TRANSCUTANEOUS BILIRUBINOMETRY IN PAKISTANI NEWBORNS: A PRELIMINARY REPORT

Pages with reference to book, From 155 To 156

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ABSTRACT

Neonatal hyperbilirubinemia is a frequently encountered problem in the neonatal period and carries a potential risk of encephalopathy. Early detection and quantification is important, and transcutaneous bilirubinometry (TcB) has been recommended as a non-invasive method for rapid screening. We prospectively compared the efficacy of TcB in 65 normal Pakistani jaundiced newborns undergoing simultaneous serum bilirubin measurements. Although the correlation between the two methods was significant ($r=0.66$, $P<0.01$), the scatter was wide and the specificity only 53%. Although the technique offers the potential for non-invasive early screening of neonatal hyperbilirubinemia, it requires further validation in a larger study in our population (JPMA 41: 155, 1991).

INTRODUCTION

Neonatal hyperbilirubinemia is a common clinical problem encountered in the neonatal period in Pakistan[1]. Although the vast majority of jaundiced newborns have physiological jaundice requiring little or no intervention, a distressingly large number are admitted to neonatal nurseries with pathological hyperbilirubinemia and present with established kernicterus[2]. Although, delayed clinical recognition and late referrals are significant factors, another important consideration is the lack of resources for prompt and repeated bilirubin estimations in every case. It has been estimated that some 43% of all jaundiced newborns have at least one serum bilirubin determination[3]. There is therefore considerable interest in the development of a quick, non-invasive and cost-effective method for screening jaundiced newborns. The relationship between dermal icterus and serum bilirubin concentration has intrigued physicians for some time. The close association between rising serum bilirubin concentration and the spread of dermal icterus has been well described[4]. Gosset devised an icterometer in 1960 which utilised transparent yellow strips for comparison against the newborn infants' skin colour[5]. However, in view of the interobserver variability, the search for a more objective screening method continued. It was noted that the spectral reflectance of the newborn's skin correlated stronglywith serum bilirubin[6], and utilising this information, Yamanouchi et al demonstrated the successful use of a rechargeable portable, hand-held bilirubinometer in estimating the degree of hyperbilirubinemia in Japanese full-term infants[7]. Since their initial description, the technique of transcutaneous bilirubinometry (TcB) has been validated in different races including Chinese[8], Mala[9] and White[10] infants. However, there are concerns about the validity of the technique in other pigmented populations including Black[11] and Saudi[12] newborns. There are no reports to date, of the use of transcutaneous bilirubinometry in Pakistani newborn children.

PATIENTS AND METHODS

The study was carried out in the newborn nursery of the Aga Khan University Hospital at Karachi. We prospectively evaluated TcB in all consecutive newborn babies undergoing routine blood sampling for evaluation of hyperbilirubinemia. The birth weight and postnatal age of all infants was recorded and

gestational age assessed by the technique of Dubowitz et al[13]. At the time of blood sampling for bilirubin assessment, three consecutive reflectance readings were obtained using the hand-held bilirubinometer (Minolta/Air-Shields Jaundice meter 101, Honeywell, Pennsylvania, USA) applied the forehead as per the operating instructions[14]. The mean of three consecutive readings was used as the TcB Index. Serum bilirubin was measured on an autoanalyser (Astra, Beckman Instruments Inc., California) using the modified Jendraasik-Grof method[15], within 2 hours of collection. All babies were nursed in open bassinets during this period and none were receiving phototherapy. A total of 100 consecutive readings and simultaneous serum bilirubin measurements were obtained. The correlation coefficient, regression equation, sensitivity and specificity of the test were estimated by standard techniques[16].

RESULTS

A total of 63 consecutive newborn infants were studied. Of these53 (84%) were term infants. The mean birth weight and gestational age of these infants was 2985 g (95% confidence intervals 2920-3050 g) and 39.1 weeks (38.9-39.4 weeks) respectively. There were 10 stable preterm infants with a mean birth weight and gestational age (95% confidence intervals) of 2298 g (1847-2750 g) and 35.3 weeks (34.4-36.2 weeks) respectively, who were studied prior to the institution of phototherapy. The mean serum bilirubin was 12.0 mg/dl (11.3-12.6 mg/dl, 95% confidence intervals).

