

## BRIEF REPORT

# Comparison of the correlation of various site transcutaneous bilirubin measurements with serum bilirubin levels at the end of phototherapy

It has traditionally been accepted that transcutaneous bilirubinometry is not recommended to be used during phototherapy despite limited research. Here, we investigated if transcutaneous bilirubin (TcB) measurements could provide an alternative to total serum bilirubin (TSB) measurements in newborns after phototherapy by performing simultaneous TSB and TcB measurements from newborn infants at their 24-hour treatment. TcB measurements were taken from three covered (the glabella, pubis and gluteus maximus) and one uncovered (the sternum) body sites.

The study was carried out from 1 January to 31 May 2017 at the Department of Pediatrics, Ufuk University Faculty of Medicine, Ankara, Turkey. We included all newborn infants born at 35 weeks of gestation or more, who were diagnosed with significant hyperbilirubinemia and subsequently treated with phototherapy.

Phototherapy was delivered continuously through the plexiglass of the incubator, and the infants wore eye masks and diapers except for short breaks for feeding or diaper changes. When phototherapy was completed, TcB measurements were performed on the glabellar region just above the internasal area under the eye mask, the mons pubis, 1–2 cm above the commissura labiorum anterior under the baby diaper and the centre of left gluteal region under the baby diaper. The sternal region, which was the control area, was also measured. We used a Bilichek transcutaneous bilirubinometer, the Respironics Model B800-16 (Respironics Inc.) under constant room light. At the same time, venous blood was collected from the antecubital vein for TSB measurements, using the colourimetric diazotised sulfanilic acid reaction (Roche Diagnostics GmbH). Maximum time period between the TcB and TSB measurements was 10 minutes. All diagnostic and therapeutic procedures were within the routine institutional protocols, except for the TcB measurements, where the parents provided verbal and written informed consent. The study was approved by the University's Ethics Committee (number 20170202/7).

SPSS, version 23.0 (IBM Corp.) and Excel 2016 (Microsoft Corp.) were used to analyse the data. The Shapiro-Wilk test was used to determine normal distribution. The Pearson correlation test and linear regression analysis analysed the correlation between TSB and TcB measurements. The intercept and slope values of the regression equation compared the regression models. The Bland-Altman

analysis was performed to detect bias of TcB measurements taken at the glabellar, sternal, pubic and gluteal regions.

We enrolled 78 newborn infants with a mean birth weight of  $3006 \pm 441.2$  grams and a mean gestational age of  $37.7 \pm 1.7$  weeks. TSB levels on admission and after 24 hours of phototherapy were  $320.28 \pm 43.43$   $\mu\text{mol/L}$  ( $18.7 \pm 2.53$  mg/dL) and  $151.5 \pm 40.52$   $\mu\text{mol/L}$  ( $8.85 \pm 2.36$  mg/dL), respectively. Glabellar, sternal, pubic and gluteal TcB values after phototherapy were  $140.9 \pm 41.89$   $\mu\text{mol/L}$  ( $8.23 \pm 2.44$  mg/dL),  $149.11 \pm 39.33$   $\mu\text{mol/L}$  ( $8.72 \pm 2.3$  mg/dL),  $149.28 \pm 41.38$   $\mu\text{mol/L}$  ( $8.72 \pm 2.41$  mg/dL) and  $57.28 \pm 34.88$   $\mu\text{mol/L}$  ( $3.34 \pm 2.04$  mg/dL), respectively.

The correlation coefficients between TSB and TcB measurements taken from the glabellar, sternal, pubic and gluteal sites were 0.78, 0.46, 0.95 and 0.83, respectively.

We used 95% confidence intervals of the slope and intercept values of the regression equations to compare. The strongest correlation was observed in the pubic region, with a slope of 0.93, an intercept of 0.45 and a correlation coefficient of 0.95. The correlations are shown in A, C, E and G subfigures of Figure S1. According to the results of Bland-Altman analysis, bias of the glabellar, sternal, pubic and gluteal TcB measurements was 11.2  $\mu\text{mol/L}$  (0.65 mg/dL), 97.2  $\mu\text{mol/L}$  (5.68 mg/dL), 2.4  $\mu\text{mol/L}$  (0.14 mg/dL) and 2.2  $\mu\text{mol/L}$  (0.12 mg/dL), respectively (B, D, F and H subfigures of Figure S1). The low bias of pubic TcB measurement in addition to its highest correlation coefficient among other TcB measurements confirms its appropriateness to use as an alternative to simultaneous TSB measurement.

Akin et al<sup>1</sup> demonstrated that TcB is not affected from the lowering effect of phototherapy on measurements at least seven hours after stopping phototherapy. However, they did not study if TcB measurements were affected by phototherapy light during or just at the end of treatment. This observation encouraged us to find solutions about the reliability of TcB just at the end of phototherapy.

Radfar et al<sup>2</sup> reported a correlation coefficient of 0.92 between simultaneous TSB and TcB measurements carried out under a photopaque patch on the glabellar regions of 170 newborn infants. Their finding was different from the 0.78 we observed for the same site, but their measurements were taken after eight hours, not 24.

Tan and Dong<sup>3</sup> studied 70 newborn infants after 24 hours of phototherapy. They reported correlation coefficients of 0.60, 0.74

**Abbreviations:** TcB, transcutaneous bilirubin; TSB, total serum bilirubin.

and 0.60 between TSB and two light-exposed areas, namely adjacent to the glabellar area and sternal area, and the glabellar area that was not exposed. We also found a weak correlation between TSB and TcB measurements taken from the sternal area that was continuously exposed to phototherapy light ( $r = .46$ ).


Murli et al<sup>4</sup> investigated the correlations between TcB and TSB in 100 Indian newborn infants, with a different model of the BiliChek, the Respironics Model 989805644871 (Philips Children's Medical Ventures). The authors reported that the correlation coefficients after 12 and 24 hours of phototherapy were 0.44 and 0.55 when measurements were performed on the sternum which was covered by a photo-opaque patch. The 24-hour correlation coefficients (0.55) in that study were lower than those we determined from the glabellar, pubic and gluteal regions: 0.78, 0.95 and 0.83, respectively. However, the studies used different BiliChek models and ethnic populations.

Johnson et al<sup>5</sup> validated using TcB during phototherapy by taking simultaneous TSB and TcB measurements from under a strip of black tape on the sternal region of 32 newborn infants. They reported a good correlation below a TSB of 249.66  $\mu\text{mol/L}$  and an overestimated mean value of 11.11  $\mu\text{mol/L}$  with TcB and emphasised that TcB may underestimate TSB values above that level. Our study did not find that.

Performing TcB measurements on the pubic region during phototherapy provided a safe, noninvasive alternative to costly and invasive TSB measurements.

#### CONFLICT OF INTEREST

None.

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#### REFERENCES

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3. Tan KL, Dong F. Transcutaneous bilirubinometry during and after phototherapy. *Acta Paediatr.* 2003;92:327-331.
4. Murli L, Thukral A, Sankar MJ, et al. Reliability of transcutaneous bilirubinometry from shielded skin in neonates receiving phototherapy: a prospective cohort study. *J Perinatol.* 2017;37:182-187.
5. Johnson SM, Vasu V, Marseille C, et al. Validation of transcutaneous bilirubinometry during phototherapy for detection and monitoring of neonatal jaundice in a low-income setting. *Paediatr Int Child Health.* 2020;40:25-29.

#### SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.