

Maternal assessment of neonatal jaundice after hospital discharge

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KEY POINTS FOR CLINICIANS

- Although kernicterus, or bilirubin encephalopathy, is preventable, it is still occurring.
- Parents should be provided with educational materials about newborn infants that include information about jaundice.
- It may be useful for parents to be instructed how to assess the level of jaundice in their infant or to be given an Ingram icterometer to monitor their infants for jaundice after discharge.

■ **OBJECTIVE** To determine whether mothers can accurately assess the presence and severity of jaundice in their newborns, both visually and with an icterometer, after hospital discharge.

■ **STUDY DESIGN** Mothers were taught how to examine their infants for jaundice by determining the extent of caudal progression of jaundice and by using an Ingram icterometer. The mothers documented the examinations for 7 days after discharge. Home health nurses examined the babies for jaundice after discharge and obtained serum bilirubin levels.

■ **POPULATION** Mothers of infants cared for in the normal newborn nursery of a 340-bed community hospital.

■ **OUTCOME MEASURED** Maternal assessment of the presence of jaundice and its caudal progression.

■ **RESULTS** Jaundice extending below the nipple line had a positive predictive value of 55% and a negative predictive value of 86% for identifying infants with bilirubin levels of ≥ 12 mg/dL. Ictrometer readings of ≥ 2.5 had a positive predictive value of 44% and a negative predictive value of 87% for identifying infants with bilirubin levels of ≥ 12 mg/dL. The 3 infants with bilirubin levels ≥ 17 mg/dL were recognized by their mothers as having jaundice below the nipple line and had icterometer readings of ≥ 2.5 .

■ **CONCLUSIONS** Further study is needed to determine the optimum method of parental educa-

tion about newborn jaundice. However, maternal use of the Ingram icterometer and determination of jaundice in relation to the infant's nipple line are both potentially useful methods of assessing jaundice after hospital discharge.

■ **KEY WORDS** Jaundice, neonatal; hyperbilirubinemia; perinatal. (*J Fam Pract* 2002; 51:445-448)

From 1% to 4% of full-term infants are readmitted to the hospital for jaundice in the first week of life, representing as many as 109,000 admissions¹. Delayed diagnosis of jaundice puts babies at risk for kernicterus, which had virtually disappeared in the United States but is now on the rise. There are anecdotal reports of 22 full-term infants born in the early 1990s who developed kernicterus after discharge from the hospital within 48 hours of birth.¹ The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) recently issued a Sentinel Event Alert recommending that organizations take steps to raise awareness among neonatal caregivers of the potential for kernicterus and its risk factors by reviewing their current patient care processes with regard to the identification and management of hyperbilirubinemia in newborns and by identifying risk reduction strategies that could enhance the effectiveness of these processes.²

The JCAHO alert cites the American Academy of Pediatrics (AAP) Practice Parameter for Management of Hyperbilirubinemia in the Healthy Term Newborn, which is based on available data and expert consensus, as an example of a guideline for identifying at-risk newborns and their diagnosis and treatment. The AAP guideline suggests checking for jaundice by blanching the skin with digital pressure to reveal its underlying color. The guideline states that clinical assessment must be done in a well-lighted room and suggests that as the bilirubin level rises, the extent of caudal progression may be helpful in quantifying the degree of jaundice.³

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The AAP jaundice guideline suggests that the use of an icterometer (transcutaneous jaundice meter) may be helpful in the clinical assessment of jaundice.³ A variety of instruments have been tested in different patient populations.^{4,8} A potential role for such devices is their use by parents. The Ingram icterometer (Cascade Health Care Products, Salem, Ore.) is particularly promising because of its low cost (\$17) and simplicity.⁵ It is a simple handheld device, made of clear plastic, on which are painted 5 transverse stripes of precise and graded hue. The stripes and spaces between them are 3/16 inch wide and are numbered from 1 (lightest in color) to 5 (darkest). When the icterometer is used, the painted side is pressed against the tip of the infant's nose until the skin becomes blanched. The yellow color of the blanched skin can then be matched with the yellow stripes on the instrument, and a jaundice score assigned.

The purpose of my study was to determine whether mothers can accurately assess the presence and severity of jaundice in their newborns, both visually and with an icterometer, after hospital discharge. Maternal assessments were compared with bilirubin levels and home health nurse assessments to determine their accuracy. Serum bilirubin levels were used as the reference standard. Maternal comfort with the examination techniques was also assessed.

METHODS

This study was approved by the Ramsey (now Regions) Hospital institutional review board. Mothers who gave birth at Regions Hospital in St. Paul, Minn., participated in the study. Mothers on the postpartum ward were invited to participate, but were excluded if they were not proficient in reading English, did not have a telephone, or lived more than 10 miles from the hospital. Infants were excluded if they were in the intensive care nursery, were not discharged on the same day as the mother, or if they received phototherapy. Mothers were advised to follow their health care providers' instructions about timing for the first follow-up visit, and any provider instructions regarding jaundice.

