



Evaluation of Transcutaneous Bilirubinometry (TcB) in the First Hours of Life to Predict Subsequent Invasive Bilirubin Testing during the Birth Hospitalization

Meghan Saumur, Vinita Chandwani, Greg Jackson, William D. Engle

Dept. of Pediatrics, University of Texas Southwestern Medical Center, Dallas, TX



ABSTRACT

Evaluation of Early Transcutaneous Bilirubinometry (ETcB) to Predict Subsequent Hyperbilirubinemia– Meghan E. Saumur, Gregory L. Jackson, William D. Engle

Background: TcB is well-established for non-invasive monitoring of trends in neonatal bilirubin values. It is not known whether an ETcB value will assist in (a) predicting subsequent TcB values, or (b) the need for treatment of hyperbilirubinemia.

Objective: To determine whether an ETcB value alone – or used to calculate a rate of rise (ROR) in TcB – will identify those neonates who are at higher risk for subsequent jaundice, with or without a need for phototherapy (PHT).

Design/Methods: ETcB values were obtained (utilizing the JM-103™) within 6h of delivery from a convenience sample of neonates admitted to the Parkland Memorial Hospital Newborn Nursery. ROR was calculated as the average hourly increase between ETcB and subsequent TcB obtained at 18-36h of age. TcB percentile values were obtained from a previously published nomogram developed at Parkland. The predictive values relating (a) ETcB alone and ROR to subsequent TcB values, and (b) need for PHT, were determined using selected ETcB and ROR cutoff values.

Results: 516 study neonates had a mean birth weight of 3401±468 grams and gestational age of 39±1.4 weeks; 83% were Hispanic, and 53% were male. ETcB mean±SD was 1.1±1.0 mg/dL (median 0.9 mg/dL, range 0-5.7 mg/dL). For those neonates who subsequently received PHT (n=16), ETcB mean±SD was 2.2±1.6 mg/dL (median 1.7 mg/dL, range 0.3-5.7 mg/dL); p=0.002 vs no PHT. Correlations between ETcB and TcB values at 24h, 36h, and 48h were r=0.31, 0.40, and 0.32 respectively (all p values <0.001). Predictive indices are shown in the Table.

TcB >95th percentile at 42-66 hours*					
	Sens	Spec	PPV	NPV	p ^ψ
ETcB [‡] cutoff values					
≥ 0.80	0.87	0.50	0.16	0.97	0.0007
≥ 0.90	0.78	0.57	0.16	0.96	0.002
ROR [§] cutoff values					
≥ 0.11	1.00	0.13	0.11	1.00	0.09
≥ 0.18	0.83	0.48	0.15	0.96	0.007
≥ 0.25	0.52	0.88	0.31	0.95	0.00003

*evaluated using local Hispanic TcB nomogram; ^ψChi square
[‡]mg/dL for ETcB; [§]mg/dL per hour for ROR

As shown in the Table, the NPV was always ≥0.95 when using ETcB or ROR as the predictor variable for subsequent TcB >95th %ile. Furthermore, for neonates with ROR ≥0.25, 79% had TcB >75th %ile at 42-66h (vs 32% with ROR <0.25; p<0.001). Of those neonates who subsequently were treated with PHT, the ROR was ≥0.30 mg/dL in 63%.

Conclusions: ETcB appears to be higher in those neonates who subsequently require PHT. Its primary usefulness, however, may be its ability to identify those neonates at low risk of subsequent hyperbilirubinemia.

BACKGROUND

- Transcutaneous bilirubinometry (TcB) is well-established for monitoring neonatal bilirubin levels non-invasively .
- TcB determinations are performed using a handheld device (see Figure 1) that sends and receives light to and from the skin.
- With an algorithm that corrects for factors such as hemoglobin and skin pigments, an estimate of tissue bilirubin (a proxy for serum bilirubin) is registered on the device display .
- At Parkland Memorial Hospital Newborn Nursery, our routine is to obtain daily TcB values on all newborns. In addition, beginning in April 2011, a TcB determination has been obtained within 6h after birth (“early TcB,” ETcB).
- Total serum bilirubin (TSB) determination is not routine, and is ordered when TcB values are of concern and/or a neonate appears to have significant jaundice. It is not known whether an ETcB value – before the onset of clinical jaundice – will predict the subsequent need for additional TSB determination(s), or subsequent phototherapy.



