Section: Pediatrics

Research

COMPARISON OF TRANSCUTANEOUS BILIRUBIN TO SERUM BILIRUBIN LEVELS BEFORE AND AFTER PHOTOTHERAPY IN TERM AND PRE-TERM NEONATES

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Abstract

Background: The measurement of total serum bilirubin (TSB) has been considered the gold standard for many years, but it is intrusive, uncomfortable, stressful, and takes a lot of time. To compare the transcutaneous bilirubin levels with serum bilirubin levels (Gold standard) in term and late pre-term neonates admitted to the hospital. **Materials and Methods:** A Prospective interventional study was conducted at Kanyakumari Government Medical College Hospital from August 2020- August 2021 (1 year). Two hundred seventy-eight babies, Neonates attending with jaundice were included during the study period. Serum bilirubin estimation and transcutaneous bilirubin readings are to be taken immediately after a baby with jaundice was admitted or as soon as jaundice appeared in an already hospitalised neonate. **Result:** Among 278 neonates, the male was 138 (49.6%), and the female was 140 (50.4%). 154 (55.4%) were significant weight loss, and 124 (44.6%) were insignificant weight loss. In gestational age, 256 (92.1%) were appropriate, and 22 (7.9%) were small for gestational age. There was a significant difference ($p<0.0001$) in TCB and TCS mean values before and after phototherapy. The differences between TCB and TSB were significantly related to the term (Pre-term, Term). The birth weight was correlated with TSB and TCB before and after the phototherapy using spearman's rho. The correlation coefficient observed was -0.141 before and -0.005 after phototherapy. **Conclusion:** Our study concludes the TSB level estimated by the conventional method significantly correlates with the bilirubin value measured by the transcutaneous bilirubinometer in pre-term neonates.

INTRODUCTION

Neonatal jaundice is a frequent source of worry for parents and caregivers throughout the neonatal period. It affects many infants after the first 24 hours of life and resolves independently during the following several days. If untreated, severe and persistent jaundice may result in bilirubin encephalopathy and irreversible brain damage.[1] Kramer's scale or other modalities have traditionally been used to screen infants with neonatal hyperbilirubinemia. Once jaundice is diagnosed, blood bilirubin samples for total serum bilirubin (TSBL) are typically taken to confirm the diagnosis and begin treatment. However, serum TSBL sampling is a time-consuming process. It requires qualified medical personnel and may result in nosocomial infections. Furthermore, laboratory testing is both expensive and time demanding, causing needless delays in the start of phototherapy and hospital release.[2]

TBL (transcutaneous bilirubin) measuring devices utilize multiwavelength spectral reflectance from the skin surface to determine total serum or plasma bilirubin without needing blood collection. Physicians, nurses, and other medical professionals at hospitals and clinics, as well as those in the community, can perform TBL as a Point of Care (bedside) test. It is a non-invasive, quick test for identifying infants with neonatal hyperbilirubinemia.[3] Clinical practice has increasingly favoured non-invasive TBL evaluation in full-term, and near-full-term infants since this approach may reduce the need for TSB testing once TSB levels exceed 240 mol/L (14 mg/dL). Efficacy, safety, and usefulness have all been shown in various studies. For example, in a randomized controlled study conducted in the Netherlands, blood bilirubin samples in the TBL group were significantly lower than in the non-TBL group. TBL is a low-cost test that may be done on the forehead or the mediastinum. However, studies show that measurements taken on

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the mediastinum are more accurate than measures taken on the forehead. Despite its usefulness, TCBL is only used as a screening tool in 27% of hospital wards.[4]

Despite TBL being an excellent screening technique, the TSBL test is now the most reliable method for identifying and initiating phototherapy. Most TBL research proves its accuracy by comparing TSBL to TBL levels. A decrease in severe new-born jaundice, readmission for phototherapy, and the length and rate of phototherapy is associated with introducing TB into a hospital or community-based screening. TBL sensitivity and specificity were found to be 88% and 53% in a study conducted at an institution 25 years ago.[5] Similar research from the same period in Pakistan revealed high sensitivity. Since then, technology has progressed considerably, introducing newer, more complex, more precise equipment. Nevertheless, according to recent data from Pakistan, TBL and TSBL have a strong connection.[6]

There is a diverse body of evidence on the use of TBL in pre-term babies under 35 weeks of gestation. However, small sample numbers were used in previous research, and data on the effects of phototherapy and the anatomical location of assessment was inconsistent. There is also a scarcity of information on the impact of ethnicity on TBL in pre-term babies. Furthermore, few recent studies have classified agreement between TBL and TSBL among pre-term babies by prematurity gestational age groups, particularly after the start of phototherapy.[7]

Hence, the present study was conducted to compare the TcBR levels with SBR levels (Gold standard) in term and late pre-term neonates admitted to the hospital for better management of jaundice.

AIM

To compare the transcutaneous bilirubin levels with serum bilirubin levels (Gold standard) in term and late pre-term neonates admitted to the hospital.

