Recognition of the Presence and Severity of Newborn Jaundice by Parents, Nurses, Physicians, and Icterometer

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ABSTRACT. Objective. To determine how well parents, nurses, physicians, and an Ingram icterometer can detect the presence and the severity of jaundice in newborns.


Patients or Other Participants. Nurses and physicians caring for nursery infants and parents of the infants.

Interventions. Physicians and nurses examining newborns documented whether they detected jaundice in the infants and, if so, the estimated bilirubin level and the extent of cephalocaudal progression of the jaundice. An assistant taught the parents how to examine the infants for jaundice and determine its cephalocaudal progression. The assistant also obtained icterometer readings. Bilirubin testing was performed according to usual clinical practice.

Outcome Measures. Nurse and physician estimates of bilirubin levels; parent, nurse, and physician assessment of the presence of jaundice and its cephalocaudal progression; icterometer readings; bilirubin levels.

Results. There was moderate agreement about the presence of jaundice in the infants (pairwise $\kappa$, 0.48). However, all infants with bilirubin levels $>12$ mg/dL were correctly identified as jaundiced by all examiners. The parents’ assessment of cephalocaudal progression and the icterometer readings were most highly correlated with serum bilirubin levels (adjusted Pearson correlations, 0.71 and 0.57, respectively).

Conclusions. Many parents can be taught to accurately assess cephalocaudal progression of jaundice in the hospital. The icterometer is a useful tool for assessing jaundice severity. Both parent assessment and the icterometer were more highly correlated with bilirubin levels than physician and nurse estimates in this study. Additional research is needed to determine how accurate these methods of clinical assessment are at the higher bilirubin levels that typically occur after hospital discharge.

E ach year, $\sim60\%$ of the 4 million newborns in the United States become clinically jaundiced.1 Few issues in neonatal medicine have generated such long-standing controversy as the possible adverse consequences of neonatal jaundice and when to begin treatment, particularly in the treatment of the otherwise healthy term newborn without risk factors for hemolysis.1

Until recently, prevailing recommendations were that neonatal jaundice be evaluated aggressively.2 Bilirubin levels were recommended for all jaundiced infants.3,4 The 1992 edition of the classic textbook Nelson Textbook of Pediatrics emphasized that jaundice “intensity bears no clinically dependable relation to the degree of hyperbilirubinemia . . . . Therefore, bilirubin determinations should be done on all jaundiced infants.”3

A major problem with the traditional approach to jaundice evaluation is that following bilirubin levels has become more difficult. The recommendation that bilirubin levels be monitored closely in all jaundiced infants was developed when most infants were bottle-fed and remained in the nursery for several days. Bilirubin levels were lower and usually peaked while the baby was still in the hospital, making the recognition and follow-up of jaundice a relatively simple matter.

Currently, higher breastfeeding rates have led to a higher prevalence of jaundice. Earlier hospital discharge requires the parents to recognize jaundice, seek attention for it, and make multiple visits to the doctor’s office or laboratory to follow its progress.

However, a “kinder, gentler approach” to jaundice in the term newborn is now recommended2 and incorporated into a practice parameter by the American Academy of Pediatrics (AAP).1 The new guidelines are quite clear about treatment recommendations, but rather vague about evaluation recommendations. Clinicians are advised to measure infants’ total serum bilirubin when the jaundice is “clinically significant” by medical judgment.” No additional definition of clinically significant jaundice is given, and the AAP states that “adequate data are not available from the scientific literature to provide more precise recommendations.”1

The AAP does suggest detecting jaundice by blanching the skin with digital pressure to reveal the underlying color of the skin. The guidelines also state that clinical assessment must be performed in a well-lighted room. Several studies have documented that jaundice is first seen in the face and progresses cau-
daily to the trunk and extremities. The guidelines suggest that as the total serum bilirubin level rises, the extent of cephalocaudal progression may be helpful in quantifying the degree of jaundice.

Three studies have found good correlation between serum bilirubin levels and the advancement of dermal icterus. However, all three studies used one or two trained observers who examined the infants while they were completely naked. Blue-white fluorescent light was used in one study and varied lighting in the others. One of the studies included Asian infants only. A second study, from Denmark, did not state the races of the infants, but they presumably were primarily white. The third study, from Maryland, also did not state the races of the infants. The author did state that clinical jaundice detection was difficult in black newborns when their skin is deeply pigmented. However, he reported that even in these infants, the nonpigmented palms and soles are a useful area for clinical inspection. Whether jaundice is indeed more difficult to detect in black infants has been debated by other authors.

The ability of nurses and physicians to accurately assess jaundice severity in the more typical hospital nursery setting with infants of a variety of races has never been studied.

