Initial Assessment of Jaundice in otherwise Healthy Infants - A Comparison of Methods in Two Postnatal Units

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Abstract
Transcutaneous bilirubin (TcB) has the potential to reduce total serum bilirubin (TSB) sampling. The principal aim of this study was to determine and compare the number of initial TSB samples (TSBs) in two postnatal units (hospitals A & B) whereby hospital A used TcB and hospital B did not. A secondary aim was to determine the clinical factors that led to initial TSBs exceeding exchange transfusion level in both hospitals. Results demonstrated both hospitals had similar populations and patient numbers following selection criteria. 1645 neonates (10.4%) had one or more TSBs performed in hospital A, versus 2373 neonates (15.1%) in hospital B (p < 0.01). Fourteen neonates in hospital A and 3 neonates in hospital B had initial TSBs above exchange transfusion level. For neonates with TSBs above exchange, preventable factors related to earlier testing and follow up. In routine clinical practice, TcB is associated with a significantly reduced number of TSB measurements. TSB levels above exchange transfusion are linked to preventable factors, in otherwise healthy neonates.

Introduction
The use of transcutaneous bilirubin (TcB) has become an attractive method of estimating serum bilirubin in the evaluation of neonatal jaundice. TcB is immediate and non-invasive but has limited accuracy when correlated to total serum bilirubin (TSB). Various TcB devices have been evaluated in term and preterm neonates of varying ethnicities. The vast majority of studies involve small patient numbers and report potential reduction in TSB sampling ranging from circa 34% (n = 303) to 55% (n = 300). There are limited reports describing the use of TSB in routine clinical practice in relation to potential reduction of TSB sampling over time. The primary aim of our study therefore was to compare the number of serum bilirubin measurements in a hospital which uses TcB in the routine evaluation of jaundiced neonates, versus a hospital which does not.

Methods
This was a retrospective study comparing two postnatal units (hospitals A and B) located in Dublin, Ireland over a two year period (2007-2008). We determined the total number of initial TSB measurements performed in otherwise healthy neonates at or above (³) 36 weeks gestation in both hospitals. Testing and follow up of jaundiced neonates in both hospital guidelines were based on the current AAP, 2004 guidelines on the management of neonatal jaundice. In hospital A jaundice was assessed clinically, followed by TcB testing with the Jaundice Meter JM-103fi. The limits of this device had been determined with a cut-off value of 200 µmol/L, above which a venous TSB was performed. In hospital B jaundice was assessed clinically followed by heel-prick or venous TSB testing if required. TcB was not used in hospital B.

To achieve a similar cohort of patients, the following selection criteria were applied to each hospital. Inclusion criteria: (1) All neonates e2500 grams (g) and e36 weeks gestation. (2) All neonates inborn who had TSB measurements performed between 12 to 144 hours of life. These neonates were on the postnatal wards or attending outpatient clinics managed exclusively by each individual hospital service. (3) Only the initial TSB of each neonate was included, as we sought to compare the initial assessment prior to commencement of phototherapy. Exclusion criteria: (1) All neonates who were admitted to the neonatal intensive care or high dependency units for a diagnosis other than jaundice. (2) Neonates whose mothers were Rhesus negative or known to have atypical antibodies (who may have had cord Coombs testing performed).

Following selection criteria, the number of initial TSBs of both hospitals were compared. As part of a secondary analysis, higher TSBs above the exchange transfusion level in both neonatal cohorts studied.

Secondly, guidelines regarding neonatal jaundice as published by the American Academy of Pediatrics (AAP, 2004) and Canadian Paediatric Society (CPS, 2007) aim to identify, evaluate, treat and follow up all term and near-term neonates at risk of severe hyperbilirubinaemia. This systematic approach reduces the prevalence of severe hyperbilirubinaemia and related adverse events. Practices however, vary in the assessment and treatment of neonatal jaundice and since cases of severe hyperbilirubinaemia continue to occur, it is possible that those guidelines are not used efficiently. Therefore, a secondary aim of our study was to investigate the factors that resulted in any initial TSBs above the exchange transfusion level in both neonatal cohorts studied.
classified on the exchange transfusion nomogram according to risk and neonates above exchange had their case notes examined to determine any potential preventable or contributory factors. Statistical analysis was carried out using SPSS v15.0. Pearson Chi-Square was used to compare the number of initial TSBs in both hospitals. Mean TSBs were compared between hospitals using an Independent Sample t-test and the mean age of first TSB sampling using the Mann Whitney U test. A p value < 0.05 was chosen as statistically significant.

