

## Transcutaneous Bilirubinometry in Preterm Neonates

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This prospective study was conducted to evaluate the accuracy of transcutaneous bilirubinometry in preterm newborns less than 32 weeks of gestation. Serum bilirubin values measured by direct spectrophotometry were considered as standard, the range was 2.2-12.5 mg/dL. 32 jaundiced infants of less than 32 weeks of gestation without phototherapy, including 10 ELBW neonates, were enrolled. Close correlation ( $R=0.933$ ) existed between total serum bilirubin and transcutaneous bilirubin values measured over sternum.

**Keywords:** *Diagnosis, Hyperbilirubinemia, Preterm neonates, Transcutaneous bilirubinometry.*

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**M**ost preterm newborns develop hyperbilirubinemia during the first week of life(1). Transcutaneous bilirubinometry is a screening test for identifying the need for total serum bilirubin (TSB) measurements in order to reduce the number of blood samplings. It is an objective, noninvasive technique, which provides real-time results and avoids pain and local infection. The easily repeated noninvasive bilirubin measurement may be advantageous in infants with very or extreme low birth weight (VLBW, ELBW). Although Minolta Air-Shields JM-103™ bilirubin levels have been shown to correlate with TSB levels in term and near-term infants(2,4-6), data on its use in preterm infants are limited(7,8). The aim of this prospective study was to assess the accuracy of transcutaneous bilirubinometry in premature newborns of less than 32 weeks of gestation, including VLBW and ELBW infants, and to identify an appropriate site of measuring.

### METHODS

The study was approved by the institutional review board of Jessenius Medical Faculty registered with Office for Human Research Protections

(IRB00005636). Newborns were enrolled in the prospective study if they required TSB level measurement on clinical indication within the first week of life. The exclusion criteria were phototherapy, exchange transfusion, edema and poor peripheral circulation. Transcutaneous bilirubin (TcB) level was determined as the computerized mean value of three consecutive scans over each site: forehead, sternum and abdomen. Blood sampling was performed within 10 minutes of noninvasive measurement. TSB levels were measured in the clinical chemistry laboratory using direct spectrophotometry. Correlation coefficients ( $r$ ) between TcB and TSB were calculated using Pearson linear regression analysis.  $P$  value of less than 0.05 was considered statistically significant. Differences between TSB and TcB, and their 95% confidence intervals (95%CI) were calculated.

### RESULTS

The study group consisted of 32 jaundiced preterm infants (11 males, 21 females) of Caucasian race, including 10 VLBW and 10 ELBW neonates. Gestational age at birth ranged from 25 to 31 weeks (mean  $\pm$ SD, 29.2 $\pm$ 2.2), postnatal age from 1 to 6

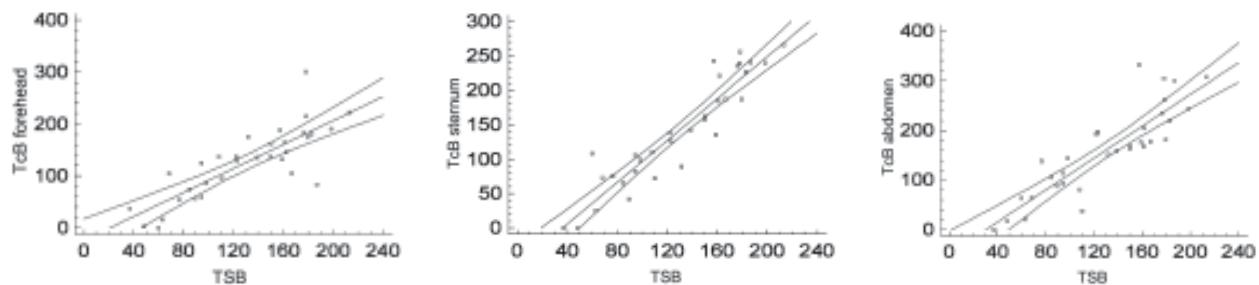


FIG.1 Linear regression plots of total serum bilirubin (TSB) versus transcutaneous bilirubin (TcB) measurements obtained from different body sites (forehead, sternum, abdomen) ( $n=32$ ).

days, birthweight from 670 to 1950 g (mean  $\pm$ SD,  $1297.5 \pm 366.9$ ).

TSB values ranged from 2.2 to 12.5 mg/dL ( $7.6 \pm 2.8$ ). The correlation between TSB and TcB obtained over sternum was significant and very close ( $r=0.933$ ). It was significant and intermediately close over forehead and abdomen ( $r=0.818$  and  $0.875$ , respectively) (Fig.1). 95% CI for the mean difference was  $0.3 \pm 0.8$  mg/dL ( $P \geq 0.05$ ) for forehead,  $0.7 \pm 0.8$  mg/dL ( $P \geq 0.05$ ) for sternum, and  $1.8 \pm 1.1$  mg/dL ( $P < 0.05$ ) for abdomen. Non-significant differences were assessed when measured over forehead and sternum. Measurements over abdomen overestimated serum bilirubin levels significantly. (Fig.2).