The ability of parents to detect and respond to jaundice in their newborns is also unknown. However, early hospital discharge places just that responsibility on the parents. The AAP recommends that follow-up should be provided to all neonates discharged <48 hours after birth by a health professional in an office or a clinic or at home within 2 to 3 days of discharge. The health professional should be able to detect a jaundice problem at such a visit. However, there is evidence that pediatric care providers are not following these recommendations. In a study of 130 newborns discharged from a large and relatively affluent community hospital well-infant nursery, chart review revealed that the presence of risk factors such as jaundice or gestational age <37 weeks made no difference in the scheduled date of the first clinic visit. It also made no difference whether discharge was before or after 48 hours of age. In fact, 67% of those discharged under 48 hours had a first follow-up visit scheduled for >2 weeks later.

The advice given to parents about neonatal jaundice from both lay and medical sources varies tremendously. A parenting book written by the Columbia University College of Physicians and Surgeons recommends that parents call the health care practitioner “if the infant appears to be getting jaundiced or yellow (check the whites of the eyes).” However another parenting book written by a physician provides detailed instructions on how to check for jaundice and instructs the parents to call “if the color gets deeper after day 7” or “the jaundice is not gone by day 14.” The “kinder, gentler approach” recommends that the parents be instructed to return for a bilirubin test if the jaundice extends to the baby’s feet or markedly increases in intensity.

This approach has been criticized in an unreferenced statement that “parents commonly . . . fail to recognize severe jaundice.” More information is needed to assess the parents’ ability to recognize jaundice in their newborns.

The AAP guidelines also suggest that the use of an icterometer or a transcutaneous jaundice meter may also be helpful in the clinical assessment of jaundice. These devices have not been used in most US hospitals. Various instruments have been tested on differing patient populations. Particularly promising because of its low cost ($) and simplicity is the Ingram icterometer. (Cascade Health Care Products, Salem, OR). Successful Ingram icterometer use has been reported from two institutions that obtained serum bilirubin levels only on infants with icterometer readings of ≥3.

The purpose of this study was to: 1) assess the ability of nurses and physicians to determine the presence and severity of neonatal jaundice in a typical nursery setting with infants of different races; 2) determine whether parents can be taught to accurately assess jaundice in their newborns while in the hospital; and 3) assess the clinical efficacy of the Ingram icterometer as used by a research assistant.

METHODS

The study took place in the normal newborn nursery at St Paul Ramsey Medical Center in St Paul, MN, with the approval of the Ramsey Institutional Review Board. Nurses and physicians caring for infants in the nursery were asked to complete a study form after examining infants ≥2 days old. Infants receiving phototherapy were excluded. First the examiners documented on the form whether the infant was jaundiced and whether they were aware of any bilirubin test results performed on the baby. If the examiners thought the infant was jaundiced, they were to guess the bilirubin level after assessing the infant in their usual manner. Then according to instructions on the form, the nurses and physicians examined the infants for jaundice in the manner suggested by the AAP, by blanching the skin and determining the cephalocaudal progression of jaundice. The examiners marked the progression by drawing 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 examiner was used to determine the cephalocaudal progression. The nurses and physicians were asked not to compare their findings until after they had completed their forms.

A research assistant took the babies to the parents and gave them written and verbal instructions on how to detect jaundice. The assistant had a medical laboratory technician degree, but had not worked in the field for the past 10 years. Parents were excluded if, in the assistant’s judgment, they were unable to read and understand the instruction form. The assistant ensured that all the room lights were on and that the window blinds fully open when the parents examined the infants. Parents documented their findings on a form similar to that used by the clinicians. The assistant asked the parents for information about their level of education and primary language.

The assistant then used the Ingram icterometer to obtain readings from the nose of the infants. It is a simple hand-held device made of clear plastic, on which are painted five transverse stripes of precise and graded hue. The stripes and spaces in between 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 and a jaundice score assigned. The assistant was not aware of the examination findings of the nurse or physician. Infants remaining in the nursery after the third day of life were also examined on subsequent days.

Demographic data were collected from the infants’ charts, as well as from the results of any bilirubin tests performed. The study did not influence or alter any decision to obtain bilirubin testing.
Data were also collected from the nurses and physicians about their level of training and years of clinical experience. Inter-rater agreement on the question “Does this baby have jaundice?” was assessed using the $\kappa$ statistic. Agreement of actual bilirubin levels with cephalocaudal progression estimates and with icterometer readings was measured using Pearson product moment correlations. The mean differences in standardized scores between indices (eg, bilirubin level and cephalocaudal progression) were analyzed using $t$ tests and analysis of variance to determine whether accuracy of estimates are affected by various factors (eg, level of training, race of infant, and so forth).

RESULTS

A convenience sample of 171 infants was included in the study. The infant’s mean gestational age was 39 weeks. The mother’s race or ethnic group was white in 50%, black in 24%, Asian in 13%, Hispanic in 9%, and a variety of others in 4%. The infants were examined by 20 family physicians and four pediatricians. Fourteen of the physicians were faculty, and 10 were residents. Thirty-six registered nurses examined the infants. Most worked part-time in the newborn nursery. A total of 147 parents performed examinations. The parents’ primary language was English (81%); Spanish and Hmong made up 6% each. A total of 26% of parents completed graduate school, and 46% completed high school.

