CORRELATION BETWEEN TOTAL SERUM BILIRUBIN LEVELS AND TRANSCUTANEOUS BILIRUBINOMETER VALUES IN NEONATAL JAUNDICE

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ABSTRACT

Background: Jaundice in newborns is a prevalent postnatal complication, typically benign in nature. To assess neonatal jaundice, the development of non-invasive techniques, such as the transcutaneous bilirubinometer, has proven instrumental. This study focuses on evaluating neonatal bilirubin levels using transcutaneous bilirubin (TcB) meters, which employ a non-invasive approach by measuring light transmission through the skin.

Objective: The objective of this research is to conduct a comparative analysis between transcutaneous bilirubin levels in neonates and their corresponding total blood bilirubin levels.

Method: A cross- sectional study was conducted over the course of six months in the neonatal unit at Bahria International Hospital in Lahore. Systematic random sampling was used to recruit a total of 100 instances of newborn jaundice. Babies' demographic information was collected after they were born. The transcutaneous bilirubinometer (TCB) JM-105 was used to measure their bilirubin levels. Bilirubin levels in the serum were measured and documented simultaneously. The results of the two tests were compared to determine the degree of correlation between them.

Results: Out of 100 neonates, 61(61%) were male. For all weight ranges mean TCB values significantly correlated with mean serum bilirubin level ($p<0.001$) with correlation coefficient 0.778.

Conclusion: In newborns, total serum bilirubin (TSB) levels are highly associated with transcutaneous bilirubin (TcB) levels. Therefore, TcB can be utilized to direct care for these infants.

Keywords: Neonatal Jaundice, Total Serum Bilirubin Transcutaneous Bilirubinometer

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INTRODUCTION

Sixty percent of full-term and eighty percent of preterm infants get neonatal jaundice. Although newborn jaundice often resolves on its own, it can be fatal if bilirubin reaches a particular serum level and then deposits in the basal ganglia of the brain, causing encephalopathy and kernicterus. Early newborn death rates were estimated to be 1309.3/100,000 worldwide in 2016, although this is not uniformly the case.[1-2]

The mechanism behind elevated serum bilirubin levels is an imbalance between bilirubin production and conjugation. Liver immaturity, leading to reduced glucoronyl conjugation, is the primary cause of physiological jaundice. Premature birth, severe hemolysis from Rh or ABO incompatibility, G6PD deficiency, other hemolytic anemia, sepsis, neonatal infections, delayed meconium passage, intestinal obstruction, polycythemia, and cephalohematoma are all causes of pathological jaundice.[3-5]

To avoid bilirubin-related toxic encephalopathy, phototherapy or exchange transfusion must be used to treat pathological jaundice when serum bilirubin levels

rise over safe thresholds. All of this requires constant monitoring of serum bilirubin levels, can lead to a hospital stay, causes emotional distress for the parents, and strains their finances.[6]

Clinical assessment of jaundice severity is unreliable, especially in infants with dark skin. Serum bilirubin levels are most reliably measured by van den Bergh reaction-based biochemical testing. Blood collection, however, is an intrusive operation that might be unsettling for care givers. The constant monitoring of bilirubin levels required by hyperbilirubinemia leads to substantial blood loss and ultimately anaemia.[7]

The usual biochemical way of measuring bilirubin levels can be replaced with the transcutaneous bilirubinometer, which is an alternative that is simple, non-invasive, painless, and saves time. There have been a number of studies done to demonstrate that its application is appropriate. While some of them detect a good connection between total blood bilirubin and transcutaneous bilirubin and recommend for its use as a suitable alternative of the conventional approach, other research found that there was a significant difference between the levels of bilirubin that were obtained using the two methods.[8-10]

Because the results were inconclusive, we decided to perform research to determine the diagnostic accuracy of the subcutaneous bilirubinometer by comparing the levels of bilirubin it measured to the levels of bilirubin found in serum. The objective of this study was to determine the source of jaundice in the study population, document the demographic characteristics of newborns who presented with jaundice, and correlate the levels of bilirubin measured by a subcutaneous bilirubinometer with those measured using a conventional biochemical approach.

