

# Correlation Between Transcutaneous and Serum Bilirubin Measurements in Neonates in a Tertiary Neonatal Care Center

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## ABSTRACT

**Introduction:** Hyperbilirubinemia is one of the common problem in Neonates. An estimation of the bilirubin value is essential for decision making in jaundiced babies. Transcutaneous bilirubin screening is a quick, noninvasive technique to measure bilirubin level in neonates. The objective of this study was to evaluate the Transcutaneous bilirubin and analyse the correlation with serum bilirubin values and find out whether Transcutaneous bilirubin measurement could avoid invasive serum bilirubin measurement.

**Materials and Methods:** Retrospective study was conducted in the neonatal unit of Kilpauk Medical college. All newborns with history of Jaundice and neonates in nursery who were clinically diagnosed to have jaundice during the period November 2015 to January 2016 were included in the study. 267 babies who met the inclusion criteria were enrolled in the study. Transcutaneous bilirubin measurement was done using the Transcutaneous Jaundice Meter and simultaneously a serum sample serum bilirubin estimation done. Babies who had received prior phototherapy, exchange transfusion and unstable babies in shock were excluded from the study.

**Results:** There seems to be a close correlation between Transcutaneous bilirubin measurement and Total serum bilirubin measurement. The overall mean difference between the two values was only 1.35mg/dl. The mean difference seems to correlate very closely when the bilirubin values are low.

**Conclusion:** The study demonstrates clearly that there is good correlation between the Transcutaneous bilirubin measurement and Total serum bilirubin measurement. The Transcutaneous bilirubin values were higher than the Total serum bilirubin values.

**Keywords:** Transcutaneous bilirubin, Total serum bilirubin, Transcutaneous jaundice meter

## INTRODUCTION

Hyperbilirubinemia is one of the common problems in Neonates. An estimation of the bilirubin value is essential for decision making in jaundiced babies. TcB screening is a quick, noninvasive technique to measure bilirubin level in Neonates.<sup>1</sup> Many previous studies have shown that transcutaneous bilirubin measurement provides a close estimate of total serum bilirubin levels.<sup>1-6</sup> Each study has used a different Transcutaneous Jaundice meter for estimation of TcB.<sup>1</sup> The test is easy to perform and obviates the need for pricking the baby for blood sample for TSB measurement and sending to lab and waiting for the report. We used the M and B Electronic Instruments Co., Ltd Transcutaneous Jaundice Detector model MBJ-20 to evaluate the Transcutaneous Bilirubin. Jaundice is one of the most common condition in newborn. Serum bilirubin estimation is one of the essential investigation done to assess the severity of Jaundice. Serum bilirubin estimation is traditionally done on serum sample drawn by venipuncture which is invasive and painful.<sup>2,3</sup> Hence there was need for a non invasive, reliable method to assess the bilirubin level. The objective of the study

was to find out whether Transcutaneous bilirubin measurement could be reliably used to assess jaundice and avoid veni puncture for serum bilirubin measurement.

## MATERIAL AND METHODS

The study was conducted in the neonatal unit of Kilpauk Medical college and Hospital as Prospective cross sectional study. All newborns referred to the neonatal unit with history of Jaundice and neonates in nursery who were clinically diagnosed to have jaundice were included in the study. 267 neonates who met the inclusion criteria during the period November 2015 to January 2016 were enrolled in the study. Informed consent was obtained from the parents of the newborns. TcB measurement was done using the Transcutaneous Bilirubinometer. Measurement was obtained over the sternum. Simultaneously a serum sample was collected and sent to biochemistry lab for serum bilirubin estimation. Babies who had received prior phototherapy, exchange transfusion and unstable babies in shock were excluded from the study.

The Transcutaneous bilirubin measurement was done using the MBJ 20 Transcutaneous Jaundice detector. 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 institutional Ethics committee.

## STATISTICAL ANALYSIS

SPSS version 21 was used for statistical analysis. Correlation, regression, paired t test, intra class correlation, ROC curve and Bland and Altman plot were done to infer the data.

