BiliCheck transcutaneous bilirubinometer: a screening tool for neonatal jaundice in the Chinese population

BiliCheck經皮膽紅素計：一種篩檢華人新生兒黃疸的工具

Objective. To verify the usefulness of the BiliCheck transcutaneous bilirubinometer as a screening device for neonatal jaundice in a Chinese population compared with the Minolta Airshields JM 102.

Design. A prospective correlation study that compared transcutaneous bilirubin measurements with serum bilirubin levels.

Setting. Obstetric ward and a neonatal unit of a regional hospital in Hong Kong.

Patients. Neonates with gestation above 32 weeks with neonatal jaundice who were admitted between April 2001 and February 2002.

Main outcome measures. Transcutaneous measurements of serum bilirubin obtained from the forehead and the sternum with two instruments: BiliCheck and Minolta Airshields JM 102.

Results. A total of 77 term and six near-term babies (gestation, 32-37 weeks) were recruited. The mean age at the time of data collection was 3.96 days (range, 2-9 days). The correlations between serum bilirubin and transcutaneous bilirubin measurements of the two devices at the two sites were high, with a coefficient of 0.718 (95% confidence interval, 0.610-0.800; n=100) for forehead measurements, and 0.814 (95% confidence interval, 0.740-0.870; n=99) for sternum using the Minolta Airshields JM 102; and a coefficient of 0.757 (95% confidence interval, 0.657-0.827; n=98) for forehead measurements, and 0.794 (95% confidence interval, 0.700-0.862; n=92) for sternum using the BiliCheck. For BiliCheck, a cut-off point of 250 μmol/L at the forehead and 260 μmol/L at the sternum had a specificity of 61.9% and 70.0%, respectively with a sensitivity of 100% for the detection of serum bilirubin concentrations of 250 μmol/L or higher. This level is commonly used as the level for initiation of treatment such as phototherapy.

Conclusion. BiliCheck is a useful screening tool for neonatal jaundice in the Chinese population and is comparable with the Minolta Airshields JM 102.

Key words: Bilirubin/blood; Comparative study; Infant, newborn; Jaundice, neonatal; Neonatal screening

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Introduction

BiliCheck (SpectRx, Inc, Norcross [GA], US) has been available for 5 years and offers an alternative means to the Minolta Airshields JM 102 (Hill-Rom Air Shields, Ashby de la Zouch, UK) of transcutaneous measurement of bilirubin. Its usefulness as a screening test for neonatal jaundice has been well tested in various groups of patients: term or near-term babies,1–4 preterm babies,5,6 sick babies7 in neonatal intensive care units, and in multi-racial populations.8,9 The results of previous studies all confirm a good correlation between transcutaneous bilirubin (TcB) and serum bilirubin levels with reasonable sensitivity and specificity.

The ability of BiliCheck to distinguish, by means of spectral subtraction theory, the light absorption of bilirubin from that of other factors such as haemoglobin and melanin enables unbiased measurement independent of race, age, and weight of newborns.10 In practice there are nonetheless some exceptions. The correlation between TcB and serum bilirubin level becomes progressively poor in babies younger than 30 weeks and in those who have received phototherapy.6 Hence, it remains important to test whether the basic assumption of its accuracy, regardless of numerous variables, is true. To date, all studies have been based on principally Caucasian populations. In two studies with higher proportions of Asians, they still comprised only 13% to 15% of the study samples.8,9 The aim of this study was to verify usefulness of BiliCheck in a Chinese population and compare it with the older Minolta Airshields JM 102.

Methods

This was a prospective study on term and near-term babies with gestation above 32 weeks admitted to our unit between April 2001 and February 2002. The study was conducted in our hospital with an obstetric unit that delivers 3000 to 4000 babies each year. The babies were recruited from the postnatal ward or neonatal ward if they were principally Caucasian populations. In two studies with higher proportions of Asians, they still comprised only 13% to 15% of the study samples.8,9 The aim of this study was to verify usefulness of BiliCheck in a Chinese population and compare it with the older Minolta Airshields JM 102.

The TcB was taken on the forehead and the sternum with the TcB. The correlations between serum bilirubin and TcB were highly positive and significant at the level of 0.01 (2-tailed). Serum bilirubin had higher correlations with TcB at the sternum than at the forehead. Among all, the highest correlation coefficient was obtained for TcB at the sternum using the Minolta Jaundice Meter. The scatterplots of the relationship between serum bilirubin concentration and TcB
In term and near-term babies with physiological jaundice, serum bilirubin concentration at the level of 250 µmol/L or above was a commonly used indicator for initiation of treatment such as phototherapy. This level was used to determine the sensitivity and specificity of the two devices. Because of the potential risk of hyperbilirubinaemia in newborn babies, a lower specificity was accepted to achieve a sensitivity of 100% to ensure all cases were detected. For Minolta Airshields JM 102, a cut-off point of 20 at the forehead and 21 at the sternum produced a specificity of 50% and 78%, respectively with a sensitivity of 100%. For BiliCheck, a cut-off point of 250 µmol/L at the forehead and 260 µmol/L at the sternum produced a specificity of 61.9% and 70.0%, respectively with a sensitivity of 100%.

A graphical presentation using the receiver operating characteristics (ROC) curves was constructed to compare the two devices (Fig 2). The TcB taken at the sternum using the Minolta Airshields JM 102 produced the best ROC curve (area under the curve was 0.881 at cut-off point of TcB >21). The second best was produced by TcB at the sternum using the BiliCheck (area under the curve was 0.845 at cut-off point of TcB >260 µmol/L). The values of area under the curve using the BiliCheck and the Minolta Airshields JM 102 at the forehead were 0.81 and 0.75, respectively.
Discussion

BiliCheck has the theoretical advantage of isolating the light absorption of bilirubin from that of other factors such as haemoglobin or melanin. This is achieved by spectral subtraction and thus generates TcB independent of factors such as race, age, and weight of newborns. Previous studies have confirmed that TcB derived from BiliCheck is not affected by haemoglobin level, gestational age, or ethnicity. This is the first study of the use of BiliCheck in an entirely Asian, in this study, entirely Chinese population. We confirmed that in a Chinese population, the correlation of TcB derived from BiliCheck with serum bilirubin were 0.757 and 0.794 at the forehead and sternum, respectively. For BiliCheck, a cut-off point of 250 µmol/L at the forehead and 260 µmol/L at the sternum produced a specificity of 61.9% and 70.0%, respectively with a sensitivity of 100%. These figures were comparable with those found in a white population.

Another characteristic of our studied population is that TcB was taken later in life (3.96 days; range, 2-9 days). This reflects the later development of jaundice in Chinese babies compared with Caucasians.

The differences among the ROC curves of measurements taken at the forehead and the sternum using BiliCheck and Minolta Airshields JM 102 are small. In concordance with the results of previous studies, we conclude that BiliCheck and Minolta Airshields JM 102 are useful screening tools for neonatal jaundice in Chinese term and near-term babies. The newer BiliCheck device is not superior to the older Minolta device.

Declaration

No conflicts of interest were declared by the authors.

References