Transcutaneous Bilirubin Measurement Correlation with Total Serum Bilirubin in Healthy Newborns

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Objective: To evaluate the relation between the transcutaneous bilirubin (TcB) measurement and the total serum bilirubin (TSB) measurement in the newborns in Bahrain.

Setting: Salmaniya Medical Complex and Jidhafs Maternity Hospital, Bahrain.

Design: A Prospective Study.

Method: Newborns from May to September 2015 were included in the study. Serial transcutaneous bilirubin (TcB) measurements were obtained utilizing the Dräger Jaundice Meter JM-103. Simultaneously, TSB measurements were performed for comparison.

Result: Eighty-eight newborns were included. One hundred twenty-eight transcutaneous bilirubin TcB measurements were paired with TSB measurement. The mean ± SD of (TcB–TSB) difference for the 128 paired measurements was 1.09 ± 2.16 mg/dL, with differences ranging from 6.18 mg/dL to 7.00 mg/dL. The correlation between the paired measurements was 0.75 (P-value < 0.0005).

Conclusion: TcB measurement is a viable tool for bilirubin screening in newborns.

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Neonatal jaundice is common in newborns[1]. It is estimated that more than 60% of term babies develop neonatal hyperbilirubinemia and jaundice[1,2,3]. Jaundice is a transient benign physiologic process that affects the majority of newborns because of the delayed hepatic enzyme maturity and the short half-life of the fetal red blood cells[1]. Nevertheless, a significantly high level of hyperbilirubinemia could result in devastating brain damage known as kernicterus. Close monitoring for hyperbilirubinemia in babies during the first ten days of life is very crucial to avoid such complication by providing early therapeutic intervention[2-10]. Serum blood measurement for the total bilirubin level TSB is the gold standard test for bilirubin measurement. Nevertheless, measuring the serum bilirubin is not always convenient for the newborn, the parents and the physician since it requires blood drawing and it is costly[5,6,11,13-21]. TcB meters are widely used for screening newborns for jaundice[3,5,9,12]. It is relatively less expensive compared to the cost of TSB measurement[2,5,10.12.20]. Practically, TcB is used as a screening test for newborns with hyperbilirubinemia, and once the level approaches the treatment level, a confirmatory TSB test is performed. The transcutaneous bilirubin measurement devices have been used for more than ten years in newborn nurseries all over the world[3,7-9]. They have been tested for the accuracy and correlation with the gold standard TSB test. A good correlation with the TSB, especially with fair and medium colored skin was revealed[4,11].

Jaundice and hyperbilirubinemia is a very common problem in newborn nurseries in Bahrain, especially with the high prevalence for glucose-6-phosphate dehydrogenase (G6PD) deficiency among Bahrainis, which is recognized as a major risk factor for kernicterus[22]. In spite of the fact that our clinicians constantly deal with newborns with hyperbilirubinemia, we still do not have a validity reassuring research on the transcutaneous bilirubin measurement technique on our newborns. We believe that proving a good correlation between the TcB measurement and the TSB level would encourage our physicians to adopt the transcutaneous bilirubin measurement technique as a screening tool.

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The aim of this study is to evaluate the correlation between the transcutaneous TcB and total serum bilirubin measurement on the newborns in Bahrain.

METHOD

A prospective study on newborns during the months of May to September 2015 was performed. All term newborns' parents were approached and those who gave consent to participate in the study were included. Serial TcB measurements on the newborns using the Dräger Jaundice Meter JM-103 were performed. Simultaneous TSB test was performed. All newborns were included in the study except premature newborns of less than 38-weeks' gestation and unhealthy newborns with medical problems or those who were admitted to the Neonatal Intensive Care Unit. According to the United Nations Department of Economics and Social Affairs: Population Division, the number of births in Bahrain for the year 2015 was close to 16,000[23].

Data was entered and analyzed using SPSS Version 20.0. Quantitative variables are presented as mean ± SD and qualitative variables are presented as counts and percentages. Odds ratio and Chi-square were used to measure the association between variables. P-value < 0.05 is considered significant.

RESULT

Eighty-eight newborns were included in the study. Forty-eight (54.5%) were males. Seventy-four (84%) were Bahraini newborns while 14 (15.9%) were non-Bahrainis, see table 1. One hundred twenty-eight paired readings were performed, TSB and TcB measurements. The blood sample was obtained simultaneously with the transcutaneous bilirubin testing. The blood sample was protected from light and processed within half an hour in the majority of cases to a maximum of one hour after the sample collection.