## RESULTS

Paired sample statistics of 267 neonates for TcB and TSB was analysed. The mean for TcB was 13.08 mg /dl and the mean of TSB was 11.73 mg /dl. The overall mean difference between the TSB and TcB values was only 1.35mg/dl with a correlation

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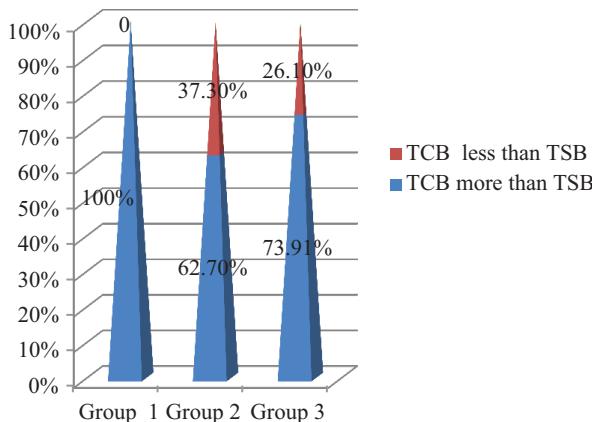
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	No	Paired Mean Differences	P value and Significance	Correlation	Intra Correlation		Regression Coefficient
					Single Measures	Average Measures	
Total group	267	1.3461	<0.0001	0.7351	0.7229	0.83914	0.5465
Group 1 (TSB < 9.9)	60	1.9500	<0.001	0.9586	0.8694	0.9301	0.9189
Group 2 (TSB 10-14.9)	161	1.314	<0.001	0.3491	0.2530	0.4039	0.1219
Group 3 (TSB 15 and above)	46	0.6696	0.06	-0.2708	-0.2204	-0.5655	0.07332
ROC	267	Sensitivity	Specificity	Criterion	Area Under curve		
		100	70.9	>14.4	0.915969		

**Table-1:** Statistical Analysis- consolidated.

TSB VS TCB Difference	Level 1 TSB ≤ 9.9	Level 2 TSB 10-14.9	Level 3 TSB ≥ 15
TCB More than TSB	60(100%)	101 (62.73%)	34 (73.91%)
TCB Less than TSB	0	60 (37.27%)	12 (26.1%)
Total	60(100%)	161 (100%)	46 (100%)

**Table-2:** TCB AND TSB Relationship**Figure-1:** TCB AND TSB relationship

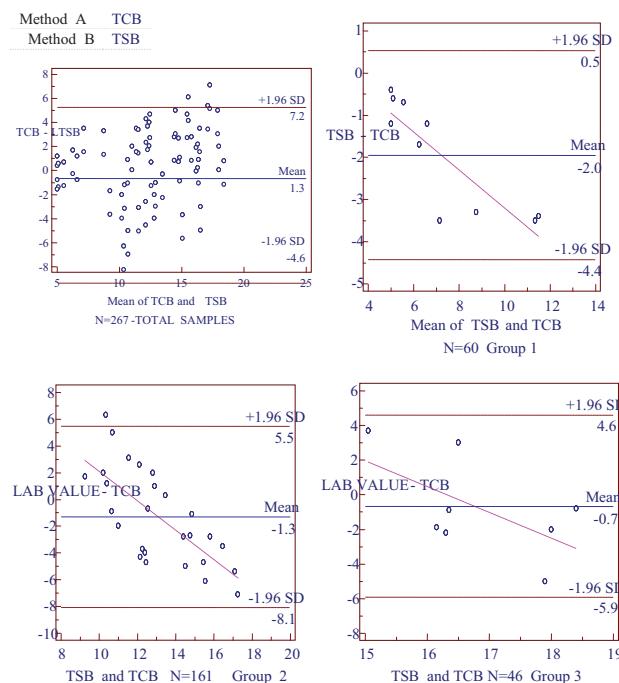
coefficient of 0.7351 with a 95 % confidence interval of 0.6746 to 0.7858 with significant  $P < 0.0001$  (Table-1).

