Maternal Ability to Correctly Detect Significant Jaundice in Indian Neonates

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Abstract

Background: The ability of mothers to correctly detect jaundice in their newborns is largely unknown. The objective was to ascertain the ability of mother to correctly detect the presence of significant jaundice in her newborn. Materials and Methods: This cross-sectional study was conducted in a tertiary care hospital in eastern India from February 2015 to July 2016. All inborn neonates more than 34 weeks of gestation were included. Congenital malformations, perinatal asphyxia, neonatal sepsis, readmission after discharge, and isoimmunization were excluded. A total of 505 inborn newborns were independently assessed by the mother and the treating pediatrician for significant jaundice every day till discharge. Each newborn underwent total serum bilirubin estimation on suspicion of significant jaundice by either of the two or at discharge, whichever was earlier. Results: The sensitivity, specificity, positive predictive value (PPV), and negative predictive value of maternal detection of significant jaundice was 51.47%, 88.33%, 39.29%, and 92.12%, respectively. Conclusion: Mothers have poor sensitivity and PPV to detect significant neonatal jaundice in the Indian population.

Keywords: Maternal detection, neonatal jaundice, predictive ability

Introduction

Neonatal jaundice is the most common condition requiring medical attention in the 1st week of life and almost 60% of term neonates and almost 80% of preterm neonates develop jaundice.[1] It is also the commonest cause of readmission after they are discharged from birth hospitalization.[2] Excessively high levels of bilirubin in a neonate may cause neurological damage, and approximately 5%–10% of the neonates with clinically significant jaundice will need some form of therapy to prevent neurological damage.[3] Typically, in Indian hospitals, a neonate without any comorbidity is discharged by about 48 h of life, and often, there is pressure to discharge the mother–infant dyads even earlier for administrative and domestic reasons. The jaundice usually appears between 24 and 72 h of age and increases to its peak value after the baby has been discharged. Thus, early discharge of a newborn after delivery places the responsibility of detecting jaundice usually on the parents when follow-up in hospital is not feasible due to limited access to health care or infrequent home visits by a health-care worker. However, the ability of mothers to correctly detect jaundice in their newborns is largely unknown.[4]

Therefore, we planned this cross-sectional study to ascertain the ability of mothers to correctly detect significant jaundice in newborn population born in a tertiary care hospital of India.

Materials and Methods

Subjects and setting
We conducted this cross-sectional study in postnatal wards of a teaching service hospital in eastern India between February 2015 and July 2016. All intramural neonates born at more than 34 weeks were eligible for the study. Neonates with major malformations, perinatal asphyxia with APGAR score of 6 or less at 5 min of birth or umbilical arterial pH of <7, neonatal sepsis, Rh isoimmunization and neonates readmitted after discharge were excluded. Gestational age (GA) was ascertained...
from the 1st day of the last menstrual period or by first-trimester ultrasound or by the Expanded New Ballard Score performed within 24 h of birth in that order of preference. Informed written consent was obtained from one of the parents and the study was approved by the institute ethics committee.

**Methodology**

The enrolled study neonates on exclusive breastfeeds were independently assessed for jaundice by the respective mothers and the treating pediatrician every day till discharge (discharge was typically planned at least after 72 h of birth) [Figure 1]. The mothers were from multiple ethnicity, and all were educated till at least 10th pass. All mothers were taught on 1st day of childbirth to blanch the skin of their babies with digital pressure to look for jaundice over the forehead, chest, abdomen, thighs, legs, palms, and soles in this order, in addition to the gross appearance of skin and eyes. Each mother then was asked in morning rounds, daily, if she felt her baby was looking yellow over skin and eyes, and if yes, was it visible till legs. For visual appearance, jaundice visible over legs was considered to be significant jaundice. After the rounds were over, a pediatrician not involved in daily rounds had own independent assessment about the presence of jaundice, and it was considered significant if jaundice appeared over legs. Total serum bilirubin (TSB) was measured on suspicion of significant jaundice by either mother or the pediatrician. In case of no suspicion of significant jaundice by either, the neonates were tested for TSB at discharge. TSB was measured by Diaz method of Pearlman and Lee on nonhemolysed serum or plasma sample after complete clot formation. The analysis was done by Siemens Dimensions EXL 200-fully automated analyzer. Neonate was considered to have any jaundice if TSB was ≥6 mg/dL. TSB value was plotted on the American Academy of Paediatrics (AAP) chart and any value above the cut off for phototherapy, depending on GA and presence of risk factors as per AAP chart, was taken as significant jaundice requiring intervention (phototherapy).

