

## Original Research Article

# Correlation of serum bilirubin and transcutaneous bilirubin in newborns

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### ABSTRACT

**Background:** Hyperbilirubinemia is a very common entity in newborns. Screening all the babies for hyperbilirubinemia is must. Serum bilirubin is the standard method of checking the bilirubin in newborns. This is very cumbersome, invasive and time consuming method. Hence many newborns will be discharged without screening. Transcutaneous bilirubinometry would help us in making this task easy and safe. Hence the present study was planned.

**Methods:** This is an institutional cross sectional study conducted in a tertiary care hospital for a period of 6 months. After a written informed consent from parents/ guardians and considering selection criteria, 500 newborns with clinical jaundice were included in study. Each newborn was examined, transcutaneous bilirubin checked at forehead and sternum and serum bilirubin was done at the same time. Data was statistically analyzed to see the correlation between TcB and TSB.

**Results:** Out of 500 newborns, 316 were males, 184 were females and 475 were term gestation and 25 were preterm. Coefficient of correlation was 0.73 and 0.72 for total serum bilirubin versus forehead and sternum respectively which were statistically significant.

**Conclusions:** Transcutaneous bilirubinometer readings closely correlate with that of serum bilirubin. Hence TcB can be used as a safer, economical and effective tool in screening newborns for hyperbilirubinemia.

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

### INTRODUCTION

Hyperbilirubinemia is very common in neonates and, in many, a benign problem. Jaundice is observed in the 1st week of life in around 60% of term infants and 80% of preterm newborns. The yellow color usually is a result from the accumulation of unconjugated bilirubin pigment in the skin.<sup>1</sup> Jaundice is visible at a serum bilirubin level of 5 to 7 mg/dl. Jaundice usually appears in a cephalocaudal direction. Dermal pressure reveals the progression of jaundice (face, approximately 5 mg/dl; mid-abdomen, 15 mg/dl; soles, 20 mg/dl), but clinical

examination cannot reliably estimate serum bilirubin levels. Noninvasive tests for transcutaneous bilirubin measurement that correlate with serum bilirubin levels may be used to screen newborns, but testing of serum bilirubin level is indicated in patients with elevated transcutaneous bilirubin levels, progressive jaundice, or risk of hemolysis or sepsis. The National institute for health and clinical excellence neonatal jaundice guidelines recommend measurement of serum bilirubin levels in all newborns with visible jaundice. The gold standard is total serum bilirubin (TSB).<sup>2</sup> According to AAP (American academy of pediatrics), pre-discharge

serum bilirubin assessments are required in order to prevent kernicterus. Transcutaneous bilirubinometry (TcB) is an alternative to TSB which would be useful in blood sampling for a frequent and usually benign clinical condition.<sup>3</sup> A noninvasive bilirubinometer (TcBM), that measures transcutaneous bilirubin levels, was developed by Minolta Camera Company, Ltd.<sup>4</sup> Total serum bilirubin is commonly determined by spectro-photometric methods by analyzing serum sample requiring drawing of blood causing pain and trauma to the neonate. Bilirubinometers work by directing light into the skin of the neonate and measuring the intensity of specific wavelength that is returned. The meter analyzes the spectrum of optical signal reflected from the neonate's subcutaneous tissues which are converted to electrical signal by a photocell. Signals are analyzed by a microprocessor to get a serum bilirubin value. The skin components, which impart the spectral reflectance, are melanin, dermal maturity, haemoglobin and bilirubin.<sup>5</sup> They permit rapid measurements but do not provide fractionation information.<sup>6</sup> Neonatal hyperbilirubinemia is a very common entity and requires screening of all babies at discharge by traditional serum bilirubin which is cumbersome, hence the objective of this study was to see whether Transcutaneous bilirubin can correlate with serum bilirubin and can replace it. Hence the present study was planned.

## METHODS

Current study is an institutional cross-sectional study conducted at neonatal intensive care unit of Raichur institute of medical sciences (RIMS) Raichur, a tertiary care hospital from October 2020 to March 2021.

### Inclusion criteria

All newborns visiting NICU RIMS Raichur with clinical Jaundice were included in the study.

### Exclusion criteria

Hemodynamically unstable newborns, newborns who received phototherapy or exchange transfusion and newborns with cutaneous lesions like hemangiomas, abrasions etc. at forehead or sternum were excluded from the study.