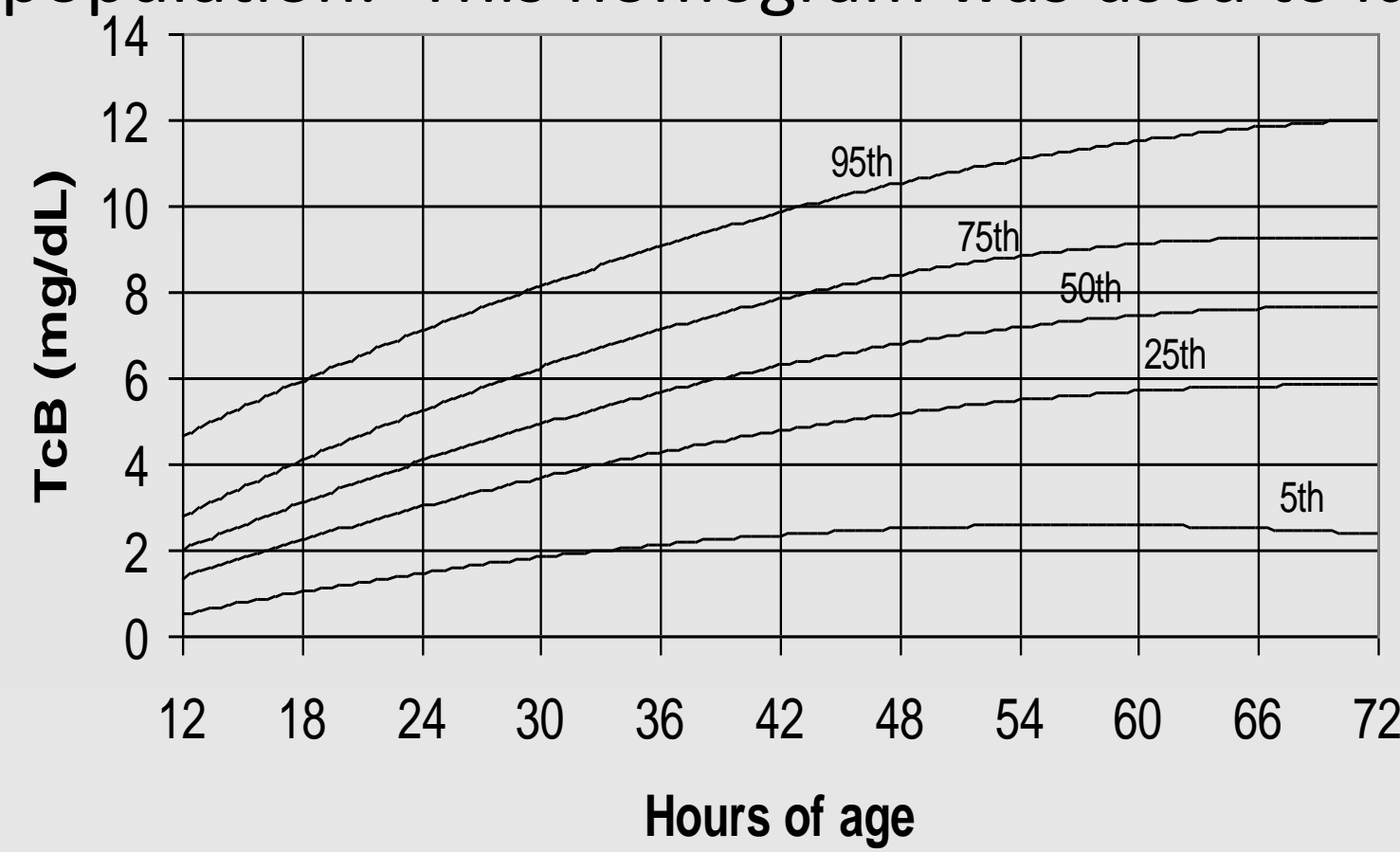
Figure 1

OBJECTIVES

- To determine whether an **ETcB value** will identify those neonates who are at higher risk for subsequent hyperbilirubinemia and/or treatment with phototherapy
- To determine whether the **rate of rise** between ETcB and later TcB values would predict subsequent hyperbilirubinemia and/or treatment with phototherapy