Table 1: Personal Characteristics of the Newborn Babies

		No.	%
Gender	Male	48	54.5%
	Female	40	45.5%
Nationality	Bahraini	74	84.1%
	Non-Bahraini	14	15.9%
Total		**88**	**100%**

Mean of TcB–TSB Difference

TSB ranged from 5.1 mg/dL to 19.4 mg/dL; seven TSB values (5.5%) were ≥ 15 mg/dL. The mean ± SD of (TcB–TSB) difference for the 128 paired measurements was 1.09 ± 2.16 mg/dL, with differences ranging from 6.18 mg/dL to 7.00 mg/dL. The correlation between the paired measurements was 0.75, P-value < 0.0005, see table 2.

Table 2: Mean TcB -TSB Difference

TSB	No.	%	Mean TCB-TSB Difference
5 - 8.9	48	37.5	1.64
9 - 10.9	22	17.2	1.80
11 - 12.9	30	23.4	0.72
13 - 14.9	21	16.4	0.55
15.0	7	5.5	-1.67
Total	**128**	**100**	**1.19**

The mean difference between the TcB and the TSB was positive for TSB values less than 14.9 mg/dl and became negative for values above 15 mg/dl. The lowest mean difference was for TSB values between 11 and 14.9 mg/dl, see figure 1. No adverse events were encountered in the study.

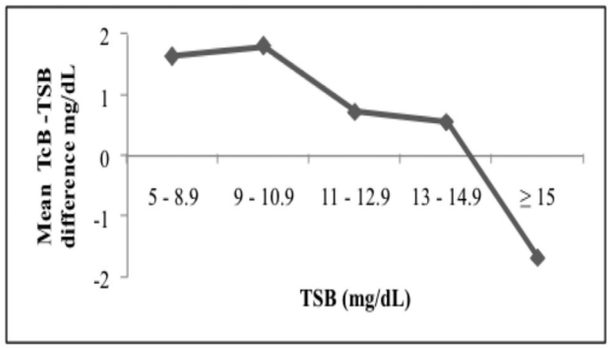

Figure 1: TcB–TSB Difference at Variable TSB Levels

DISCUSSION

The TcB measurements on our newborns showed a correlation coefficient similar to other studies performed in different ethnic groups[13].

In this study, the relation between the TcB and the TSB measurement was significant. The mean difference was minimal between the TSB levels of 11 to 14.9 mg/dl. The TcB tends to overestimate the TSB (positive TcB–TSB difference) for levels lower than 14.9 mg/dl. On the contrary, the TcB measurement tends to underestimate the TSB (negative TcB–TSB difference) if the TSB is above 15 mg/dl. Overestimation would cause extra cost by doing further confirmatory TSB testing while the main danger resides in underestimation for the TSB. The underestimation would result in the poor recognition of newborns who would need treatment for high bilirubin measurements.

The study finding is similar to the result by Taylor et al[13]. Their mean TcB–TSB difference was 0.84±1.78 mg/dL and the correlation between paired measurements was 0.78. While in this study, the mean TcB–TSB difference was 1.09±2.16 mg/dL and the correlation coefficient was 0.75, which is highly significant (P-value < 0.0005).

Al Saedi et al[4] have conducted a study to evaluate the accuracy of TcB measurement in healthy, jaundiced Saudi term newborns, and he found a significant correlation between TcB and TSB. Romagnoli et al found that the correlation between the between JM-103 and TSB was r=0.8686[3]. Sanpavat et al showed a correlation coefficient of 0.80 between TcB and TSB using the JM device[7]. Raimondi et al compared three devices for TcB measurements and found that the correlation for JM-103 is 0.85[8]. Panburana et al showed a linear correlation with a significant correlation coefficient (r=0.81, p < 0.001)[10].

The main limitation of our study was the small sample size. It was challenging to convince parents to return to the hospital after discharge for a bilirubin measurement. We recommend that future studies could be performed on a larger sample size especially that this topic is a high priority for

physicians who deal with newborns. The technique of testing hyperbilirubinemia should carry less economic burden on the families and should be less invasive.

CONCLUSION

Transcutaneous bilirubin measurement is a viable tool for bilirubin screening in newborns. The TcB measurements on our newborns showed a correlation coefficient similar to other studies performed in different ethnic groups. We recommend utilizing the TcB as a screening tool for jaundice among newborns in Bahrain. We also stress on being cautious with TcB readings exceeding 15 mg/dl (this is also emphasized by the producer manual) since readings above 15mg/dl could be underestimating the actual bilirubin level. Utilizing the transcutaneous bilirubin measurement technique as a screening measure for hyperbilirubinemia among newborns in Bahrain could be cost effective and a reliable method if used with caution. Further multicenter research is recommended.

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