A total of 132 icterometer readings and 89 serum bilirubin levels were obtained. The physician and nurse exams were completed a mean of 50 and 27 minutes, respectively, before bilirubin testing. The parent exams were completed a mean of 40 minutes after bilirubin testing. The bilirubin levels ranged from 1.6 to 18.5 mg/dL. Only 11 infants had bilirubin levels >12 mg/dL, the level at which the AAP guidelines suggest considering phototherapy for infants 25 to 48 hours old. Three infants did receive phototherapy.

There was only moderate agreement between physicians, nurses, and parents about whether an infant was jaundiced. The pairwise $\kappa$ comparing physician versus nurse, physician versus parent, and nurse versus parent examinations were all $-0.48$. However, in the 11 infants with bilirubin levels >12 mg/dL, all three types of examiners agreed that the infants were jaundiced.

To determine the examiner’s ability to clinically assess the severity of jaundice, Pearson correlations with actual bilirubin values were calculated. The results are shown in Table 1. The parents’ assessment of cephalocaudal progression of jaundice correlated best with bilirubin levels, followed by the icterometer readings. The worst correlations were the nurse and physician assessments of cephalocaudal progression of the jaundice.

The accuracy of the physician and nurse estimates of bilirubin levels was unaffected by a variety of factors, including physician and nurse level of training or experience or the race or ethnic group of the infants.

DISCUSSION

The clinical assessment of jaundice in newborns by nurses and physicians was less than optimal in this study. The estimates by nurses and physicians of bilirubin levels in infants thought to be jaundiced were significantly correlated statistically with actual bilirubin levels. However, the level of the correlations do not inspire confidence that these estimates are sufficiently accurate to be clinically useful. This finding may reflect the traditional practice of obtaining bilirubin levels on all jaundiced infants and the ease of obtaining bilirubin tests in the hospital. Nurses and physicians may not feel the need to attempt to carefully assess jaundice severity clinically when accurate blood levels are so readily available.

The parents’ assessment of cephalocaudal progression of jaundice had the best correlation with actual bilirubin levels. Therefore, determining the cephalocaudal progression of jaundice is a reasonable method to assess jaundice severity even in a typical hospital setting with varied lighting, infants of varying races, and minimally trained observers.

The correlation of Ingram icterometer readings with actual bilirubin levels was also promising, given its low cost and ease of use. The Ingram icterometer has been used in nursery settings elsewhere to decrease unnecessary bilirubin testing. In this study, restricting bilirubin testing to infants with icterometer readings $\geq 2.5$ would have eliminated many unnecessary tests but identified all infants with bilirubin levels $>12$ mg/dL.

The bilirubin levels in this study were relatively low, reflecting the brief hospital stay of most infants. Additional research is needed to determine how accurate these methods of clinical assessment are at higher bilirubin levels, which typically occur after discharge from the hospital. Obtaining bilirubin levels after discharge is more difficult than in the nursery, making accurate clinical assessment an even more important skill. Because home health nurses are playing an increasing role in the care of infants after discharge, their ability to clinically assess jaundice is important to study. In addition, the icterometer could be a potential useful tool for them. Because many parents are not receiving the early follow-up recommended by the AAP, the ability of parents to assess the cephalocaudal progression of jaundice in their infants after discharge should also be studied.

ACKNOWLEDGMENTS

This research was funded by a grant from the Ramsey Foundation.

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**TABLE 1. Actual Bilirubin Level Versus Clinical Assessment of Jaundice**

<table>
<thead>
<tr>
<th>Assessment Method</th>
<th>Observed Pearson Correlation</th>
<th>Adjusted Pearson Correlation*</th>
<th>$P$ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parent assessment of caudal progression</td>
<td>.66</td>
<td>.71</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Icterometer</td>
<td>.61</td>
<td>.57</td>
<td>.002</td>
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<tr>
<td>Nurse bilirubin estimate</td>
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<td>.52</td>
<td>&lt;.001</td>
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<tr>
<td>Physician bilirubin estimate</td>
<td>.43</td>
<td>.55</td>
<td>&lt;.05</td>
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<tr>
<td>Nurse assessment of caudal progression</td>
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<td>.48</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>Physician assessment of caudal progression</td>
<td>.26</td>
<td>.35</td>
<td>NS</td>
</tr>
</tbody>
</table>

* Pearson correlation adjusted for restricted range of bilirubin test results.
I thank Pamela Ristau for her invaluable assistance with the data collection for this study.

REFERENCES

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Pediatrics 1997;100;e3
DOI: 10.1542/peds.100.3.e3

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