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Comparison of Total Serum Bilirubin and Transcutaneous bilirubin in Term Neonates in a Tertiary Care Hospital in Jharkhand

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Abstract: ***Objective:*** *To compare total serum bilirubin and transcutaneous bilirubin in term neonates.*
Method: *Jaundice was assessed in term neonates with transcutaneous bilirubinometer and then plasma bilirubin level before starting phototherapy.*
Results: *Analysis of correlation between TSB & TcB demonstrated that the forehead and sternum measurements had a significant correlation with plasma assay- strong (upto 88.2%) and very strong (upto 90.3%).*
Conclusion: *Transcutaneous bilirubin correlates significantly with total serum bilirubin. It can be used as a screening method to measure the value of bilirubin.*

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I. Introduction

Hyperbilirubinemia is the most common morbidity in the first week of life, occurring in 60% of term and 80% of preterm neonates. It is also the most common cause of re- admission after discharge from birth. Jaundice in neonates is visible in skin when total serum bilirubin exceeds 5 to 7 mg/dl. Causes of increased TSB concentration in neonates includes increased bilirubin production due to RBC degradation; decreased bilirubin clearance due to immature hepatic function and increased entero-hepatic circulation[1].

Major risk factors include the following:

- Pre-discharge TB in a high risk zone (>95th percentile for age in hours according to Bhutani nomogram.)
- Jaundice within the first 24 hours of birth.
- Immune hemolytic disease.
- Previous sibling with jaundice.
- Cephalhematoma.
- Gestational age < 38 weeks.
- East Asian race.

Therefore any high risk infant should have an universal systematic assessment before discharge, close follow and prompt intervention when indicated[2]. The determination of TSB is an invasive, costly and time-consuming work. Transcutaneous bilirubin is an useful adjunct to TSB measurement and routine employment of TcB can reduce the need for blood sampling. TcB can be reliably used in neonates ≥ 35 weeks and after 24 hours of age. Hour specific TcB can be sed for prediction of subsequent hyperbilirubinemia. However, TcB measurements are not reliable in certain circumstances such as during or after phototherapy, after sunlight exposure or TB levels ≥ 15mg/dl. TcB can overestimate TB in dark pigmented infants and underestimate TB in light skinned infants. Therefore, routine use of TcB for screening high—risk neonates is a cost effective procedure[2].

TcB was first used by Yamanouchi et al in 1980. The newer generation of transcutaneous bilirubinometer determines the yellowness of the subcutaneous tissue by measuring the difference in the optical densities for light in the blue (450nm) and green (550nm) wavelength region. The measuring probe has 2 optical paths. When the measuring probe is pressed against the sternum or forehead of the infant, the built-in xenon lamp passes through the glass fiber and illuminates the skin and subcutaneous tissue repeatedly, and then finally returns to the sensor side of the glass fiber. The denser the transcutaneous bilirubin, the weaker the reflected blue light. The reflected green light remains unchanged regardless of the density of the bilirubin. Because the optical density difference shows a linear correlation with the total serum bilirubin concentration, it is converted to the estimated bilirubin concentration and indicated digitally[3].

II. Material And Methods

The present study was conducted in the Department of Pediatrics and Neonatology, Rajendra Institute of Medical Sciences Ranchi. This is a tertiary care hospital with 1000 bedded multi disciplinary teaching facilities and advanced diagnostic tools.

Study Design: Cross-sectional Observational study

Study Location: Department of Pediatrics & Neonatology, RIMS, Ranchi.

Study Duration: February 2019 to January 2020.

Study population: The study population constituted patients who are neonates born in this institute who has visible jaundice.

Study Tool: Transcutaneous bilirubinometer (Drager JM—105 non-invasive TcB).

Sample size: 135 term neonates.

Inclusion criteria:

1. Neonates born in this institute with visible jaundice.
2. Neonates $\geq$ 37 weeks of gestation.

Exclusion criteria:

1. Any outborn neonate.
2. Neonates < 37 weeks of gestation.
3. Neonates in whom phototherapy has been started.
4. Any sick neonate (sepsis, shock, major congenital anomaly, birth asphyxia, skin disease).
5. Neonatal Cholestasis.

