COMPARISON OF SERUM BILIRUBIN ESTIMATION WITH TRANSCUTANEOUS BILIRUBINOMETRY IN NEONATES

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ABSTRACT

Objective: To assess usefulness of Minolta Airshield transcutaneous bilirubinometer by comparing bilirubin values obtained by transcutaneous jaundice meter with serum bilirubin estimation.

Design: Analytical crosssectional study.

Place and duration: NICU Military Hospital Rawalpindi Pakistan Jun 2002 to May 2005.

Subjects and Methods: One hundred and fifty neonates admitted to NICU because of visible jaundice were included in the study. Serum was sent to laboratory for total bilirubin estimation. At the same time bilirubin was also checked by a Jaundice Meter. Data was tabulated and t-test applied to compare the two values.

Results: One hundred and fifty paired estimations were performed. The transcutaneous bilirubin values ranged from 8.0 mg/dl to 20.4 mg/dl. While serum bilirubin by jaundice meter values ranged between 5.3 mg/dl and 26.0 mg/dl. A Scatter diagram was plotted. It showed a correlation coefficient of 0.78.

Conclusion: Bilirubin values obtained by transcutaneous bilirubin meter were not significantly different from laboratory values thus proving the fact that transcutaneous bilirubinometer is a useful device to measure bilirubin.

Keywords: Minolta Air Shield Jaundice meter, Neonatal jaundice, Transcutaneous bilirubinometry.

INTRODUCTION

Jaundice is one of the most common conditions found in newborn infants, around 60% in term and 80% in preterm infants and hence measurement of serum bilirubin concentration probably is the laboratory test performed most often in the newborn nursery[1,2]. A large number of admissions in the neonatal intensive care unit are due to neonatal hyperbilirubinemia with a concern that due to immaturity of blood brain barrier these infants are at a risk of developing neonatal encephalopathy[3]. Moreover hyperbilirubinemia has been named as one of the most common causes of readmission to neonatal unit for term babies[4]. Thus early recognition of hyperbilirubinemia is of cardinal significance and requires evaluation in the form of noninvasive and inexpensive screening[5]. Skin puncture collection of blood exposes a neonate to pain, trauma and risk of infection. A noninvasive device Minolta Air Shields Jaundice Meter has been shown to be useful for predicting serum bilirubin in newborns hence diminishing the need to do skin punctures[6]. It is a portable light weight instrument that uses reflectance measurements on the skin to determine the amount of yellow color present in the skin determining transcutaneous bilirubin (TcB)[5]. However early studies at the time of its manufacturing recommend that optimal use of the instrument requires the relationship between serum bilirubin concentration and the transcutaneous bilirubinometry index to be determined for each device, institution and population[7]. Keeping this fact in mind a study was designed to establish the usefulness of a jaundice meter in infants presenting to the Military Hospital Rawalpindi.

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SUBJECTS AND METHODS

This analytical cross sectional study was carried out at the Military Hospital Rawalpindi initially from Jun 2002 to Jan 2003 and subsequently from Jan 2005 to May 2005. One hundred and fifty neonates (n=150) between 0 and 14 days, suffering from visible jaundice and admitted in the neonatal intensive care unit of

the Military Hospital Rawalpindi were included. Infants with age more than 14 days, low birth weight neonates with weight less than 2500 gm, neonates previously exposed to phototherapy, neonates who have had exchange transfusion and pre-term neonates less than thirty seven weeks of gestational age were excluded from the study. Transcutaneous bilirubin measurements were taken by application of Minolta Air Shield Jaundice Meter JM 102 to the forehead of infants. Three such readings were taken and the average value recorded on the data form. Blood samples were obtained from a peripheral vein under strict aseptic conditions within thirty minutes of transcutaneous bilirubin measurements. The sample was appropriately labeled and transported to the Chemical Pathology Department of Army Medical College Rawalpindi Laboratories.

Serum bilirubin was estimated by a vitalab selectra 2 Merck (Germany) analyzer. It is a fully automated random access chemistry analyzer with a throughput of 180 tests per hour. Total serum bilirubin was analyzed using Merckotest kit (Germany) No.1.14364.001 based on DPD (dichlorophenyldiazonium) method at a wavelength of 546nm against sample blank. To certify the validity of results Human diagnostic (Germany) controls were run along with the patient's samples. Normal controls were used as Humatrol N lot No. N/018 and elevated controls were used as Humatrol P lot No. P/016 (Diagnostica- MERCK, Germany).

