Research Article

Correlation Between Transcutaneous and Serum Bilirubin in Healthy Neonates with Jaundice

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Abstract

Background: Neonatal hyperbilirubinemia poses major concern. Total serum bilirubin (TSB) measurement is invasive method. Transcutaneous bilirubin(TcB) screening is an attractive modality as it is quick, non-invasive test to screen for hyperbilirubinemia.

Objective: To determine the correlation between transcutaneous and serum bilirubin measurements in healthy neonates with jaundice.

Methods: This cross-sectional study was conducted in the Department of Pediatrics, King Edward Medical University, Lahore from July to December 2018. Total of 95 neonates of clinically suspected jaundice, aged from 24 hours upto 28 days of either gender, gestational age 36-40 weeks and birth weight ⩾2000 grams were included by non-probability consecutive sampling. Each baby was subjected to serum bilirubin measurements. Three measurements were taken via the transcutaneous bilirubinometer, taking the average value to be used for analysis. Newborn was labeled as having jaundice when bilirubin was >5mg/dl. Data were analyzed through SPSS version 22. Pearson's correlation analysis was performed to estimate coefficient of correlation between transcutaneous and serum bilirubin measurements.

Results: A total of 95 neonates with jaundice were enrolled. Correlation between TcB and TSB measurements was 0.885 (p value <0.01). There was also positive correlation between TcB and TSB measurements for age-at-admission [r=0.803 for < 7 days, r= 0.961 for 7-21 days (p value < 0.01)], gender [r=0.903 for males, r=0.804 for females, (p value <0.01)], gestational age [r=0.926 for <37 weeks gestation, r= 0.845 for 37-40 weeks (p value <0.01)], and birth weight [r=0.933 for birth weight <2500grams, r= 0.806 for birth weight 2500-3500 grams (p value <0.01)].

Conclusion: There was strong positive correlation between transcutaneous and serum bilirubin measurements in healthy neonates.

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Introduction

Neonatal hyperbilirubinemia is cause of concern for parents and pediatricians. It can be clinically detected during first week of life.[1] The precise measurement of serum bilirubin is important for early identification of hyperbilirubinemia so that potential brain damage may be prevented.[2]

Currently, three methods for measurements of bilirubin are available - serum bilirubin measurement using various chemical reactions, non-invasive transcutaneous method, and capillary method using a spectrophotometer.[3] Total serum bilirubin (TSB), although gold standard, is invasive method.[4] Transcutaneous bilirubin (TcB) screening is an attractive modality because it is quick, non-invasive test to screen for hyperbilirubinemia. Begum et al[5] reported high sensitivity of TcB at different levels. Similarly, Simsek et al[6] have found positive correlation between these two measurements. Reports from various parts of the globe are there about the variable accuracy of TcB according to the skin color of the babies. Authors in past have also found that TcB tend to under-read in light skin tone babies and over-read in darker skin tone babies. Varughese et al[7] observed better correlation of TcB in light skin tone babies. However the results remain largely conflicting.

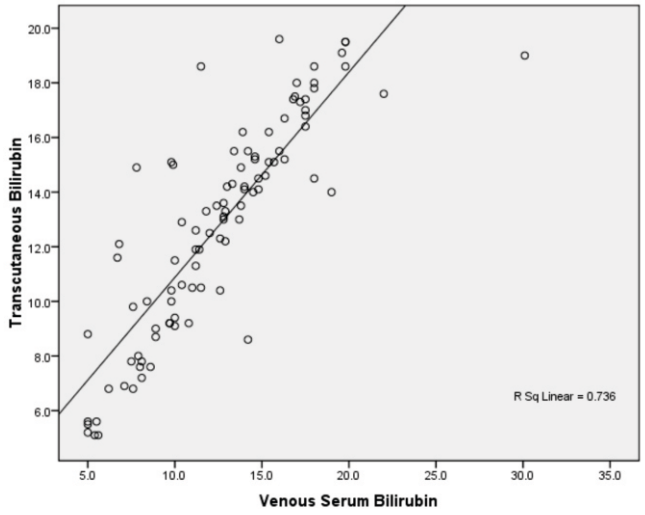
Limited data is available in our local areas regarding correlation between TcB and TSB measurements in neonates. The present study was conducted at our tertiary centre with the objective to establish the correlation between TcB and TSB measurements in healthy neonates admitted with jaundice in our set-up.

