice. [4] Transcutaneous bilirubin levels are inaccurate on a baby who has already commenced phototherapy. However transcutaneous bilirubin level measurements may be accurate when a photo-opaque patch is applied to the baby's skin (normally the forehead) whilst the baby is receiving light bank phototherapy and the transcutaneous bilirubin level measurement is performed on the skin that has not been exposed to phototherapy. Due to individual variance, any clinical decision has to be taken based on the transcutaneous trend more than on a single value. [5] A transcutaneous bilirubin meter may be particularly useful in health care settings where total serum bilirubin level results are expected to take longer than 6 hours before becoming available. Prevention of kernicterus in the term or late preterm

neonate is a primary focus of newborn care.[6] To promote early detection of significant hyperbilirubinemia, members of the American Academy of Pediatrics Subcommittee on Hyperbilirubinemia recommended that all newborns should be screened for neonatal jaundice before discharge with either a serum bilirubin level or transcutaneous bilirubin measurement. [7]QTcB screening is a potentially attractive modality because it's a quick, non-invasive technique to screen for hyperbilirubinemia. It is easy to perform multiple measurements on the same newborn. Also, rather than waiting for a serum bilirubin level which is to be performed in the laboratory, which is quite cumbersome. Results are quick and instantaneous in the transcutaneous bilirubin meter. [8]

## Methodology:

THIS Cross-sectional observational study was done with healthy Babies delivered and admitted to the inpatient postnatal ward of the department of pediatrics in Vydehi Institute of Medical Sciences And Research Center, Bangalore, during the study period (January 2015 – May 2016). 300 Samples collected during the study period will be considered for the study, satisfying inclusion and exclusion criteria. The gestational age of the baby will be assessed according to the Expanded Ballard Score within 24hrs of birth. Babies in the postnatal ward satisfying the inclusion and exclusion criteria will be identified. Transcutaneous bilirubinometry on the forehead and sternum on the newborn will be done within 10 minutes of blood collection for serum bilirubin determination, which will be done at around 72 hours as a pre-discharge screening.

**Inclusion criteria:** Any term neonates with physiological jaundice, defined as yellowish discoloration of the skin according to the Kramer scale. Breastfed only neonates were enrolled for the study. Physiological jaundice at 72 hrs was checked and documented.

## Exclusion criteria:

A very sick newborn (sepsis, congenital malformation, pathological jaundice, conjugated hyperbilirubinemia).A newborn < 37 completed weeks.Newborn with birth weight < 1800 grams. Newborn receiving / received phototherapy/ exchange transfusion. All healthy newborns were

delivered and admitted in the postnatal ward in the department of pediatrics, records of which were maintained in a registration book that would specify the identification and time of birth and date of birth of the baby. The gestational age of the baby was assessed according to the Expanded Ballard Score within 24hrs of birth. Babies in the postnatal ward satisfying the inclusion and exclusion criteria were identified. A transcutaneous bilirubin meter on the forehead and sternum on the newborn was done within 10 minutes of blood collection for serum bilirubin determination, which will be done at around 72 hours as a pre-discharge screening. The transcutaneous jaundice detector device used for the study is BILIPROBE, MBJ20. MBJ20 Transcutaneous jaundice detector is developed with advanced electronics and optics, adopting Filter optics, spectrum splitter, controlled spectrum filter, NFM switching, and information processing techniques. It uses dual wavelengths 450nm and 550nm which reach different layers of the skin. Serum bilirubin was estimated in the biochemistry lab using the Diazo method. The study was approved by the Institutional Ethics committee.