The primary objective was to ascertain sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of the ability of mothers to correctly detect significant jaundice in her newborn. One of the secondary objectives was to ascertain sensitivity, specificity, PPV, and NPV of the ability of pediatrician to correctly detect the presence of significant jaundice in the neonates. The other secondary objectives were to determine the prevalence of neonatal jaundice (any jaundice) and to ascertain sensitivity, specificity, PPV, and NPV of the ability of mother and the pediatrician to detect any jaundice.

**Sample size and statistical analysis**

The sample size was calculated using assumed prevalence of significant jaundice of 10%, with null hypothesis of having
sensitivity of 50% and alternate hypothesis of ±20%, with the power of 80% and of 5%, the total sample size required was 490.\(^7\) Statistical analysis was performed using IBM Statistics SPSS version 20 (IBM, USA). We computed the sensitivity, specificity, PPV, and NPV with corresponding 95% confidence interval (CI).

**RESULTS**

A total of 508 neonates were eligible for study and 3 among them had birth asphyxia and were excluded. A total of 505 neonates were included in this study and the mean maternal age was 26.7 ± 3.9 years. The study subjects were families of serving personnel and were homogenous with respect to socio-economic status. They belonged to all over the country. Among the enrolled neonates, 462 (91.5%) were born term and 43 (8.5%) were born preterm. 170 (33.66%) neonates were born to mothers with O positive blood group. 222 (43.96) neonates were born to primigravida mothers, and 170 (33.66%) neonates were delivered by cesarean section. Among the enrolled neonates, 399 (79%) neonates had any jaundice, and out of them, 86 were correctly predicted to have jaundice by their respective mothers and 122 were correctly predicted by the pediatrician. Sixty-eight (13.4%) among the enrolled neonates had significant jaundice, and among them, 35 were correctly predicted by their respective mothers and 58 were correctly predicted by the pediatrician. The sensitivity, specificity, PPV, and NPV of maternal detection of significant jaundice was 51.47% (95% CI – 37.43%–62.57%), 88.33% (95% CI – 84.94%–91.19%), 39.29% (95% CI – 31.25%–47.95%), and 92.12% (95% CI – 90.16%–93.72%), respectively, with an accuracy of 83.3% (95% CI – 79.75%–86.46), as depicted in Table 1. The sensitivity, specificity, PPV, and NPV of the detection of significant jaundice by the pediatrician was 85.29% (95% CI – 74.61%–92.72%), 85.35% (95% CI – 81.69%–88.54%), 47.54% (95% CI – 41.45%–53.71%) and 97.39% (95% CI – 95.46%–98.51%), respectively, and an accuracy of 85.35% (95% CI – 81.96%–88.32%).

The proportion of neonates with jaundice detected by their respective mothers increased as TSB level increased, and there was a significant linear relationship \((P < 0.05)\). Odds ratio was calculated with respect to TSB < 10 mg/dL. The odds of serum bilirubin (10.1–15) getting detected by mother was 1.15 times than if bilirubin was < 10 mg/DL and is 8.9 times if bilirubin was >15 mg/dL [Table 2].

**DISCUSSION**

In our study, we found high specificity and NPV of maternal ability to detect significant jaundice. However, for either minimal jaundice or significant jaundice, the sensitivity by maternal assessment was poor. This study was important for multiple reasons. First, India has a predominantly breastfed neonatal population, and breastfed babies often have relatively higher and prolonged bilirubin peaks,\(^{[6,8]}\) and second for many administrative and domestic reasons, the mother–infant dyads are often discharged very soon from the hospital. Third, many of our newborn population reside in rural and far-flung areas, and it may not be feasible always to come for follow-up by a pediatrician. Parents have often failed in the past to recognize severe jaundice,\(^{[9]}\) even though in our study, the proportion of neonates with jaundice detected by mothers increased as TSB level increased. Finally, the Indian neonates usually have pigmented skin, and the presence and severity of jaundice may be underestimated.\(^{[6,10]}\)

We found the prevalence of any jaundice to be 79% and significant jaundice to be 13.4%. The reasons for slightly higher prevalence than the described literature\(^{[1-3]}\) is that there were more primigravida mothers and more cesarean section deliveries, ours being a tertiary care center. The studied population was also a mix of term and late preterm neonates and all neonates were exclusively breastfed. All the above reasons are considered to be risk factors for neonatal jaundice.\(^{[6,8]}\)