METHOD

This cross-sectional study was carried out at the nursery of Bahria International Hospital in Lahore between January to June in 2023. Following receipt of ethical clearance from the regional review board, the research was initiated. The appropriate sample size was determined to be 100 instances by taking the correlation value of 0.82, adding a 95% confidence interval, and basing the power of the test on 80%.[11] A total of one hundred newborns presenting with jaundice were recruited through the use of a systematic random sampling strategy. In this method, every other instance of neonatal jaundice was recruited, and this was done regardless of the gestational age at delivery or the source of the jaundice.

The researchers decided not to include unhealthy newborns or those who had conjugated hyperbilirubinemia in their research. Prior to the enrollment of the parents' neonates in the study, verbal informed permission was obtained from the parents. Variables such as gender, gestational age at birth, mode of delivery, body weight, and day of life at presentation are some of the things that may be recorded on a Performa. For this investigation, a transcutaneous bilirubinometer (TCB) model JM-105 was utilized.

The sternum was chosen as the location for the recording of the transcutaneous bilirubin level. The level was logged by staff members who had received training. Within five minutes of recording the level, trained staff took a venous blood sample of 1.5 ml from the patient using a disposable syringe. The sample was then promptly transferred to the laboratory for serum analysis. Each reading was written down on a separate proforma. SPSS version 25 was used to do the analysis on the data. Calculations of descriptive statistics were carried out. A p-value of less than 0.05 was taken to indicate statistical significance. It was decided to calculate the Karl Pearson correlation coefficient.

RESULTS

Total 100 neonates were enrolled in the study. Gender distribution showed that 61% neonates were males and 39% were females. About 40.0% neonates presented within first three days of their life, while 60% neonates had ages between 4-7 days. Almost one third study population 36% were low birth weight (1.5kg-2.5kg), while 39(39%) had between 2.6-3.0 kg weight, 18% had between 3.1-3.5 kg and 7% had weight between 3.6-4.5 kg.

Table-1: Demographic variables of study population (n=100)

Gender	n (%)
Male	61.0
Female	39.0
Total	100.0
1.5-2.5kg	36.0
2.6-3.0kg	39.0
3.1-3.5kg	18.0
3.6-4.5kg	7.0
Total	100.0
28-32 weeks	3.0
33-36 weeks	10.0
37-40 weeks	87.0
Total	100.0
SVD	33.0
C-section	67.0
Total	100.0
0-3 days	40.0
4-7 days	60.0
Total	100.0

According to gestational age of the enrolled neonates, 87% neonates were born full term. Regarding mode of delivery, 33% neonates were delivered through

spontaneous vaginal delivery, while 67% neonates through cesarean section.

The mean serum bilirubin level of the neonates was 12.86±2.46 (range 8-18mg/dl) and mean transcutaneous bilirubin value was 13.26±2.49 (range 8-20mg/dl). There was a positive correlation between mean serum bilirubin and mean TCB value with a Karl Pearson correlation coefficient as 0.778 and p-value ≤0.05.

Table-2: Correlation between total serum bilirubin levels and transcutaneous bilirubinometer values

Correlation between total serum bilirubin levels and transcutaneous bilirubinometer values	n	100
	r	0.778
	p-value	0.001

DISCUSSION

Because newborn jaundice is the most prevalent neonatal health concern, a significant amount of research work has been done in order to search for viable methods for the accurate clinical evaluation of jaundice and to design alternative means for the trustworthy judgement of bilirubin levels. Considering the illness burden, this study has been carried out in an effort to lessen the impact of the condition. In 1980, TCB was developed as a feasible replacement for the traditional laboratory approach. It was put through rigorous testing to determine its precision and accuracy, and its application was proposed for the screening of jaundice.[12]