After obtaining consent, the author or a study assistant showed the mothers how to examine their infants for jaundice by 2 methods. Each mother was instructed to examine her baby in a well-lighted room. First, the mother was shown how to look for jaundice by digitally blanching the skin on the cheek. The mother then documented whether she saw any underlying yellow color on her baby. Next, the mother was shown how to determine the caudal progression of the jaundice and to draw a horizontal line on an illustration of a baby corresponding to

where the jaundice ended. The distance from the top of the infant's head to the line drawn by the mother was used to determine the caudal progression. The mother was then shown how to use the Ingram icterometer and obtain a reading from the baby's nose. Each mother was given an icterometer and a study booklet to document her examination for a total of 7 days, beginning the day after discharge from the hospital. The study booklet also contained some demographic questions, and questions about the mother's comfort level with both methods of jaundice assessment. The mother was instructed to return the booklet and icterometer by mail when completed. The mother was sent a \$25 gift certificate when the study materials were returned.

Within 7 days of discharge, a home health nurse visited each mother and infant in the home. The nurses were trained in the same methods of clinically assessing jaundice, and they assessed each infant by visually determining the caudal progression and by use of the icterometer. The nurse did not share the results of her examination with the mother. The nurse obtained bilirubin levels from all infants and notified the infants' health care providers of any bilirubin levels higher than 14 mg/dL.

Standard descriptive statistics were calculated for all variables. Categorical relationships were assessed using kappa and chi-square statistics, as appropriate. All analyses were performed using Statistical Package for Social Sciences for Windows, version 10.0.5.

RESULTS

A total 113 of 177 mothers returned their study packets. Home health nurses visited 96 of the 113 mothers; the other 17 mothers were not visited because they declined the visits or could not be located. Although all babies were to have serum bilirubin levels determined whether or not they appeared jaundiced, only 90 of the 96 infants had the blood test. For the other 6 infants, either insufficient blood was drawn or the mother refused the test. On the day of the nurse's visits, mothers documented in their study booklets the caudal progression of jaundice (for 56 infants) and icterometer readings (for 55 infants).

The educational levels of the mothers were as follows: 15% completed grade school or less; 40% completed high school; and 45% completed college. The mothers reported being from the following racial and ethnic groups: white, 59%; Hispanic, 16%; black, 14%; Asian, 8%; and other, 3%. A total of 53% of the women were primiparous, 84% completed examination forms for their babies for all 7 days, and 53% assessed their infants as being jaundiced during the study.

On the day of the nurse's visit, there was moder-

ate agreement between the nurses and the mothers about the presence of jaundice in the infants ($\kappa=0.50$; $P < .001$). For those infants with jaundice, there was little agreement on the extent of caudal progression between the nurses and the mothers (correlation = 0.36; $P > 0.1$), but there was moderate agreement between their icterometer readings (correlation = 0.58; $P < .05$).

The total serum bilirubin results ranged from 0.8 mg/dL to 18.8 mg/dL, with a mean of 7.4 mg/dL. The mean bilirubin level of infants thought to be jaundiced by their mothers was 11.3 mg/dL, while the mean bilirubin of infants not thought to be jaundiced was 4.8 mg/dL ($P < .001$).

The mothers' icterometer readings and determinations of jaundice to the nipple line or below it are compared with bilirubin levels in Table 1. Table 2 summarizes the diagnostic accuracy of jaundice extending to the nipple line or below it, and for icterometer readings of ≥ 2.5 , in identifying bilirubin levels of ≥ 12 mg/dL and ≥ 17 mg/dL. A bilirubin level of ≥ 12 mg/dL is the level at which the AAP guideline suggests considering phototherapy for infants aged 24 to 47 hours, and 17 mg/dL is the level at which phototherapy should be considered for infants older than 72 hours.³

The mothers of the 3 infants with bilirubin levels ≥ 17 mg/dL recognized that their infants were jaundiced and determined that the jaundice extended below the nipple line. The icterometer readings obtained by the mothers were 2.5, 3, and 3.5. The corresponding icterometer readings by the nurses were 4.5, 3.5 and 3.

The study booklet contained 6 questions about the mothers' reactions to the study. Almost all of the mothers (98%) responded that the method for checking for caudal progression of jaundice was explained clearly, and even more (99%) felt the use of the icterometer was explained clearly. A total of 69% of the mothers felt it was "very easy" or "easy" to check for caudal progression, and 80% felt it was "very easy" or "easy" to use the icterometer. Forty-six percent of the mothers reported that checking their babies for jaundice made them "very worried" or "somewhat worried" about their babies' health. Mothers with less education were significantly more likely to report being worried than mothers with higher education levels ($P < .05$). However, 93% of the mothers reported that checking their babies for jaundice made them "very reassured" or "somewhat reassured" about their babies' health.