There have been a few attempts in the past to assess how well parents can detect the presence of neonatal jaundice and severity of it. In the study from the USA, in a multiethnic newborn population, the parental assessment of cephalocaudal progression of neonatal jaundice correlated with serum bilirubin levels even better than nurses and physicians.\(^{[4]}\) In another study by the same authors, mothers were found to have very good NPV (86%) for identifying infants with bilirubin levels of ≥12 mg/dl when assessed in their neonates after discharge from the hospital. However, the maternal assessment had a poor PPV of only 55% in their study.\(^{[1-3]}\) These results are in agreement with our study in which we found high NPV for maternal detection of significant jaundice. In another study on a population of 555 predominantly full-term healthy newborn population, nurses were asked to assess jaundice on a scale of 0–5, depending on the extent of jaundice progression. The authors concluded that the grades of jaundice

| Outcome          | Assessor    | Sensitivity (%) | Specificity (%) | PPV (%)      | NPV (%)      | Accuracy (%) |
|------------------|-------------|-----------------|-----------------|--------------|--------------|--------------|
| Significant jaundice | Mother     | 51.47 (37.43-62.57) | 88.33 (84.94-91.19) | 39.29 (31.25-47.95) | 92.12 (90.16-93.72) | 83.3 (79.75-86.46) |
| Significant jaundice | Pediatrician | 85.29 (74.61-92.72) | 85.35 (81.69-88.54) | 47.54 (41.45-53.71) | 97.39 (95.46-98.51) | 85.35 (81.96-88.32) |
| Any jaundice      | Mother     | 18.55 (14.85-22.71) | 88.68 (81.06-94.01) | 86.05 (77.7-91.61) | 22.43 (21.03-23.90) | 33.27 (29.17-37.56) |
| Any jaundice      | Pediatrician | 23.81 (19.71-28.30) | 74.53 (65.14-82.49) | 77.87 (70.85-83.59) | 20.63 (18.67-22.73) | 34.46 (30.31-38.78) |

PPV: Positive predictive value, NPV: Negative predictive value

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4. High specificity and NPV of maternal ability to detect significant jaundice. However, for either minimal jaundice or significant jaundice, the sensitivity by maternal assessment was poor.
5. India has a predominantly breastfed neonatal population, and breastfed babies often have relatively higher and prolonged bilirubin peaks.
6. Second for many administrative and domestic reasons, the mother–infant dyads are often discharged very soon from the hospital.
7. Many of our newborn population reside in rural and far-flung areas.
8. Parents have often failed in the past to recognize severe jaundice, even though in our study, the proportion of neonates with jaundice detected by mothers increased as TSB level increased.
9. The Indian neonates usually have pigmented skin.
10. All the above reasons are considered to be risk factors for neonatal jaundice.
correlated poorly with the serum bilirubin values, and only complete absence of jaundice had excellent NPV to rule our significant hyperbilirubinemia.[12] Similarly, in another study, infants with jaundice face downwards up to nipple line had shown consistent bilirubin values <12 mg/dL.[13] There were attempts to help mothers in earlier detection of jaundice, using transcutaneous icterometry, utilizing a Perspex plastic strip comprised of yellow strips of increasing intensity with alternate strips of transparent areas through which blanched skin color could be compared.[14] Many novel methods of detection of jaundice by parents have come up in recent times like advanced image processing techniques using a standard smartphone and color calibration cards in which jaundice can be successfully detected in neonates with jaundice.[15] Bilistrip™, a simple, low cost mechanical two-color icterometer, to be used by mothers, have shown sensitivity and NPV of more than 95% in detecting neonates requiring phototherapy.[16] However, at many places in India, we often rely on visual estimation of neonatal jaundice for screening purpose, even though recommendations are there against the use of visual assessment even by healthcare providers and to use either noninvasive transcutaneous bilirubin (TcB) or TSB.[6,7] TcB can be measured easily by a transcutaneous bilirubinometer, which gives a valid estimate of TSB at <15 mg/dL.[6,17,18]

To the best of our knowledge, this has been possibly the first study from India in attempting to know the ability by mothers in detecting jaundice in their newborns. Our study has a few limitations as well. The study was carried out in hospital setting, and bilirubin levels were relatively low in initial a few days of life. More useful would be to study their ability to detect jaundice after discharge from the hospital, when the bilirubin values are likely to go even higher. Our study being hospital based; it may not be generalizable at the community setting.

**Conclusion**

Mothers have poor sensitivity and PPV to detect significant neonatal jaundice in the Indian population even though odds of jaundice getting detected by mother are more as bilirubin levels are higher. Nevertheless, neonates should be followed up for jaundice by a pediatrician if clinically indicated. There is a need to study parental ability to detect jaundice after initial discharge from the hospital in community setting.

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Nil.

**Conflicts of interest**

There are no conflicts of interest.

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