As a result of advances in technology, increasingly superior and precise models of TCBs are becoming accessible over time. In light of the fact that its dependability and connection with the gold standard approach have been demonstrated successfully in a number of studies, the usage of TCB is currently widespread across the whole globe. It is a simple process that can be performed at the bedside, and it provides an instant response. This helps save time, money, and difficulties linked to pricking. In Pakistan, many varieties of TCBs are utilized across the nation's assortment of newborn care facilities. One of them is called JM-105, and it is utilized in the nursery that we have. The recording approach is straightforward, straightforward to comprehend, and extremely feasible.

According to the findings of our research, there is a substantial association between the levels of bilirubin in the serum and the results acquired by TCB (r = 0.778). Recent research conducted both domestically and internationally have yielded outcomes that are comparable to one another. According to Saeed and colleagues' findings, there is a substantial positive association between the amounts of bilirubin acquired by the two approaches.[13] After confirming that the TCB readings nomograms was accurate, Hussain and his colleagues at the Agha Khan Hospital in Karachi carried out research to adopt it.[14]

Hafeez et al[15] and Rana et al[16] demonstrated that TCB is accurate in research that was carried out in Lahore on term neonates alone. However, the results of our research demonstrated a substantial positive association between the bilirubin levels obtained using the two different methodologies in preterm infants as well. The same significant link was discovered in Cucy's study, in which the population of the study consisted solely of premature newborns.[17] As a result, the values of the TCB highly linked with serum bilirubin levels in the majority of recent research. This is because, as a result of advancements in technology, TCBs that are gradually becoming more effective are now accessible.

Even though newborn jaundice is more prevalent in preterm neonates, which is a fact that has been well proved in both the academic literature and clinical practice, the majority of our research cohort (87%) delivered at full-term. In our research, the vaginal delivery method was used for the delivery of 33 percent of the newborns who were jaundiced, while the caesarean section method was used for the delivery of 67 percent of the instances. Although research conducted in Africa found that vaginal birth was a risk factor for the development of newborn jaundice, our study did not set out to establish an association between the mode of delivery and the risk of neonatal jaundice. This ratio of modes of delivery might be merely a coincidence, and our study did not set out to find a relationship between the mode of delivery and the risk of neonatal jaundice.[18]

The traditional measurement of serum bilirubin has mostly been superseded with TCB as the method of choice in many newborn facilities. It is an option worth considering for the purpose of screening. Additional research is necessary in order to assess the efficacy of this substitution for infants who are candidates for exchange transfusion. In addition, the choice to replace may be tailored to each individual based on the degree of precision offered by the accessible equipment.

LIMITATION OF THE STUDY

The total number of the very preterm and extremely preterm neonates were not sufficient to conclude the accuracy of the TCB in that category, therefore further studies are required to target that group of patients.

CONCLUSION

In newborn jaundice, there is a strong correlation between the predicted TSB level using the traditional approach and the value of bilirubin measured using a transcutaneous bilirubinometer. The introduction of a transcutaneous bilirubinometer will reduce the need for invasive phlebotomy on premature infants and the accompanying stress on their parents. We suggest that the transcutaneous bilirubinometer be used as a screening tool to anticipate bilirubin levels, especially in preterm infants, and to guide subsequent care decisions.

Strengthening the transcutaneous bilirubinometer as a diagnostic tool will require more research with a bigger cohort of infants, as well as the estimation of TcB after phototherapy and correlation with TSB. Based on the results of this investigation, TcB levels should be utilized for screening and choosing therapeutic measures in newborns in addition to TSB values evaluated in the laboratory using established procedures.

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AUTHOR'S CONTRIBUTIONS

MS: Concept, design
AZ: Literature review, data collection,
AM: Data collection, statistical analysis
FQMH: statistical analysis, compilation
SMS: Editing and correction
NA: Compilation