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Original article

Pediatricians' knowledge and perception of the care of the infant with jaundice

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Abstract

Aim: Neonatal jaundice is a common cause for emergency department referral in the first weeks of life. Indirect bilirubin in high levels can cross the blood-brain barrier and cause bilirubin-induced neurotoxicity. This study aimed to evaluate primary care pediatricians' self-perception, attitudes, and competency regarding the care of the jaundiced neonate. We evaluated the pediatricians' knowledge of and adherence to the guidelines of the American Academy of Pediatrics and of the National Institute for Health and Care Excellence.

Methods: Structured questionnaires were distributed online by electronic mailing lists to community pediatricians.

Results: Overall, 188 physicians responded. Responses varied widely regarding the interpretation of cutaneous bilirubin levels. Adding milk formula to breastfeeding was recommended by 47 (25.0%) respondents. Twenty-six (13.8%) recommended temporary breastfeeding cessation to decrease bilirubin levels.

Conclusion: A considerable proportion of community pediatricians who responded to our survey described care for jaundiced neonates that deviates from current guidelines. Education should address the misconception that ceasing breastfeeding effectively lowers bilirubin levels.

Keywords

Breastfeeding, hyperbilirubinemia, jaundice, neonate, primary care, questionnaire.

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Background

Neonatal indirect hyperbilirubinemia is the most common adverse condition in newborns, affecting approximately 50% of full-term and 80% of preterm infants during the first week of life [1]. It results from an imbalance between the production and conjugation of bilirubin [2], and is a leading cause of medical referral to the emergency department in the first 2 weeks of life. Notably, 65% of neonatal readmissions in the first week and 8% in the second week are due to severe hyperbilirubinemia [3].

Neonatal jaundice is almost universal and usually presents as benign indirect physiologic hyperbilirubinemia, which is normal and benign. Some neonates develop severe indirect hyperbilirubinemia, requiring laboratory investigation, treatment, and follow-up [4]. Indirect bilirubin is liposoluble and, at high levels, can cross the blood-brain barrier, thereby impairing the central nervous system [3]. Kernicterus is a potential consequence of severe neonatal hyperbilirubinemia. This condition arises due to the excessive passage of unconjugated bilirubin across the blood-brain barrier, leading to irreversible damage to the basal ganglia, the cerebellum and the auditory system [5].

Primary care physicians represent the backbone of the pediatric healthcare system. During the first few days after discharge from the nursery, a neonatal follow-up visit is usually scheduled with a doctor or well-baby clinic for physical examination, measurements and parental guidance. The physicians' goal is to identify, investigate and refer neonates who need further attention regarding threatening or severe indirect hyperbilirubinemia.

Parents have cited jaundice as a reason to discontinue breastfeeding [6], but data are lacking regarding physician recommendations in this regard. This raises concern, given the recognized role of low caloric intake and dehydration in the development of neonatal hyperbilirubinemia [7].

This study aimed to evaluate primary care physicians' self-perception, attitudes and competency regarding the care of the jaundiced neonate. We evaluated pediatricians' knowledge of and adherence to the guidelines of the American Academy of Pediatrics (AAP) [4] and the guidelines of the National Institute for Health and Care Excellence (NICE) [8].

Methods

Research design

This study entailed a structured questionnaire that was distributed online, according to an electronic mailing list, to community physicians working in Clalit Health Services, the largest healthcare service in Israel. The questionnaires were filled out from January to March 2021. The study was exempt from review by the district review board and the ethics committee.

Measurement and data collection

Participants were asked to fill out a questionnaire that included demographic details, information regarding residency, specialty and sub-specialty, years in practice, and whether they also worked in a hospital. In addition, details were accessed regarding the location, size, number of physicians, and equipment in their clinic. They were asked about the existence and use of a neonatal jaundice protocol, the presence of a nurse in the clinic, and the use of a trans-cutaneous bilirubinometer. Information was accessed regarding clinical issues, including risk factors, workup, treatment options, and referral or follow-up. Breastfeeding was defined as full or partial breastfeeding at the time of assessment [9]. At the end of the questionnaire, physicians were asked specifically if they were familiar with the AAP guidelines.