Data was analyzed on SPSS – 10. Descriptive statistics were used to interpret the data. Independent samples t-test was applied to compare bilirubin through both methods. Correlation coefficient was calculated between the bilirubin values obtained from serum and transcutaneously. A p value <0.05 was considered as significant.

RESULTS

A total of one hundred and fifty paired estimations were performed. The transcutaneous bilirubin values ranged from 8.0 mg/dl to 20.4 mg/dl, the mean being 13.14 mg/dl (SD = 4.109). Similarly serum samples sent to laboratory for bilirubin estimation revealed bilirubin value between 5.3 mg/dl and 26.0 mg/dl with a mean of 13.18 mg/dl (SD = 2.83). A T-test was applied to compare the two values (Table 1 & 2).

A Scatter diagram of transcutaneous bilirubin values and laboratory bilirubin was plotted. It showed good correlation between the two values with a correlation coefficient of 0.731 (r =0.731) (Figure).

Table-1: Description of Serum Bilirubin by two methods (n=150)

T- Test

Pair	Mean	SD	Std. Error deviation
Manual (lab) serum Bilirubin	13.145	4.109	.336
Transcutaneous bilirubin	13.185	2.839	.232

Table-2 Paired Samples Correlations

Pair	Correlation	Sig.
Manual (lab) serum bilirubin & Transcutaneous bilirubin	.731	.000

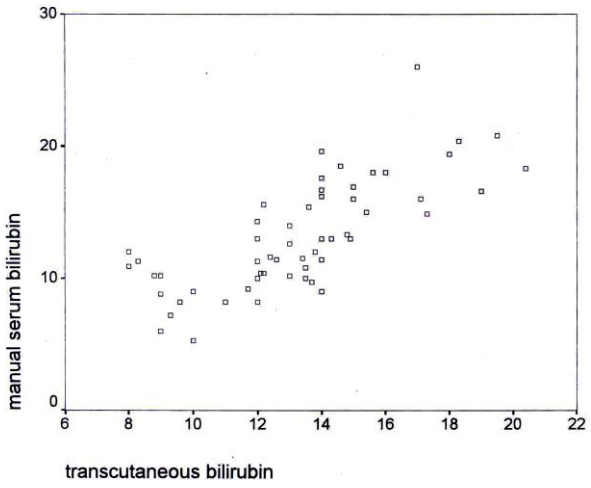

Fig 1 Scatter plot showing comparison between transcutaneous bilirubinometery and laboratory serum bilirubin estimantion

DISCUSSION

Neonatal jaundice is an important clinical entity confronting today's neonatologist. It contributes to a major share of admissions in the neonatal intensive care units. In 1994 and subsequently in 2004 the Provisional Committee on hyperbilirubinemia of American Academy of Pediatrics (AAP) published a "practice parameter" and developed an algorithm dealing with the evaluation and treatment of hyperbilirubinemia in healthy term newborns[7-9]. The AAP algorithm begins with the evaluation of a term newborn with jaundice and subsequently recommends measurement of the infant's total serum level if the jaundice appears to be "clinically significant" by a medical judgment. The problem with this recommendation is that the ability of clinicians to diagnose "clinically significant" jaundice varies widely[10,11]. Some studies suggest that the ability of physicians and nurses to estimate serum bilirubin levels clinically is no better than guesswork[9], whereas others have shown that newborns whose TSB levels exceed 12 mg/dl will, at least, always be identified as "jaundiced"[8]. Noninvasive (transcutaneous) devices for estimating serum bilirubin provide substantially greater accuracy than visual assessment[12]. Trancutaneous bilirubin measuring devices have been used throughout the world for quite a long time for estimation of significant hyperbilirubinemia[13]. Use of similar instruments is still not widely prevalent in Pakistan and Paediatricians frequently rely on invasive methods of bilirubin measurements. Repeated sampling is unduly expensive for a majority of our population and poses the risk of trauma and infection to a newborn.

