



Uses and Limitations of Transcutaneous Bilirubin Measurement

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Disclosure

Relevant Financial Relationship(s)

None

Off Label Usage

None

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Outline

- Introduction
 - Risk of hyperbilirubinemia (kernicterus)
 - American Academy of Pediatrics (AAP) recommendations
 - Transcutaneous Bilirubin (TcB)
- Mayo study of TcB
- Conclusions

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Introduction

- Bilirubin levels increase in newborn period due to:
 - Shortened lifespan/fragility of neonatal red blood cells
 - Immaturity of conjugation system in liver
 - Increased reabsorption via enterohepatic circulation
 - Nutritional factors (breast feeding)
 - Less protein to bind/excrete bilirubin
 - Other factors
- High unbound bilirubin levels are toxic to brain

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Kernicterus

- Chronic form of Acute Bilirubin Encephalopathy (ABE)
 - Athetoid CP
 - Auditory dysfunction
 - Dental-enamel dysplasia
 - Paralysis of upward gaze
 - Intellectual and other handicaps (less frequent)

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Historical Information

- Prior to late 1960: Most kernicterus was due to Rh isoimmunization
- 1994 AAP practice parameter: Management of hyperbilirubinemia in the healthy term infant
- 1994-2004: Increasing case reports of Acute Bilirubin Encephalopathy (ABE)
- 2004 AAP practice parameter: Management of hyperbilirubinemia in the newborn infant 35 or more weeks gestation

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Focus of the Guideline

- Reduce the frequency of severe hyperbilirubinemia and bilirubin encephalopathy
- Minimize the risk of unintended harm
 - Increased anxiety
 - Decreased breastfeeding
 - Unnecessary treatment and excessive cost

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Key Elements to the Recommendation

- Promote and support breastfeeding
- Establish nursery protocols for identification and evaluation of newborn jaundice
- Recognize visual estimation may lead to errors
- Interpret bilirubin levels according to age
 - Key recommendation to help interpret values
 - Often ignored or forgotten in some predischARGE strategies

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Key Elements to the Recommendation

- Assess every newborn for the risk of hyperbilirubinemia (HB) before discharge
 - Two options
 - PredischARGE total serum bilirubin (TsB) or TcB
 - Plot on age-based nomogram
 - Bhutani nomogram most commonly used
 - A few TcB nomograms now exist
 - Assess clinical risk factors

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Mayo Study of TcB

- Very few studies of TcB have interpreted values in relation to patient age
- Ideal use in our practice would be to do TcB first and plot in existing serum-based nomogram
 - If high risk, confirm with serum bilirubin
 - If low risk, discharge without serum bilirubin
- Little data to know whether this approach safe/effective

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Mayo Study of TcB

Study design

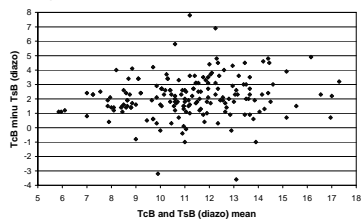
- 200 infants with clinical suspicion of hyperbilirubinemia, have serum bilirubin ordered by physician in Methodist nursery
- Measure BiliChek TcB within 30 minutes of serum bilirubin drawn
- Measure serum bilirubin diazo (current) method and direct photometric measurement of unconjugated bilirubin (Vitros)
- Record gestational age, postnatal age (hours), and mother's ethnicity for each infant

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Mayo Study of TcB: TcB vs. diazo TsB

Figure 1: Bland-Altman Plot of TcB vs. TsB (diazo)

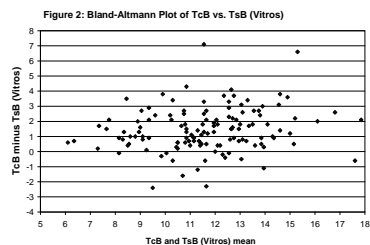


- Median bias (TcB minus TsB) = 2.0 mg/dL
- Bias relatively constant over range studied

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Mayo Study of TcB: TcB vs Vitros TsB



- Median bias (TcB minus TsB) = 1.3 mg/dL
- Bias relatively constant over range studied

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Mayo Study of TcB

- Each TcB and TsB value, combined with postnatal age in hours, used to determine risk zone (low, low-intermediate, high-intermediate, high-risk) according to Bhutani
- Sensitivity and specificity of high-risk TcB for predicting high-risk TsB was calculated

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Mayo Study of TcB

Serum bilirubin (diaz)	Transcutaneous bilirubin		Total
	Low or low-intermediate risk	High-intermediate or high risk	
Low or low-intermediate risk	48	77	125
High-intermediate or high risk	1	51	52
Total	49	128	177

51/52 (98%) sensitivity for predicting high-risk diazo TsB
48/125 (38%) specificity for predicting low-risk diazo TsB

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Mayo Study of TcB

Serum bilirubin (Vitros)	Transcutaneous bilirubin		
	Low or low- intermediate risk	High-intermediate or high risk	Total
Low or low- intermediate risk	35	29	64
High-intermediate or high risk	4	63	67
Total	39	92	131

63/67 (94%) sensitivity for predicting high-risk Vitros TsB

35/64 (55%) specificity for predicting low-risk Vitros TsB

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Mayo Study of TcB

- TcB minus TsB bias was not associated with:
 - Gestational age
 - Postnatal age
 - Mother's ethnicity
- TcB minus TsB bias as a function of tube type:
 - Diazo TsB
 - Clear tube: Median bias 2.2 mg/dL
 - Amber tube: Median bias 2.0 mg/dL
 - $p = 0.7437$, NS
 - Vitros TsB
 - Clear tube: Median bias 1.7 mg/dL
 - Amber tube: Median bias 0.9 mg/dL
 - $p = 0.0119$

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Conclusions

- Transcutaneous bilirubin systematically overestimates serum bilirubin level as measured at Mayo
- Factors affecting relationship between TcB and TsB limited to lab factors (method, transport, calibration)
- Utility of TcB for predicting risk of hyperbilirubinemia will vary by institution

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Conclusions

- Universal TcB screening for all newborns is safe and effective
- If TcB low risk can discharge without plasma bilirubin
 - Appropriate follow-up still necessary
- If TcB high risk confirm with plasma bilirubin
 - Follow up with further plasma values as necessary

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