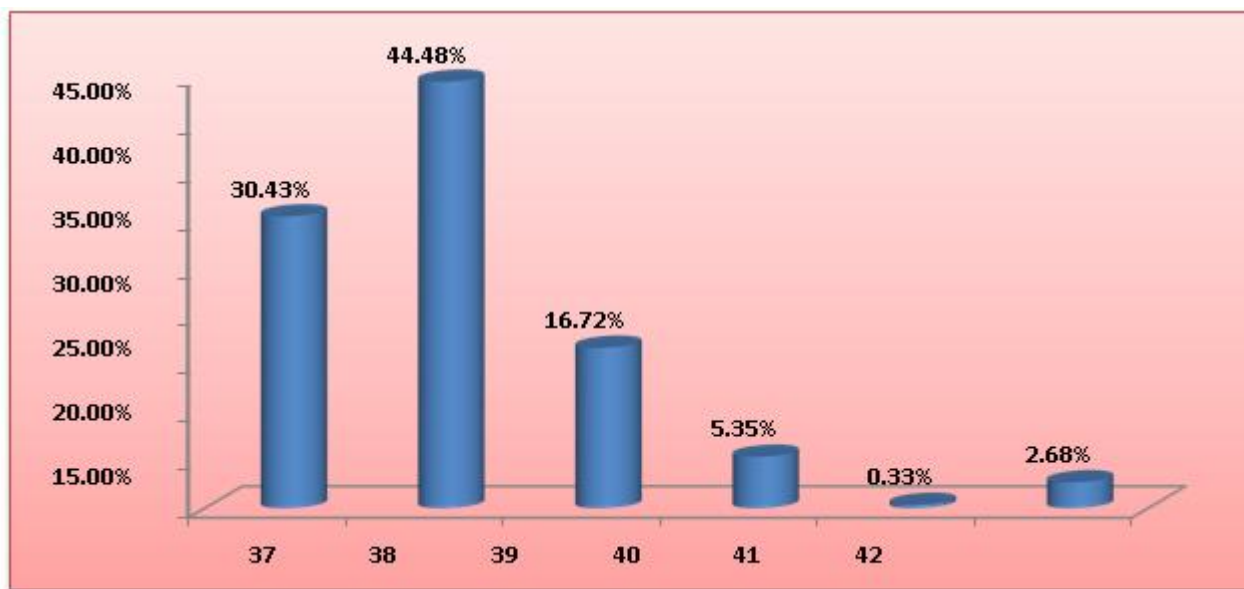
**Statistical Methods:**

The statistical analysis was performed by STATA 11.2 (college station TX USA). Receiver Operating curves were drawn for serum bilirubin levels, sternum, and forehead score to predict the phototherapy required or not and find the best cut-off, sensitivity, specificity, positive predictive value, and negative predictive value. Pearson correlation coefficient was calculated to find the relationship between the sternum with the forehead, forehead to serum bilirubin, and serum bilirubin with the sternum. P<0.05 is considered statistically significant.

**Results:**

Overall, 620 neonates were screened in the study of which 498 babies were assessed for eligibility, a total of 299 neonates were finally enrolled for the above study based on the inclusion criteria. 180 neonates were excluded from the study based on the exclusion criteria (birth weight <1800gram, sepsis, sick newborn, Rh incompatibility, phototherapy, congenital malformation, etc.). Another 19 neonate reports were not followed up. All the babies enrolled were breastfed.

**Graph :1 Shows The Distribution Of Cases According To Gestational Age**



GRAPH :1 In our study most of the neonates enrolled were between 37 to 39 completed weeks, 274 neonates (91.63%). Of the 299 babies enrolled, 177 were male neonates and 122 were female neonates. The Mean +/- SD of the birth weight of the neonates was 2.89 +/- 0.49. The Mean +/- SD for the serum bilirubin is 12.19 +/- 3.52.

**Table No 1: Mean And Standard Deviation As Per The Qtcb And Serum Bilirubin.**

	Mean	SD	Min – Max
Forehead	10.33	3.34	0.5 – 16.8
Sternum	12.40	3.44	3.1 – 22.0
Serum Bilirubin	12.19	3.52	3.19 – 25.0

TABLE:1 The mean +/-SD for transcutaneous bilirubin for forehead and sternum was 10.33 +/-3.34, and 12.40 +/- 3.44 respectively. The above table summarizes the mean and standard deviation of the QTcB with the serum bilirubin levels.

**Table 2: Depicting The Distribution Of Neonates Based On The Growth Percentile Curve.**

	Number of Cases	Percentage
AGA	273	91.30%
LGA	7	2.34%
SGA	19	6.35%
Total	299	100%

TABLE:2 Most of the enrolled neonates were appropriate for gestational age, 273(91.30%).

**TABLE :3 Correlation Between The Forehead, Sternum, And Serum Bilirubin**

	Correlation	P-value
Forehead with sternum	0.78	<0.001
Forehead with serum Bilirubin	0.71	<0.001
Serum Bilirubin with Sternum	0.90	<0.001

Table no 3: The correlation of coefficient of the sternum as a site of measurement in this study has the highest correlation of 0.90 (p<0.001) compared to the forehead with the serum bilirubin levels.