Methods

This cross-sectional study was conducted in the neonatal unit of department of Pediatrics, King Edward Medical University/ Mayo Hospital, Lahore from July to December 2018. The study was approved by the institutional review board of King Edward Medical University, Lahore. Informed consent was taken from patient's parents/guardian. Total of 95 neonates of clinically suspected jaundice (calculated at 95% confidence interval and taking expected percentage of jaundiced neonates as 60%[1]), aged from 24 hours up to 28 days of either gender, gestational age 36-40 weeks and birth weight ⩾2000 grams were included by non-probability consecutive sampling. Clinically, jaundice was suspected by any one of scleral icterus or yellow skin in daylight. Neonates with evidence of sepsis (total leukocyte count >25000/mm^3), hemolysis, direct hyperbilirubinemia, major congenital anomaly, hemangioma or ecchymosis on the forehead, sternum or abdomen, were excluded from study. Relevant history of the babies was taken and examination was performed. Then 1cc non-heparinized blood was drawn for determination of serum bilirubin by laboratory method. Simultaneous to blood sampling, three readings via the transcutaneous bilirubinometer were taken (each at the baby's sternum, forehead and abdomen) determining the average value to be used for analysis. We used biliCheck Bilirubinometer (Drager JM-105), which is noninvasive, transcutaneous bilirubinometer, using light instead of a needle, allows to measure bilirubin level. SPSS version 22 was used to analyze the data. Quantitative variables were expressed using mean and standard deviation. Pearson's correlation analysis was performed to estimate coefficient of correlation between TcB and TSB.

Results

Out of 95 neonates, 62 (65.3%) were male and 33(34.7%) patients were female. The mean age at admission was 6.41±4.26 days, while mean gestational age was 37.99±1.22 weeks. Mean weight of neonates was 2645.26±549.81 grams. Mean serum bilirubin was 12.595±4.507 mg/dl, while mean TcB was 12.828±3.950 mg/dl. Correlation between TcB and TSB measurements was 0.885 (p value < 0.01)] (Figure 1). There was also positive correlation between TcB and TSB measurements for age-at-admission [r=0.803 for <7 days, r= 0.961 for 7-21 days (p value <0.01)], gender [r=0.903 for males, r=0.804 for females, (p value <0.01)], gestational age [r=0.926 for <37 weeks gestation, r= 0.845 for 37-40 weeks (p value <0.01)], and birth weight [r=0.933 for birth weight <2500grams, r= 0.806 for birth weight 2500-3500 grams (p value <0.01)] (Table I)



[r=0.885 (p value <0.01)]

Figure 1: *Correlation between Transcutaneous and Serum Bilirubin Measurements (n=95)*

Table 1: *Correlation between Transcutaneous and Serum Bilirubin Measurements in different Strata (n=95)*

		No. of observation	Pearson correlation	p-value
Age (days)	< 7 days	57	0.803	<0.01
	7-21 days	38	0.961	<0.01
Gender	Male	62	0.903	<0.01
	Female	33	0.804	<0.01
Gestational age (weeks)	Preterm birth (< 37 weeks)	12	0.926	<0.01
	Full term (37-40 weeks)	83	0.845	<0.01
Birth weight (g)	Low birth weight(< 2500g)	40	0.933	<0.01
	Normal birth weight	55	0.806	<0.01

Discussion

Present study found strong positive correlation between TcB and TSB measurements [r=0.885 (p value <0.01)]. High correlation between cutaneous bilirubin and TSB form the basis of transcutaneous bilirubinometry, which measures the yellowness of the skin by analyzing the spectrum of light reflected by the baby's skin. Our findings are in concordance with previously performed studies, where Pearson's correlation coefficient ranged from 0.87 to 0.96.[8,9,10] However, Neocleous et al[3] from Greece reported significantly lower correlation (r=0.439) for TcB measurement. Mansouri et al[11] also reported positive correlation (r=0.89). Similar results have also been reported by Hesaraki et al[12] from Iran and Míguez et al[13] from Spanish children, observing high sensitivity of TcB. However, the researcher in later study didn't exclude patients with ABO incompatibility, hemolysis and sepsis. The differences from our study may be attributed to difference in sample size, ethnicity, and device used for TcB.

Hemmati et al[2] found good correlation at different ages between TcB and TSB after 24 hours from birth. This is comparable to our results where we found good correlation at different ages at admission [r= 0.803 for <7 days, r= 0.961 for 7-21 days (p value <0.01)]. Local studies[14, 15, 16] have also concluded that transcutaneous bilirubinometery can be accepted as a good device for the screening of neonatal jaundice. In our study, we found positive correlation for gestational age [r=0.926 for <37 weeks gestation, r= 0.845 for 37-40 weeks (p value <0.01)], and birth weight [r=0.933 for birth weight <2500grams, r= 0.806 for birth weight 2500-3500 grams (p value <0.01)]. The difference may be due to sample size of term and preterm neonates. We also did not include neonates <36 weeks. Nearly most of the studies accept TcB as reliable tool for screening of hyperbilirubinemia, especially in term neonates and non-hemolytic jaundice, to reduce repeated blood sampling.

Present study adds to the limited existing research evidence on the topic. A very important limitation to the present study was that neither we performed bilirubin measurements in first 24 hours of birth nor we included neonates <36 weeks. We also did not determine the effect of phototherapy on bilirubin measurements. We also did not see the influence of skin color in our study.

Conclusion

There was strong positive correlation between TcB and TSB measurements in healthy neonates. Due to its simplicity and painlessness, serial TcB measurements might be useful for screening neonates with jaundice.

Ethical Approval: Given
Conflict of Interest: The authors declare no conflict of interest
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