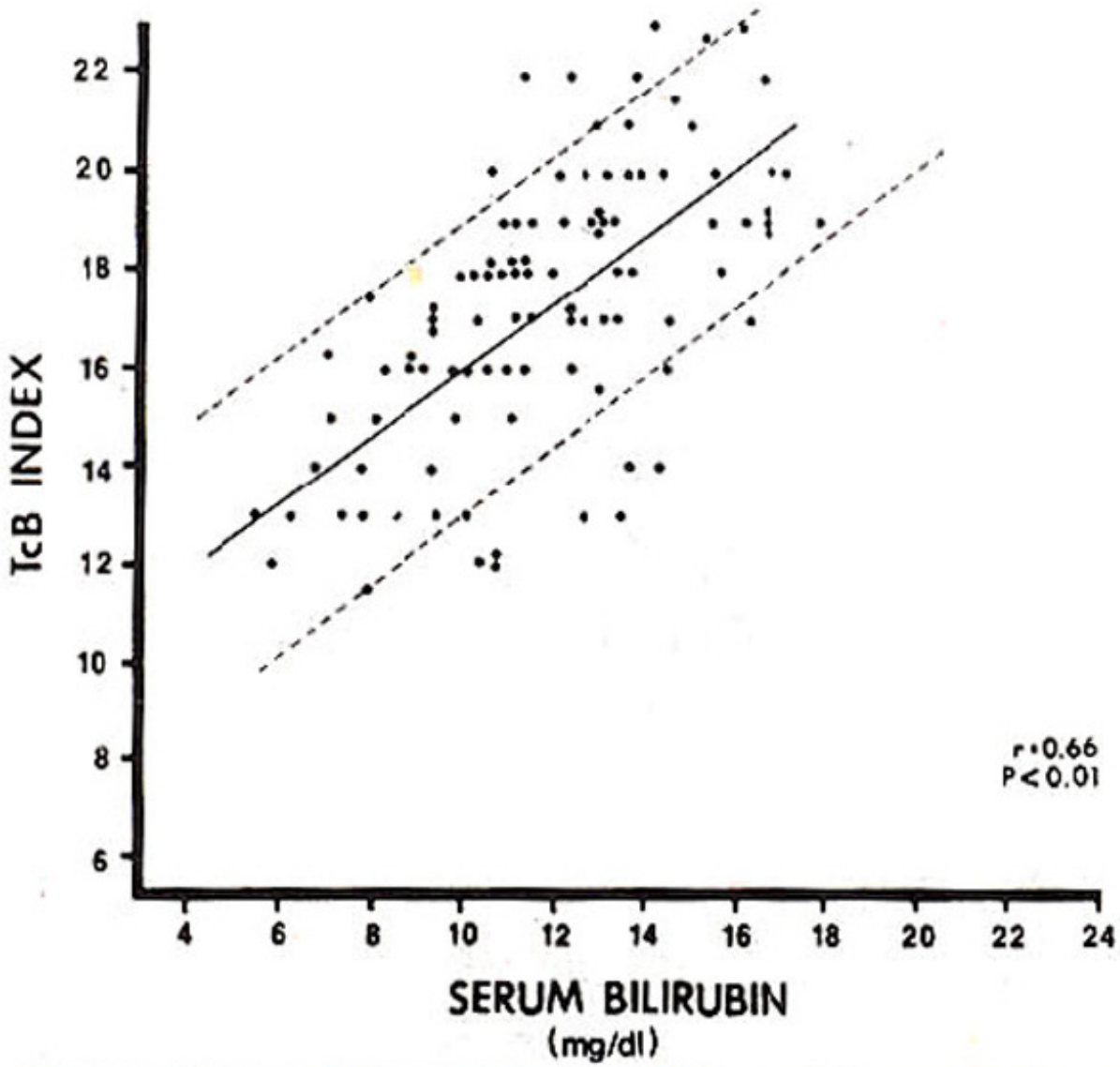

Figure. Correlation of serum bilirubin with TcB Index. y = 0.46 + 0.68 x, r = 0.66. The hatched lines represent SEyx.

The figure shows the correlation between TcB index and corresponding serum bilirubin values. The regression equation and correlation coefficient were y=O.46+O.68 x, r=O.66 (P < 0.01). However, there was a wide scatter of values. The correlation between TcB index and serum biirubin was stronger in the preterm infants (r=O.84). The TcB index at a serum bilirubin level of 12.5 mg/dl was 17. We estimated the accuracy of TcB in predicting hyperbilirubinemia at or in excess of this level and the results are shown in the Table.

TABLE. Accuracy of TcB in predicting newborns with serum bilirubin ≥12.5 mg/dl.

	Serum bilirubin (mg / dl)		
TcB Index	>12.5	<12.5	Total
> 17	35	28*	63
< 17	5**	32	37
Total	40	60	100

* = False positive

** = False negative

The sensitivity and specificity of TcB in our patient was 88% and 53% respectively. The corresponding predictive values were 56% and 87% respectively.

DISCUSSION

Although our preliminary results do show some correlation between TcB values and serum bilirubin values, the wide scatter of values and poor specificity underscores the limitations of this technique in our population. The correlation at higher values of serum bilirubin seemed stronger but there were very few values in this range, and further data would be needed before drawing any firm conclusions. Our data is however, suggestive of a stronger correlation between TcB and serum bilirubin value in preterm infants. It is possible that this may be due to the thinner skin and pigmentary immaturity in preterm infants. Although other workers have found significant correlations of TcB in premature infants[17] , the wide variation or regression coefficients on individual days limits the usefulness of the technique. Some of the wide scatter of values in our population may be related to the wide variability of pigmentation between newborn babies. It has been suggested that the incorporation of a correction factor for background signal may improve the reliability of TcB in black infants[18]. However, the process and calculations are onerous and greatly limits the usefulness of TcB measurements. In general, clinical evaluation of jaundice is difficult in pigmented individuals and our preliminary findings of the limitations of TcB in similar circumstances therefore suggests serious limitations of its usefulness as a screening tool. In addition, the necessity of drawing regression equations for individual institutions makes the technique impractical for use in a field setting. Recently, Narayanan et al[19] have revalidated the inexpensive perspex icterometer" for screening and estimation of jaundice in Indian newborn infants. The instrument was found to be a useful screening tool and offers considerable hope for use by primary care health workers. Before TcB can be recommended for screening purposes in our newborn population, it would require further validation in a larger sample in comparison with inexpensive visual screening methods.

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