### Procedure

After obtaining the written informed consent from parents/guardians, 500 newborns were included in the

study. Patient particulars like name, age, sex, gestational age, birth order, mode of delivery etc. were collected. Important information like mother's blood group, baby's blood group were also included. Each patient was examined and transcutaneous bilirubinometry was done at two places namely forehead and sternum. The jaundice meter JM-103 bilirubinometer was used. The optic head was snugly pressed against the skin and waited for the reading which was recorded. At the same time two blood samples were collected, one in plain and another in EDTA bulb and were sent for serum bilirubin (total, direct, indirect by Diazo method and blood group.

### Statistical analysis

Statistical analysis was done by finding out mean and standard deviation for TSB and TcB. Paired 't' test and a standard Pearson coefficient correlation test were performed and a Scatter plot was prepared to know how transcutaneous bilirubin correlated with serum bilirubin,  $p < 0.5$  was taken as significant. The software used was SPSS 22v.

## RESULTS

In current study, distribution of newborns showed more number of males 316 (63%) and term 475(95%) newborns with jaundice as shown in (Table 1).

**Table 1: Distribution of newborns.**

Sex	N (%)	Gestational age	N (%)
<b>Males</b>	316 (63)*	Term	475 (95)*
<b>Females</b>	184 (37)	Preterm	25 (5)
<b>Total</b>	500 (100)	Total	500 (100)

\*more in number

The mean and the standard deviation for TSB and TcB at Forehead were  $12.77 \pm 4.25$ ,  $13.17 \pm 4.68$  respectively,  $p < 0.5$ . Correlation coefficient 'r' was 0.7325 which shows a positive correlation between the TSB and TcB at Forehead (Table 2), this is also seen in scatter plot (Figure 1).

The mean and the standard deviation for TSB and TcB at sternum were  $12.77 \pm 4.25$ ,  $13.11 \pm 4.98$  respectively. The p value was significant being  $< 0.5$ . Correlation coefficient 'r' was 0.7174 which shows a positive correlation between the TSB and TcB at sternum (Table 3). This is also seen in scatter plot (Figure 2).

**Table 2: Correlation of serum bilirubin and transcutaneous bilirubin (forehead).**

Parameters	Mean	SD	Paired t-value	P value	Correlation coefficient 'r'
<b>TSB</b>	12.77	4.25	2.802	0.0053	0.7325
<b>TcB at forehead</b>	13.17	4.68			

## DISCUSSION

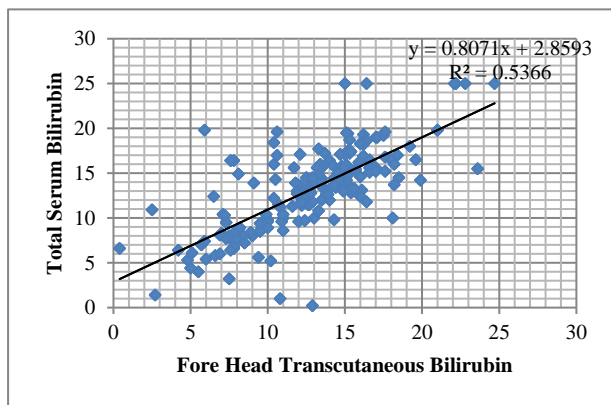
Neonatal hyperbilirubinemia is a very common problem in the newborn period. It is a life threatening disorder in newborns. Generally, physiological jaundice is the most

common type but in some regions pathological jaundice is also common.<sup>7</sup> The purpose of universal pre-discharge bilirubin screening is to find out infants with bilirubin levels >75<sup>th</sup> percentile for age in hours and identify those with rapid rise of serum bilirubin (>0.2 mg per 100 ml per hour).<sup>8</sup>

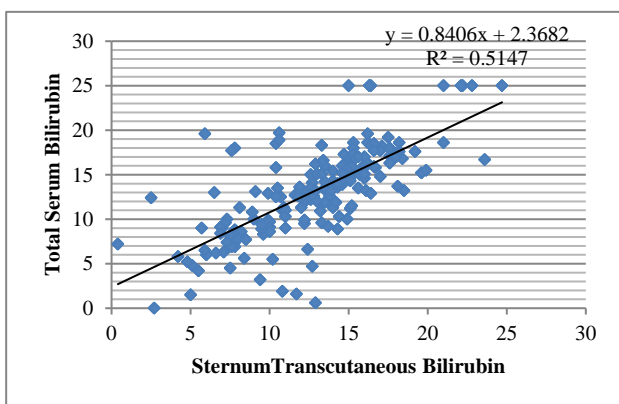
**Table 3: Correlation of serum bilirubin and transcutaneous bilirubin (sternum).**

Parameters	Mean	SD	Paired t-value	P value	Correlation coefficient 'r'
<b>TSB</b>	12.77	4.25	2.194	0.0287	0.7174
<b>TcB at sternum</b>	13.11	4.98			

Management of jaundiced neonates requires measurement of total serum bilirubin (TSB). Total serum bilirubin (TSB) is commonly performed by spectrophotometric methods by analyzing serum sample. This technique besides requiring drawing of blood causing pain and trauma to the neonate, there is a wide range of intra- and inter-laboratory variability in the bilirubin analyzers.