Out of 267 neonates with jaundice for clinical convenience they were divided in to three groups based on TSB values. Group I - 5 - 9.9 mg/dl (60 in numbers), Group II – 10 – 14.9mg/dl, (161 in numbers) Group III 15 and more( 46 in numbers) for analysis. Statistical analysis showed paired mean difference between the group I, II and III. Mean difference was 1.950 ( $P < 0.001$ ), 1.314 ( $P < 0.001$ ) and 0.670 ( $P = 0.06$ ) respectively (Table-1).

The correlation coefficient for Group I was 0.9586 with a 95% confidence interval of 0.9314 to 0.9752 with a significant  $P$  value of  $< 0.0001$ . The correlation coefficient for Group II was 0.3491 with a 95% confidence interval of 0.2055 to 0.4780 with a significant  $P$  value of  $< 0.0001$ . The correlation coefficient for Group III was 0.2708 with a 95% confidence interval of 0.5202 to 0.02119 with  $P$  value of 0.06 which was statistically non significant (Table-1).

The bland Altman plot was drawn for both TSB and TCB values. The plot reveals that difference between two rater more than 7.2 and lesser than-4.6 are out layers, which are bad sectors. Using this bad sector and good sector were classified. The ROC curve was plotted to find out the optimum cut off value of TSB with respect to badly correlated difference values (Figure-2).

The Intra class correlation between TSB and TCB were good

**Figure-2:** Bland-Altman plot

for all 267 patients. The analysis between TSB and TCB of all the three groups were done using intra class correlation, paired T test and Bland Altman plot. Of all the three groups group 1 is having very good correlation, linear regression coefficients and good Altman plot.

## DISCUSSION

Our study primary outcome was to assess the TSB - TcB difference between paired values. In 195 paired values out of 267 TcB value was greater than the corresponding TSB level and only in 72 paired values TcB measurement was less than the paired TSB level. The correlation between linked TcB and TSB levels was calculated.<sup>1,2</sup> Under estimation of TSB values would miss cases needing intervention and high TcB may lead few more serum sampling for appropriate management. The magnitude of the TcB – TSB difference would tend to vary based on the TSB level, TSB was included in all regression models.

Across all the three groups the TcB values were more than the TSB values (in 73 % of paired values) (Table-2, Figure-1). This indicates TcB can be used as a screening tool without falsely underestimating serum bilirubin values.<sup>3-5</sup> Racial differences in population was presumed to affect the transcutaneous estimation of bilirubin. Engle et al has done a study predominantly in a Hispanic Neonates.<sup>6</sup> It shows that the TcB measurement were underestimating TSB values when serum bilirubin was high. Our study done on Asian neonates also shows a similar trend. Our study was done using

MBJ 20 Transcutaneous jaundice detector and compares well with results obtained by using Bilicheck bilirubinometer done by Ebbesen et al.<sup>7</sup>

The optimum cut off value of TSB was more than 14.4mg/dl, with a sensitivity of 100 and specificity of 70.9 (Table 1). This very much correlated with the study by James A Taylor et al.<sup>2</sup> Overall, the findings in this study suggest that TcB measurements can be used effectively to screen newborn infants for hyperbilirubinemia, with TSB measurements reserved for those newborns whose TcB level is above a certain cutoff value. The limitation of the study was that it did not take in to account the differences that may exist between Preterm and Term babies in assessment of TcB.

## CONCLUSION

The study demonstrates clearly that there is good correlation between the TcB measurement and TSB measurement using the Transcutaneous Jaundice meter MBJ20. The TcB values were higher than the TSB values in 73% of our samples. We suggest that TcB measurements can be used effectively to screen newborn infants for hyperbilirubinemia, with TSB measurements reserved for those newborns whose TcB level is above a certain cutoff value.

## ETHICAL APPROVAL

Approved by institutional Ethical committee

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