**Table:4 The Underlying The Sensitivity And Specificity**

	Forehead	Sternum	Serum Bilirubin
Sensitivity (%)	77.65	88.24	88.25
Specificity (%)	64.02	71.03	84.58
Positive predicted value (%)	45.83	54.74	69.44

Negative predicted value (%)	87.74	93.83	94.76
Cut off	10.60	12.53	12.81

TABLE:4 We also assessed the sensitivity and specificity of QTcB measurements in correlation to forehead and sternum to the serum bilirubin levels along with the positive predictive value and negative predictive value

**Table No5: Receiver Operating Characteristic (Roc) Curves For Prediction Of Serum Bilirubin And Transcutaneous Bilirubin With Cut-Off Index.**

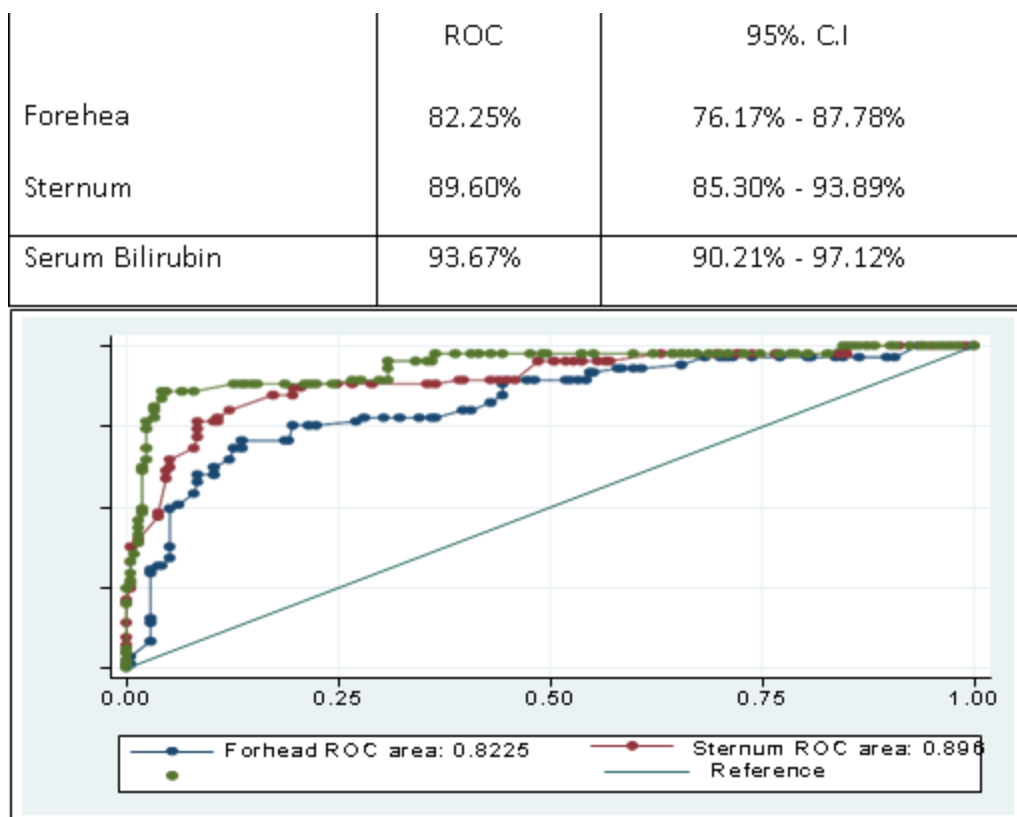
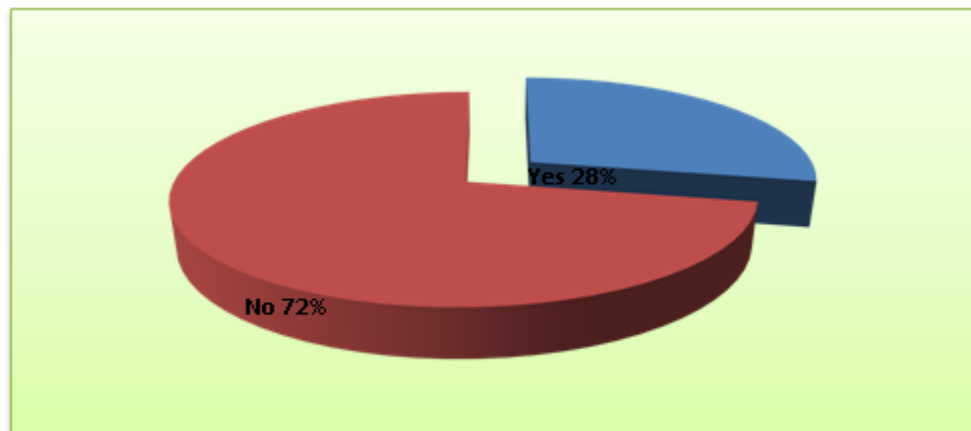


TABLE:5 With the Receiver Operative Curve, the area under the curve for both sites forehead and sternum with serum bilirubin were comparable. The cut-off values for sternum and forehead and serum bilirubin respectively are 10.60, 12.53, 12.81, with the sensitivity of 77.65%, 88.24%, and 88.25%. The specificity for the above was 64.02%, 71.03%, and 84.5% for the forehead, sternum, and serum bilirubin respectively.