DISCUSSION

The ability of mothers to detect and respond to jaundice in their newborns after discharge from the hospital has not been previously studied. Opinions

TABLE 1

Maternal assessment of jaundice, by caudal progression and icterometer readings, compared with serum bilirubin levels

Maternal test result	Serum bilirubin level (mg/dL)			
	≥ 12	< 12	≥ 17	< 17
Icterometer ≥ 2.5	11	14	3	22
Icterometer < 2.5	4	26	0	30
Caudal progression at or above nipple line	11	9	3	17
Caudal progression below nipple line	5	31	0	36

about the value of parental education regarding jaundice vary markedly. The AAP recommends that all mothers be able to recognize signs of jaundice before discharge.⁹ Others are skeptical that such education will be helpful: "Experience suggests that asking mothers to observe infants for the development of jaundice is not satisfactory. Despite such instructions, it is difficult for many parents to recognize significant jaundice."¹⁰

Several studies have documented that jaundice is first seen in the face and progresses caudally to the trunk and extremities.¹¹⁻¹³ These studies also found good correlation between serum bilirubin levels and the advancement of dermal icterus. In a previous study, parents were able to accurately assess the caudal progression of jaundice while their babies were in the hospital.¹⁴ However, the bilirubin levels in that study were relatively low, reflecting the brief hospital stay of most of the infants. In contrast, a recent study concluded that the clinical examination for jaundice by nurses and physicians had poor reliability and only moderate correlation with bilirubin levels.¹⁵ The authors did conclude, however, that finding no jaundice below the nipple line reliably predicted that an infant would have a bilirubin concentration of less than 12.0 mg/dL. In this study, finding no jaundice below the nipple line reliably predicted that an infant would have a bilirubin concentration of less than 17.0 mg/dL.

Because of the relatively small number of infants having bilirubin levels high enough to require potential intervention, the measures of diagnostic accuracy in the tables should be interpreted with caution. However, the results of my study confirm several prior reports that restricting bilirubin testing to infants with icterometer readings ≥ 2.5 would have safely eliminated many unnecessary tests.^{6,14,16} Although most of the infants in my study were white, the efficacy of the icterometer has also been docu-

TABLE 2

Diagnostic accuracy of maternal visual assessment of jaundice and of the Ingram icterometer

Test	Cut-off (serum bilirubin level, mg/dL)	SN	SP	PV+	PV-	LR+	LR-
Maternal visual assessment below the nipple line	≥12.0	69	77	55 (CI, 52-58)	86 (CI, 84-88)	3.1	0.4
Ingram icterometer reading ≥ 2.5	≥ 12.0	73	65	44 (CI, 41-47)	87 (CI, 85-89)	2.1	0.4
Maternal visual assessment below the nipple line	≥ 17.0	100	68	15 (CI, 13-17)	100 (CI, 67-100)	3.12	0
Ingram icterometer reading ≥ 2.5	≥ 17.0	100	58	12 (CI, 10-14)	100 (CI, 67-100)	2.4	0

SN denotes sensitivity; SP = specificity; PV+ = positive predictive value; PV- = negative predictive value; LR+ = positive likelihood ratio; LR- = negative likelihood ratio; CI = 95% confidence interval.

mented in Asian and black newborns.¹⁷

Previous studies have shown that neonatal jaundice and its treatments are associated with an increased risk of maternal behaviors consistent with the vulnerable child syndrome.^{18,19} This syndrome was originally described in 1964 in children whose parents believed that their child had suffered a “close call,” and thereafter perceived the child as vulnerable to serious injury or accident.¹⁸ Frequent blood tests to monitor bilirubin levels, supplementation or replacement of breast milk with formula, the physical separation of the mother and infant because of phototherapy, and prolonged hospitalization may create the impression that the infant is seriously ill, despite reassurances from medical personnel. Therefore, the mothers were asked whether the study itself served as a source of anxiety.

Almost half of the mothers in this study reported that checking their babies for jaundice made them very or somewhat worried about their babies’ health. Some of the women must have felt ambivalent, however, because almost all of them (93%) also reported that checking their babies for jaundice made them very or somewhat reassured about their babies’ health. Most of the 48 comments written by the mothers in the study booklets were very positive.

CONCLUSIONS

One of the strategies recommended by the JCAHO to reduce the risk of kernicterus is to provide parents with adequate educational materials about newborn infants that include information about jaundice.² The message given to parents should be consistent, and should reassure mothers that most jaundiced infants are basically healthy. My study results suggest that it may also be useful for parents to be shown how to visually assess jaundice or to be given an Ingram icterometer to monitor their infants for jaundice after hospital discharge. Further study is needed to determine the optimal method of parental education about newborn jaundice.

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