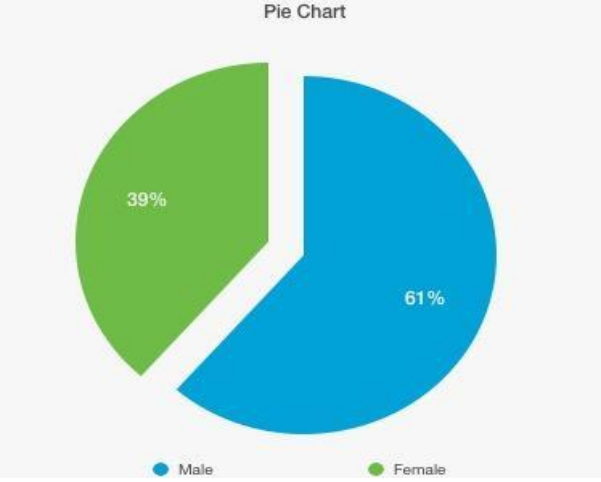
Procedure methodology:

TcB measurements at the forehead and sternum were taken on neonates with visible jaundice. Minimum three readings were taken at each site and the average was calculated. Simultaneously, a blood sample was taken for plasma bilirubin assay. Tcb measurement was performed using Drager JM-105 and plasma assay was performed by the hospital laboratory using the spectrophotometric method. Other parameters such as gestational age was determined by LMP and Ballard scoring, weight was determined by using a digital weighing scale.

Statistical analysis: Data collected was put on a master chart and analyzed statistically. The following method were employed to achieve the study objective: analysis of correlation using pearson's correlation coefficient and linear regression analysis.

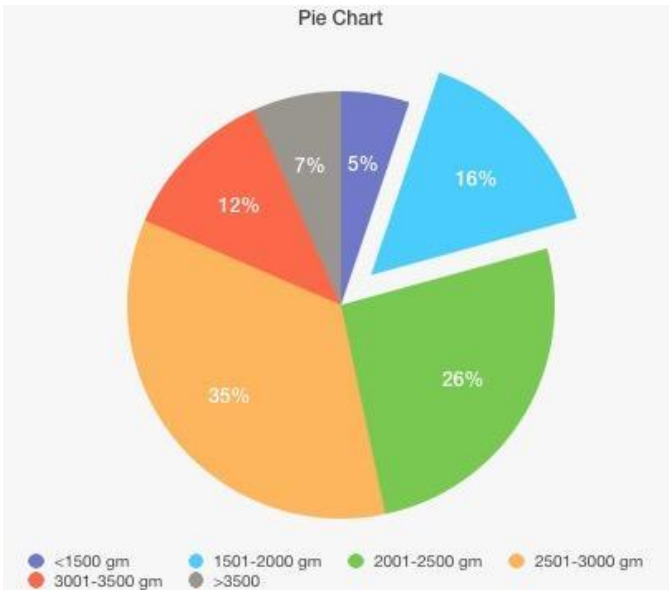
III. Result

1) Total neonates were 135, out of which 61.5% (83 neonates) were male and 38.5% (52 neonates) were female.



2) Mean gestational age was 39.4 ± 2 weeks.
3) Mean birth weight was 2.725 kg.

WEIGHT	NUMBER OF NEONATES
<1500 gm	7
1501-2000 gm	21
2001-2500 gm	35
2501-3000 gm	47
3001-3500 gm	16
>3500	9



4) Mean postnatal age when jaundice was visible was 2.9 ± 1.2 days.
5) Average time (minutes) between TcB measurement and TSB measurement was 15.62 min.
6) At the time of bilirubin measurement 69% were high risk infants. Most common cause was ABO incompatibility (46.2%).
7) Mean forehead TcB was 10.3 ± 3.6 mg//dl and mean sternum TcB was 10.1 ± 3.5 mg/dl.
8) Mean TSB before phototherapy was prescribed was 9.9 ± 3.7 mg/dl.

	N	Mean	SD	Minimum	Maximum	Median
TcB Forehead	135	10.3	3.6	3.3	17.6	9.7
TcB Sternum	135	10.1	3.5	3.5	17.8	10
TSB	135	9.9	3.7	2.8	21.2	11.6

9) Analysis of correlation between TSB & TcB demonstrated that the forehead and sternum measurements had a significant correlation with plasma assay- strong (upto 88.2%) and very strong (upto 90.3%).
10) Mean difference between TSB and Tcb at sternum had the lowest mean difference at all the time.
11) TcB overestimated TSB in majority of the readings (78.4%).
12) The correlation coefficient was better for bilirubin values < 15mg/dl. Bilirubinometer showed error when TSB values were more than 20mg/dl.