MATERIALS AND METHODS

- Neonates are eligible for admission to the Newborn Nursery (NBN) at Parkland Memorial Hospital if they are ≥2100 grams, ≥35 weeks gestation, and stable with no major abnormalities in the Delivery Room.
- Since April 2009, all NBN neonates have been screened with daily TcB determinations utilizing the Dräger JM-103™. Beginning in April 2011, all NBN neonates were additionally screened with a TcB value within 6 hours of delivery.
- Data collected from the EMR included demographic information, early TcB value, subsequent TcB values, TSB values (if obtained), and whether treatment with phototherapy was begun.
- A previously published nomogram was developed in our nursery that defined percentile values for a normal Hispanic population. This nomogram was used to identify TcB values >75th and >95th percentiles.



- Rate of rise (ROR) was calculated as subsequent TcB minus ETcB, divided by the number of hours between the values.

$$ROR = \frac{TcB - ETcB}{Time\ difference} \text{ in mg/dl per hour}$$

- The predictive values relating (a) ETcB alone and ROR to subsequent TcB values, and (b) need for phototherapy, were determined using selected ETcB and ROR cutoff values. Chi square and Fisher exact test also were used, as appropriate.
- The UTSW IRB approved this study, and informed consent was not required.

RESULTS

Table 1: Study Population

N	516
Birth weight, grams [§]	3401 ± 468
Gestational age, weeks [§]	39.0 ± 1.4
Gender, % male	53
Hispanic, %	83

[§] Mean±SD

- For all study neonates (n=516), ETcB mean±SD was **1.1±1.0** mg/dL
 - (median 0.9 mg/dL, range 0-5.7 mg/dL)
- For those neonates who subsequently received phototherapy (n=16), ETcB mean±SD was **2.2±1.6** mg/dL
 - (median 1.7 mg/dL, range 0.3-5.7 mg/dL); p=0.002 vs no PHT
- Correlations between ETcB and TcB values at 24h, 36h, and 48h were r=0.31, 0.40, and 0.32, respectively (all p values <0.001).

RESULTS (cont'd)

Table 2: Predictive Value of ETcB and ROR for TcB >**95th** Percentile* at 42-66 Hours of Age

	Sens	Spec	PPV	NPV	p ^ψ
ETcB [‡]					
≥0.80	0.87	0.5	0.16	0.97	0.0007
≥0.90	0.78	0.57	0.16	0.96	0.002

ROR [§]					
≥0.11	1	0.13	0.11	1	0.09
≥0.18	0.83	0.48	0.15	0.96	0.007
≥0.25	0.52	0.88	0.31	0.95	0.00003

Table 3: Predictive Value of ETcB and ROR for TcB >**75th** Percentile* at 42-66 Hours of Age

	Sens	Spec	PPV	NPV	p ^ψ
ETcB [‡]					
≥0.80	0.67	0.56	0.50	0.72	0.0003
≥0.90	0.64	0.60	0.42	0.78	0.01

ROR [§]					
≥0.11	0.97	0.17	0.43	0.89	0.001
≥0.18	0.74	0.58	0.53	0.77	<0.0001
≥0.25	0.42	0.91	0.67	0.80	<0.0001

*evaluated using local Hispanic TcB nomogram; ^ψChi square
[‡]mg/dL for ETcB; [§]mg/dL per hour for ROR

- For subsequent TcB >95th percentile, the NPV was always ≥0.95 when using ETcB or ROR as the predictor variable. For TcB >75th percentile, NPV ranged from 0.72-0.89.
- For the 39 neonates with **ROR ≥0.25** (versus 200 neonates with **ROR <0.25**):
 - 79%** had TcB **>75th** percentile at 42-66h (vs **32%**; p<0.0001).
 - 31%** had TcB **>95th** percentile at 42-66h (vs **5.5%**; p<0.00003).
- Of those neonates who subsequently were treated with phototherapy, when ROR could be calculated (n=8), the ROR was ≥0.30 mg/dL in 63%.

CONCLUSIONS

- Preliminary results suggest that early TcB may have utility in the identification of those term and late preterm neonates for whom subsequent hyperbilirubinemia may become a clinical issue during the neonatal hospitalization.
- We are continuing to expand the dataset to further clarify the value of an early TcB determination.