**Graph 2: Pie Chart Showing The Number Of Babies Requiring Phototherapy.**

GRAPH:2 All of the 299 breast babies who were screened for serum bilirubin and QTcB levels at 72hrs of life as per the study protocol, it was found that transcutaneous bilirubinometry is an efficient method for screening babies for physiological jaundice, it is a noninvasive and rapid way to access the bilirubin, reducing the prolonged stay of the babies in the hospital. It was also observed that based on the QTcB a quick decision can be made whether the baby requires phototherapy or not or the baby is ready for discharge. As per the above study undertaken, it was observed that out of 299 babies, 85 babies required phototherapy and had a prolonged stay in the hospital, while the other babies were ready for discharge and were discharged within 75hrs.

### Discussion:

Kernicterus, and bilirubin encephalopathy which of greater concern for neonatologists and pediatricians because the earlier discharge of the mother and the baby from the hospital prevents adequate monitoring of jaundice. The possibility of using a noninvasive, painless, and reliable method to determine the bilirubin level and its increment in the first 73hrs hours after birth could be very important in the prevention of kernicterus.[9] The primary outcome of the study is to assess the correlation between the paired samples of transcutaneous bilirubin levels to serum bilirubin level in the newborn at 72hrs of life. [10]The correlation coefficient of forehead QTcB of the forehead is 0.71 ( $p < 0.001$ ) found in this study was higher than that described by other studies while the correlation coefficient of the chest (sternum) QTcB of 0.90( $p < 0.001$ ) is comparable to the finding of Leucine Ml et.al over the sternum 0.79 to 0.92 ( $p < 0.001$ ) summarized earlier in the literature. [10]The discrepancy in the correlation of forehead and total serum bilirubin may be because the forehead is continuously exposed to ambient light hence results varying from infant to infant. Similar to findings from this study, other studies using different transcutaneous bilirubin meters have also reported

wide differences between TSB and QTcB's measured over forehead and chest with an overall tendency of forehead and chest QTcB to underestimate the TSB. The reason for this is not clear but it might have to do with light exposure to the forehead and scarcity of subcutaneous fat in the sternal area.[11] As per the study outcome, transcutaneous bilirubin meter helped in a way to take a quick decision to start with phototherapy or not. The dilemma in the early discharge of the newborn baby has been there for ages given neonatal jaundice, transcutaneous bilirubin meter allows quick, noninvasive techniques to screen the neonates at 72hrs, for neonatal jaundice. [12] Several studies done in the past has shown a good correlation between QTcB and TSB levels using various instruments available in the united states and pre-discharge QTcB measurement are recommended by the American Academy of Pediatrics as one of the methods of accessing the risk of subsequently developing or not developing hyperbilirubinemia[13] Samar Net. al in a prospective cohort concluded that the combination of QTcB with the gestational age improved the accuracy of the prediction of subsequent rising serum bilirubin level, requiring the phototherapy treatment threshold recommended by the AAP. [14] The demographic data for our cases are typical of neonatal

physiological jaundice with the preponderance of the neonate within the range of above 37 completed weeks and are only breastfed. Our study which was undertaken has some strengths and limitations, among the strengths which include that the study has included an entire population of term normal neonates admitted in the Vydehi hospital during the study period.[15] During the period of the study, our quality monitor showed more than 75% of the neonates had been discharged before 78hrs. Similar to the finding of Sathish Mishra et.al we found that simply combining the pre-discharge QTcB measurement with the infant's gestational age does provides a good prediction of the risk of developing hyperbilirubinemia. When only exclusive breast neonates were included the prediction was slightly superior although not significantly better outcomes. It is possible that pre-discharge screening will reduce the need for additional and unnecessary testing and inappropriate use of phototherapy and there is evidence that this has occurred in the past.[16,17] More testing and more treatment do harm the bonding between the mother and the baby and affect breastfeeding. As most of the infants had two

readings of QTcB in the hospital pre-discharge, the calculated risk for hyperbilirubinemia and the need to start phototherapy was very decisive and quick.[18,19,20]

**Conclusion:** There was a significant association between visual assessment of jaundice and hyperbilirubinemia. TcB, in adjunct with visual assessment, proves to be an effective screening tool than visual assessment alone. TcB is a rapid, safe, and noninvasive test for predicting neonatal hyperbilirubinemia, which helps in minimizing invasive TSB tests for screening purposes. The study demonstrates clearly that there is a good correlation between the QTcB measurement and TSB measurement using the Transcutaneous Jaundice meter MJB20 as per the study the correlation of the sternum is more to the serum bilirubin levels compared to the forehead as per the site is considered. Transcutaneous bilirubinometry can be effectively used as a screening tool to record the pre-discharge bilirubin levels and it is also effective in taking a quick decision regarding the decision of phototherapy and the stay.

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