A transcutaneous bilirubinometer named as Minolta Air shield Jaundice meter JM102 invented in Japan in collaboration with the Minolta camera Company Ltd[14]. Over years it has been found that transcutaneous bilirubin meter exhibits a high degree of correlation with serum bilirubin levels and can be used for screening newborns with visible jaundice[15]. The use of the jaundice meter JM102 is relatively simple. When meter is switched on the reset button is supposed to be pressed. This leads to the illumination of the "ready" lamp indicating that the instrument is now ready for obtaining readings. The protoprobe is then placed on the neonatal forehead and gently pressed against the skin surface. An audible click occurs and at the same time the digital display window indicates the total bilirubin concentration[11].

It has been recommended that forehead is the site of choice for transcutaneous bilirubin measurements because it is usually accessible, skin surface of forehead is taut and firm and the frontal bone structure offers the necessary resistance to activate the xenon tube mechanism. However in situation where forehead cannot be used as an effective site of measurement other body sites that can be used with the dependable accuracy are right upper chest, middle sternum, upper and the lower back[11].

A preliminary report from the department of Paediatrics of Agha Khan University Karachi clearly states the need for an extensive analysis of transcutaneous bilirubinometry before validating its widespread use in our neonatal intensive care units[16,17]. Bhutta et al compared the efficacy of transcutaneous bilirubinometry in 65 Pakistani jaundiced newborns undergoing simultaneous bilirubin measurements. Comparative results showed a fairly wide scatter, whereas our study shows a good correlation (correlation coefficient of 0.73) and a narrow scatter plot between bilirubin values obtained by Air Shield Jaundice Meter and those yielded from serum samples received from laboratory. This difference is due to an increase in the number of subjects included in the study[14].

Likewise, Laeeq et al[18] from King Edward College Lahore, carried out a similar research on 105 healthy full term jaundiced neonates. Their results revealed a good correlation between transcutaneous and bilirubin values with a coefficient of correlation 0.77 as compared to our value of 0.73. Hence both studies show good correlation indicating transcutaneous bilirubin meter as a useful

device for measurement of bilirubin in Pakistani population.

Karrar[19] and his associates from the department of Paediatrics, King Saud University, Riyadh, Saudi Arabia have performed a total of 155 transcutaneous bilirubin measurements on full term Saudi newborns with jaundice using Minolta Air Shield Jaundice meter applied to forehead. Serum Bilirubin was taken as control. Results indicated a correlation coefficient of 0.817.

Dai et al[20] in his study carried out at the St Boniface Hospital in Canada, concluded that transcutaneous bilirubin meter is a useful device for screening neonates to determine when the laboratory measurement of serum bilirubin is required. Such a practice would require a careful decision so that false negative values do not prevent appropriate serum bilirubin test from being done.

At the William Beaumont Hospital, the routine use of a Minolta Air Shields Jaundice Meter in their nursery produced a 36% reduction in the number of serum bilirubin measurements obtained and, in a hospital delivering 5000 infants annually, is estimated to save $1,600 per year[21]. We were unable to get the quote for the device but some research into pricing revealed that new bilicheck device costs around 4000 US dollars while a refurbished one would be available around 1000 US dollars.

Bilgen et al[22] compared transcutaneous bilirubin readings by using a bilirubinometer to serum bilirubin, and both reported strong evidence of a linear correlation (r _0.83 and 0.91, respectively)[22].

Samar et al[23] in a recently published mini review have pointed out that total serum bilirubin should be measured by a clinical laboratory if a newborn is shown to be at higher risk for clinically significant hyperbilirubinemia. In addition, external quality assessment to identify biases and operator training issues should be part of any TcB monitoring program.

Most studies are in agreement to the fact that the transcutaneous bilirubin values obtained from low birth weight infants, preterm babies, and those under going phototherapy or exchange transfusion do not correlate with serum bilirubin value very well. In this regard we were unable to study these parameters and hence remain a subject of further research.

However, in the end, in light of our results we would like to emphasize that Air Shield Jaundice meter is a good screening device for the measurement of bilirubin values but should not be used in deciding whether the neonate should be subjected to exchange transfusion. This can only be done after an extensive use of this device.

CONCLUSIONS

Minolta Air Shield jaundice meter is a good screening device for measurement of bilirubin. A good correlation (coefficient of correlation 0.73) was found between transcutaneous and serum bilirubin values. Its use in neonatal intensive care units in Pakistan would avoid repeated blood sampling.

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