MATERIALS AND METHODS

A Prospective interventional study was conducted at Kanyakumari Government Medical College Hospital from August 2020- August 2021 (1 year). Two hundred seventy-eight babies, Neonates attending with jaundice were included during the study period.

Inclusion Criteria

All term and late pre-term babies admitted to NICU for NNH meet the AAP nomogram for phototherapy.

Exclusion Criteria

Babies with direct hyperbilirubinemia, babies less than 35 weeks (Very pre-term and extremely pre-term), and babies with NNH in exchange transfusion range according to AAP nomogram.

To collect blood samples, parents must first provide their written approval. Serum bilirubin estimation and transcutaneous bilirubin readings are to be taken immediately after a baby with jaundice was admitted or as soon as jaundice appeared in an already hospitalised neonate. Therefore, blood samples were taken immediately after transcutaneous bilirubin reading and analysed by the acid diazo method (Vanden Bergh reaction). After that, serum bilirubin estimation and transcutaneous bilirubin readings were taken in each case of neonatal jaundice before initiating phototherapy and 6 hours after phototherapy was stopped.

Transcutaneous bilirubin reading and serum bilirubin estimation were done by different observers unaware of each other's results, and the instruments were standardised according to the manufacturer's guidelines. Using transcutaneous bilirubin tester model MBJ20, one reading at the forehead just above the glabella and one at the mid sternum were taken in a quiet child and recorded. Eyes were shielded while taking the readings at the forehead. TCB probe is to be disinfected with sterillium before using it on every baby.

Continuable data were analysed using paired and independent-sample t-tests. The Pearson chi-square test for paired data was used to compare the categorical variables. Results from a two-tailed test with a P value of less than 0.05 were considered significant. IBM-SPSS 21.0 was used for the statistical analysis.

RESULTS

Among 278 neonates, the male was 138 (49.6%), and the female was 140 (50.4%). In the mode of delivery, most of the delivery were Lower segment Caesarean section (LSCS) 179 (64.4%), normal vaginal delivery (NVD) was 97 (34.9%), and assisted vaginal delivery (AVD) was 2 (0.7%). Among the neonates, 154 (55.4%) were significant weight loss, and 124 (44.6%) were insignificant weight loss. 142 (51.1%) were multigravida and 136 (48.9%) were primi gravida. In gestational age, 256 (92.1%) were appropriate for gestational age, and 22 (7.9%) were small for gestational age [Table 1].

Of 278 neonates, 203 (73%) neonates were found with Term delivery, whereas 75 (27%) were observed with pre-term delivery. All neonates were evaluated based on AAP Score, and it was found that only 28 (10.1%) neonates were observed with high (H) AAP. In contrast, an equal proportion of neonates was found in the low (L0 and medium (M) category.

Risk factors in mothers were in 138 (49.6%) neonates, and the non-risk was 140 (50.4%). On the other hand, risk factors in babies were 150 (54%), and non-risk were 128 (46%). [Table 2]

There was a significant difference ($p<0.0001$) in TCB and TCS mean values before and after phototherapy [Table 3].

The differences between TSB and TCB before were significantly related to the term (Pre-term, Term), with a p=value of 0.011 [Table 4].

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The gestational age was correlated with the difference in TCB and TSB before and after phototherapy. However, the effect was statistically insignificant (before, p=0.343) and after, p=803). The birth weight was correlated with TSB and TCB before and after the phototherapy using spearman's rho. The correlation coefficient observed was -0.141 before and -0.005 after phototherapy [Table 5].

Table 1: Distribution of neonate's characteristics

Variable		Frequency	Percent
Sex	Female	140	50.4%
	Male	138	49.6%
Mode of delivery	Assisted vaginal delivery (AVD)	2	0.7%
	Lower segment Caesarean section (LSCS)	179	64.4%
	Normal vaginal delivery (NVD)	97	34.9%
Significant weight loss	No	124	44.6%
	Yes	154	55.4%
Gravida	Multi	142	51.1%
	Primi	136	48.9%
Gestational age	AGA (appropriate for gestational age)	256	92.1%
	SGA (small for gestational age)	22	7.9%

Table 2: Distribution of neonate risk factors

Variable		Frequency	Percent
Term	Pre-term	75	27.0%
	Term	203	73.0%
AAP category of risk factors	High	28	10.1%
	Low	125	45.0%
	Medium	125	45.0%
Risk factors in mother	No	140	50.4%
	Yes	138	49.6%
Risk factors in baby	No	128	46.0%
	Yes	150	54.0%

Table 3: Observation of mean TCS and TCB before and after phototherapy

		Mean and Std Deviation	P value
Pair 1	TCB Before	18.42 ± 3.35	<0.0001
	TCB After	11.06 ± 1.95	
Pair 2	TSB Before	18.30 ± 3.26	<0.0001
	TSB After	13.47 ± 9.03	

Table 4: Observation of Term for the difference in TCB and TSB before and after phototherapy.