Results

Number of Serum Bilirubins

The birth rates and demographic populations for both hospitals were similar as were the total number of neonates e36 weeks and e2500g. Slightly more neonates were excluded in hospital B following selection criteria yet a total of 2373 neonates had one or more TSBs performed, versus 1645 neonates in hospital A. This results in a difference of 728 serum samples (p < 0.05) which is a 31% reduction where TcB was used. The demographic variables and the total number of neonates with one or more TSB in each hospital are outlined in Table 1.

High Serum Bilirubins

Our secondary aim of identifying neonates with initial TSBs above the potential exchange transfusion level identified 14 neonates for hospital A and 3 neonates for hospital B. We applied the AAP guidelines during a critique of these 17 neonates similar to a “root cause” analysis. Seven neonates presented following discharge from hospital. The potentially preventable factors in these 7 neonates included 5 who did not have either TcB or TSB performed before discharge and in 2 neonates poor recognition of risk factors (for severe hyperbilirubinaemia) and delayed follow-up occurred. Of those remaining neonates who presented in hospital (n = 10) potentially preventable factors appeared to be earlier detection of jaundice and actual bilirubin determination within the first 24 and 48 hours of life.

Six neonates had TSBs above the critical level of 425 µmol/L. Five of these presented following hospital discharge. Similarly, we determined that bilirubin testing and earlier follow up could have been preventive. For all 17 neonates other contributory risk factors for severe hyperbilirubinaemia were often present although bruising, cephalhaematoma and family history of jaundice did not appear to be documented frequently in these cases. For neonates above the critical TSB level of 425 µmol/L, contributory and preventable factors are individualized in Table 2. For neonates below 425 µmol/L (but above exchange level) the contributory and preventable factors are grouped in Table 3. For all neonates described except one, the initial TSB was the peak TSB. This neonate had an initial TSB of 344 µmol/L at 48 hours with a rebound of 463 µmol/L at 144 hours due to delay in follow-up testing following phototherapy.

Discussion

Although TcB measurement is an immediate, non-painful method of screening jaundiced neonates there is little data comparing hospitals in relation to the amount of TSB sampling that could be prevented. This was a relatively large inter-hospital study comparing a postnatal unit which uses TcB to a similar unit which does not use TcB when evaluating neonatal jaundice. We observed where TcB was used there were significantly less TSB samples performed to the extent that introduction of TcB in hospital B could reduce TSB samples by about one third. Thus, in contrast to the many smaller correlation studies examining TcB, our findings suggest that TcB significantly reduces TSB testing in routine clinical practice. Given the high prevalence of jaundice, such a reduction provides patient benefit by reducing pain and stress associated with needle-sticks, and reduces laboratory costs.13 Furthermore we carried out a recent survey determining the use of TcB in Irish postnatal units, and noted that only 53% of the 19 units surveyed were using TcB. Therefore there is further potential to reduce the number of needlestick serum bilirubins in Irish postnatal units.

A secondary aim of our study was to identify initial TSB samples above exchange transfusion and evaluate these cases in both hospitals. In doing
so, we determined clear-cut preventable factors in a population of otherwise well neonates. Such preventable factors related to detecting but predominantly earlier testing and follow up of jaundiced neonates. Our analysis did not identify failure or fault while using TcB within its cut off value of 200 µmol/L. An interesting finding in our study was that hospital A had a higher mean TSB and rate of TSBs above exchange transfusion. The higher mean TSB could be explained by TcB use which leads to deferral of TSB testing until the appropriate TcB cut-off value is reached. The higher rate of TSBs above exchange transfusion level is difficult to explain. Apart from TcB usage, the main difference between the two hospitals was bilirubin testing performed predominantly by the attending midwives in hospital B versus the attending medical practitioners in hospital A. Data suggests that when nurses/midwives obtain a bilirubin for suspicion of jaundice without physician direction, the risk of severe hyperbilirubinemia may be reduced. Although an interesting hypotheses, our study was not specifically designed to answer this question and because it was retrospective, other confounding factors could exist.

In summary, our findings suggest that TcB significantly reduces TSB testing in routine clinical practice. Additionally, TSB levels above recommended exchange transfusion levels often arise from poor recognition of potentially preventable factors regarding detection, testing and follow up of otherwise healthy newborns.

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