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IV. Discussion

In the present study a positive correlation was found between Total Serum Bilirubin and Transcutaneous bilirubin before starting phototherapy in term neonates. The mean difference between TSB and TcB on forehead was 0.4mg/dl and between TcB on sternum was 0.2mg/dl. It was observed that sternum showed a stronger correlation to TSB than forehead.

Previous studies have demonstrated a good agreement between TSB and TcB before starting phototherapy and even patched TcB during PT in both term and preterm neonates. However in a study by Jangard, et al TcB measurement during PT was not found to be as sensitive in preterm compared to term neonates [4]. A study conducted at *Unicamp* by Leite *et al*[(5)] compared plasma and transcutaneous bilirubin measurements in a sample of neonates, the majority of whom were white (67%), with 23% mixed race and 10% black newborns. Mean gestational age was 35.7±3.7 weeks, birth weight was 2330±930g and postnatal age was 3.25 ±1.73 days. Mean total plasma bilirubin was 8.10±4.17 mg/dL and mean transcutaneous bilirubin measured at the forehead with Bilicheck was 8.82±3.88 mg/dL. In that study, the authors did not observe any significant interference from gestational age, birth weight, race or use of phototherapy on transcutaneous bilirubin measurements and they pointed out that the measurement location had been conveniently shielded from the light. Only postnatal age of less than 3 days was associated with a small statistical difference (p=0.003) between plasma assay and transcutaneous bilirubin, with plasma results being higher. The authors state that this finding may be caused by the increase in bilirubin-albumin bonding and maturation of the skin as the days pass. Zecca *et al* conducted a similar study, occluding a certain part of the skin in order to measure transcutaneous bilirubin during phototherapy, and correlated the measurements with plasma bilirubin. They used Bilicheck for transcutaneous measurements and the skin occluded was on the forehead. They concluded that transcutaneous bilirubin measurement through an area of covered skin could be a reliable method for use during phototherapy, reducing blood sampling[(6).]

Several authors have conducted studies correlating plasma and transcutaneous bilirubin across patients of different races[(7-9)]. Bhutani *et al* compared transcutaneous bilirubin measured with Bilicheck with plasma bilirubin results in patients of different races and did not detect any differences. However, in that study 99% of TB results were below 15 mg/dL[(7)]. Maisels *et al* investigated a Minolta JM-103 and found that the correlation between transcutaneous and plasma bilirubin measurements was less strong for the black population than for other population groups and that in the black population the transcutaneous measurement tended to be higher than the plasma measurement[(8)]. Slusher *et al* compared transcutaneous bilirubin with plasma bilirubin in indigenous African neonates with varying degrees of skin pigmentation and found a good correlation between the plasma and transcutaneous measurements[(9).] Pendse et al compared TSB and Tcb in preterm neonates receiving phototherapy and found that Transcutaneous bilirubin has a good correlation with total serum bilirubin after initiation of phototherapy. (r=0.918, P<0.001). Transcutaneous bilirubin at 28-32 weeks of gestation (r = 0.97) was better correlated with total serum bilirubin than those at 32-37 weeks (r =0.88). The correlation was better for neonates <72 hours old (r = 0.96) than those >72 hours of age (r = 0.82) [(10)].

In a study using the Minolta, conducted in Japan by Namba and Kitajima, results demonstrated a strong correlation between transcutaneous and plasma bilirubin, with transcutaneous tending to be higher than plasma bilirubin. However, the correlation was inadequate for patients lighter than 1000g or younger than 28 weeks' gestational age[(11)]. From the results of this study, it can be concluded that transcutaneous bilirubin measurements taken at the forehead and sternum were equivalent, exhibiting minimal differences. The mean difference between plasma and transcutaneous measurements taken before starting phototherapy was 0.4 mg/dL at the forehead and 0.2 mg/dL at the sternum. There were no significant differences in correlation between plasma and transcutaneous bilirubin measurements when the population was stratified according to any of the following variables: weight, color, sex, and postnatal age. However, Tcb vales did not correlate well with values higher than 15mg//dl and showed error with values higher than 20mg/dl.

The limitations of this study was a small sample size, exclusion of preterm neonates and effect of phototherapy on transcutaneous bilirubin.

V. Conclusion

From the present study we concluded that transcutaneous bilirubin measurement can be use for screening in neonates with visible jaundice. If values are high it can be confirmed by plasma bilirubin level. TcB will limit unnecessary blood sampling, time for result, ease to carry out the procedure and subsequent monitoring of bilirubin level in high risk infants.

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