**Figure 1: Scatter plot showing positive correlation of serum bilirubin and transcutaneous bilirubin (forehead).**



**Figure 2: Scatter plot showing positive correlation of serum bilirubin and transcutaneous bilirubin (sternum).**

This has led to the search for a non-invasive, reliable test for estimation of TSB.<sup>5</sup> Transcutaneous bilirubin devices are commonly used for screening of hyperbilirubinemia in newborns not exposed to phototherapy. However, the accuracy of TcB devices is not clear.<sup>9</sup> Transcutaneous bilirubin (TcB) test has the advantages of being noninvasive, simple to perform, less expensive, instantaneous results and prevention of repeated blood sampling of tiny baby.<sup>10-12</sup> Hyperbilirubinemia is a very common entity in newborns. Screening all the babies for hyperbilirubinemia is must. Serum bilirubin is the standard method of checking the bilirubin in newborns. This is very cumbersome, invasive and time consuming method. Hence many newborns will be discharged without screening. Transcutaneous bilirubinometry would help us in making this task easy and safe. Hence the present study was planned.

In current study, 500 newborns with neonatal hyperbilirubinemia were included. Out of 500, 316 (63%) were males and 184 (37%) were females. In a study by Mansouri et al out of 200 neonates, 124 (62%) males and 76 (38%) females, similar results were found in study by Tiwari et al which showed 102 (59%) males and 70 (41%) females.<sup>13,14</sup> In current study, out of 500 newborns with hyperbilirubinemia, 475 (75%) were of term gestation and 25(5%) were preterm. Karen et al found that, out of 150 newborns 99 (66%) were term and 51 (34%) were preterm.<sup>14</sup> Results were similar in a study by Shah et al out of 430 newborns, 250 (59%) were term and 180 (41%) were preterm.<sup>15</sup> Also study by Tiwari et al showed that out of 172 newborns, 122 (71%) were term and 50 (29%) were preterm.<sup>14-16</sup> The mean and the standard deviation for TSB and TcB at forehead were  $12.77 \pm 4.25$  and  $13.17 \pm 4.68$  respectively. The mean and the standard deviation for TSB and TcB at sternum were  $12.77 \pm 4.25$  and  $13.11 \pm 4.98$ . The study by Tiwari et al showed that mean and standard deviation of TSB was  $19.21 \pm 3.44$  and for TcB was  $18.34 \pm 2.99$ . Similar results were found by Fatih et al, Fonseca et al, and Canyang et al.<sup>17-19</sup>

The coefficient of correlation factor 'r' for forehead transcutaneous bilirubin was 0.73 and that for sternum was 0.72, the p value was also highly significant for both

forehead and sternum. This infers that, transcutaneous bilirubin at forehead and sternum correlates very well with total serum bilirubin values. Observation also shows that forehead TcB levels correlates better with TSB than sternum TcB levels. Similar results were found in study conducted by Tiwari et al where coefficient correlation was found to be 0.8 but our study measured the TcB at two different sites.<sup>13</sup> These observations are similar to results found by Shah et al which also showed a strong correlation between plasma and mean transcutaneous bilirubin measurement (CV=0.49,  $r=0.8599$ ,  $p<0.001$ ). Panburana et al showed that the TcB and TSB had linear correlation with significant correlation coefficient ( $r=0.81$ ,  $p<0.001$ ).<sup>18</sup>

### Strengths and limitations

Strength of the study is large sample size. Limitation of the study is that, the effect of phototherapy on transcutaneous bilirubinometry was not studied.

### CONCLUSION

Current study concluded that the transcutaneous bilirubin measured at forehead and sternum correlated very well with serum bilirubin hence can be used very widely to screen all the newborns before discharge. Our study also showed that the values at forehead correlated better than at sternum. Hence transcutaneous bilirubinometry can be used to screen all the newborns in a bigger way.

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*Ethical approval: The study was approved by the Institutional Ethics Committee*

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