In VLBW infants, the correlation coefficients for TSB versus TcB obtained over forehead, sternum and abdomen were 0.915, 0.862 and 0.840, respectively. In ELBW infants, these value were 0.917, 0.933 and 0.926, respectively.

## DISCUSSION

The results of studies regarding older types of bilirubinometers (Minolta JM-101<sup>TM</sup>, Minolta JM-102<sup>TM</sup>, BiliCheck<sup>TM</sup>) in premature infants are controversial(9-13), but data suggest that transcutaneous bilirubinometry has the potential to reduce the number of blood samples significantly. The present machine's method for measurement reduces the influence of skin maturation level, being advantageous in preterm neonates. In our previous studies, we found that in preterm newborns of 32-37 weeks gestation, transcutaneous measurements over forehead underestimated serum bilirubin concentrations significantly, but measurements over

sternum and abdomen were accurate, similar to as seen in term neonates(2,3). Still, data on use of the device in very premature infants are missing, except two Japanese studies, which included only few VLBW and ELBW infants(7,8).

We conclude that transcutaneous measurements using Minolta JM-103<sup>TM</sup> correlate closely with TSB levels in neonates of less than 32 gestational weeks over the presented range of TSB (2.2-12.5 mg/dL). The range of TSB does not cover the entire clinical spectrum. In comparison with term infants, the criteria for treatment of neonatal jaundice in preterm babies are lower (less than 12 mg/dL)(14). Therefore, according to our opinion, it is not of much clinical significance to extend observations until all bilirubin ranges are evaluated. However, more studies are needed with ELBW infants, as there were a limited number of them in the study.

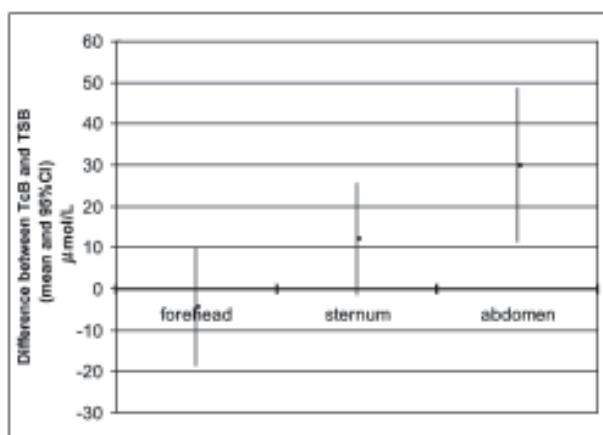


FIG.2 Mean differences ( $\mu$  mol/L) and 95% CI between transcutaneous bilirubin (TcB) and total serum bilirubin (TSB) values, according to the site of transcutaneous measurements.

**WHAT THIS STUDY ADDS?**

- Transcutaneous bilirubin concentration measurement over sternum correlates closely with total serum bilirubin values in preterm neonates of gestational age < 32 weeks, including ELBW infants, over the studied range of serum bilirubin values (2.2 to 12.5 mg/dL).

Measurements performed over sternum have proven to be the most valid, because of the closest correlation. Unlike in term infants(2), results of transcutaneous measurements over forehead differ minimally from TSB values. Transcutaneous measurements over abdomen overestimate TSB values significantly. A reliable correlation was shown between TSB and TcB in the unique populations of VLBW and ELBW infants. Our results are in agreement with those by Yasuda, *et al.*(7), at the TSB range of 1.1-20.9 mg/dL in term and in 24 preterm infants, of whom only 7 were of less than 32 gestational weeks. Our findings are not consistent with those of Namba and Kitajima(8), who considered TcB measurements as safe and accurate in preterm Japanese infants, but reported low reliability in ELBW infants and newborns of less than 28 weeks of gestation.

Although evaluation of TSB remains the standard method to indicate phototherapy and exchange transfusion in both term and preterm infants, transcutaneous bilirubinometry seems to be a suitable screening method for identification of newborns with clinically significant jaundice requiring treatment. Noninvasive bilirubin measurement over sternum in newborns of less than 32 weeks of gestation is a convenient screening method.

**Contributors:** KM, MZ and LS provided the concept and design of the study, KM, LS and HK collected data. JS statistically analyzed the data. LS drafted the manuscript which was approved by all the authors. MZ will act as guarantor of the study.

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