Term	Mean and Standard Deviation	P value
	Diff TCB & TSB BF	
Preterm	0.73 2.32	0.011
Term	-0.11 2.69	
Diff TCB & TSB AF		
Pre-term	-1.48 1.38	0.421
Term	-1.73 1.23	

Table 5: Observation of gestational age for the difference in TCB and TSB before and after phototherapy

Gestational Age	Mean and Standard Deviation	P value
	Diff TCB & TSB BF	
AGA	0.08 2.68	0.343
SGA	0.56 1.62	
	Diff TCB & TSB AF	
AGA	-1.65 1.23	0.803
SGA	-1.83 1.80	

DISCUSSION

In the present study, the gender distribution of participating infants is almost the same in both males and gender. However, the male infants were 138 (49.6%), whereas female infants were reported to be 140 (50.4%). Upon examining the gravid of all participating infants, it was found that most infants were multi gravid 142 (51.1%) and 139 (48.9%) were observed with primigravid. All the participating infants were also categorised based on AAP risk factors, and it was observed that only 28 (10.1%) of infants at high risk (H category) and Moderate (M category) and low risk (L Category) were observed to same 125 (45%) numbers of infants. Furthermore, the chances of risk factors in mothers were reported in 140 (50.4 %) cases, whereas the probability of risk factors in babies was reported in 150 (54%) infants.

TcB measurement is a viable approach for monitoring new-born hyperbilirubinemia in term and late-preterm babies, even before and after phototherapy. Pre and post-phototherapy, we found

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that TCB and TSB were highly correlated and consistent in term and late pre-term new-borns with jaundice. However, when comparing the mean TSB level before and after phototherapy, the mean TCB level in term and late pre-term new-borns is generally more significant.

Taylor et al. reported that most term and late-preterm new-borns acquire hyperbilirubinemia, and some develop substantial hyperbilirubinemia, demanding strict monitoring and urgent phototherapy treatment to avoid kernicterus.[8]

According to Radfar et al., TSB has been regarded as the gold standard for years, but measuring it is still intrusive, unpleasant, stressful, and time-consuming. TcB may assess bilirubin levels in pre-term and term neonates receiving phototherapy.[9] Engle et al. reported the TCB measurement is a rapid, simple, and non-invasive approach that outperforms ocular evaluation and may be used as a screening tool for new-borns at high risk of hyperbilirubinemia.[10]

Numerous investigations have been conducted comparing the prediction accuracy of TCB to TSB in term neonates during and after phototherapy. On the other hand, its predictive accuracy in late-preterm new-borns using phototherapy has not been thoroughly established. After starting phototherapy, there is a strong link between transcutaneous and total blood bilirubin levels studied by Pendse et al.[11]

Nahar et al. reported 54% male and 46% female infants. 31.33% of infants with low weight, the majority of infants, 76.5%, at AGA in their study.[12]

Yang et al. studied the majority of male infants (57%). In infants, there was a positive linear connection between TSB and TcB before and after phototherapy. There was a strong association and increased consistency between TSB and TcB and jaundice in both full-term and late-preterm neonates before, during, and after phototherapy.[13]

Begum et al. reported female infants were the majority (57.4%). Significant correlations exist between postnatal age and TcB and TSB. The need for phototherapy was likewise significantly high in both populations. TSB at 13 mg/dl has a 71% specificity and a 90% sensitivity.[14]

Casnocha et al. discovered that TcB was inaccurate for monitoring new-born hyperbilirubinemia before, during, or after phototherapy. There was a moderate association between TcB and TSB before and after phototherapy, whereas the correlation was less throughout treatment. The use of TcB to track hyperbilirubinemia in new-borns during and after phototherapy proved unsatisfactory.[15]

According to Jnah et al., the TCB measuring equipment (BiliChek) overestimates serum bilirubin. In contrast, the TCB level recorded by BiliChek is, on average lower than the TSB level.[16] Juster et al. found it to be the case in infants delivered at 35 weeks gestation weighing 2,000 grams. TSB and TcB were observed to be positively correlated 8 hours after phototherapy.[17]

The current research has a few drawbacks. First, our study had a tiny sample size. Second, this research only included term and late-preterm new-borns. Therefore, the link between TcB and TSB in severely premature infants is unknown. Finally, TcB measurement in pre-term new-borns has mixed findings in earlier investigations.

CONCLUSION

In premature infants, there is a strong correlation between the TSB level predicted using the traditional approach and the bilirubin value obtained using a transcutaneous bilirubinometer. Therefore, using a transcutaneous bilirubinometer will lessen the need for invasive phlebotomy on premature infants and calm the minds of their concerned parents. Furthermore, the results of this study show that TcB and TSB in new-borns with neonatal jaundice are highly correlated before and after phototherapy, and this holds for both full-term and late-preterm infants. Therefore, TcB monitoring during phototherapy for neonatal hyperbilirubinemia in full-term and late-preterm new-borns is a reasonable option.

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