Data analysis

Descriptive data were compared using Chi-Square and Fisher's exact Chi-Square analysis. Data were analyzed using SPSS® Statistics for Windows®, Version 26.0 (IBM® SPSS® Statistics for Windows®, Version 23.0. IBM Corp, Armonk, NY, USA).

Results

Overall, 188 physicians responded to the questionnaire. **Tab. 1** shows their demographic and background data. **Tab. 2** presents the proportions of respondents who perceived certain parameters as risk factors for severe hyperbilirubinemia and whether each parameter is considered a risk factor in the AAP and NICE guidelines [4, 10]. While blood group incompatibility and glucose-6-phosphate dehydrogenase (G6PD) deficiency were recognized as risk factors by almost all the respondents, there was no consensus regarding the other factors. Notably, neither exclusive breastfeeding nor having a mother with diabetes was in itself considered a risk factor. Only 24 (12.8%) physicians correctly identified all the risk factors according to the AAP and NICE guidelines.

Prolonged jaundice was defined as 1 week by 5 (2.7%), 2 weeks by 85 (45.2%), and 3 weeks by 98 (52.1%) physicians. Three weeks was defined as prolonged jaundice by 65 (72.2%) of the physicians with 10 or more years of experience and by 33 (33.7%) of the physicians with less than 10 years of experience ($p < 0.001$). Forty-seven (25.0%) physicians did not apply a constant threshold of bilirubin level for investigating prolonged jaundice, while the remaining named bilirubin values were in the range of 3-13.5 mg/dL. **Tab. 3** shows the responses regarding the work-up performed in prolonged jaundice.

Table 1. Demographic and background data of the respondents to the questionnaire (n = 188).

Parameter		Number (%)
Profession	Pediatricians	161 (85.6%)
	Pediatric residents	8 (4.3%)
	Neonatalogists	7 (3.7%)
	Family physicians	5 (2.7%)
	General practitioners	5 (2.7%)
	Unknown	2 (1.1%)
Years of experience as a physician	Under 5	67 (35.6%)
	5-10	31 (16.5%)
	Over 10	90 (47.9%)
Works also in a hospital	Yes	54 (28.7%)
	No	134 (71.3%)
Location in Israel	Center	120 (63.8%)
	Periphery	67 (35.6%)
	Unknown	1 (0.5%)
Clinic size	Under 1,000 patients	29 (15.4%)
	1,000-5,000 patients	76 (40.4%)
	Over 5,000 patients	83 (44.1%)
Number of physicians in the clinic	1	35 (18.6%)
	2-4	84 (44.7%)
	Over 5	69 (36.7%)
The clinic includes nursing staff	Yes	167 (88.8%)
	No	21 (11.2%)
Bilirubin method used in the clinic	Capillary	111 (59.0%)
	Venous	60 (31.9%)
	Unknown	17 (9.0%)

Table 2. The proportions of physicians who cited certain parameters as positive risk factors for severe hyperbilirubinemia (n = 188).

	Number (%)	Risk factor, according to APP guidelines	Risk factor, according to NICE guidelines
Blood group incompatibility	186 (98.9%)	Yes	Yes
G6PD deficiency	179 (95.2%)	Yes	Yes
Exclusive breastfeeding	77 (41.0%)	No	Yes
Exclusive breastfeeding with suboptimal intake	126 (67.0%)	Yes	NA
The mother has diabetes and the infant was macrosomic	58 (30.9%)	No	NA
A previous sibling who required phototherapy	137 (72.9%)	Yes	Yes

APP: American Academy of Pediatrics; G6PD: glucose-6-phosphate dehydrogenase; NA: not applicable; NICE: National Institute for Health and Care Excellence.

Table 3. The proportions of physicians who recommended certain diagnostic tests as part of the work-up for prolonged jaundice (n = 188).

Diagnostic test	Number (%)	Recommended by the guidelines of AAP and of NICE
Direct bilirubin	185 (98.4%)	Yes
Thyroid studies	183 (97.3%)	Review the newborn's screening results
Urinalysis	121 (64.3%)	If clinically appropriate
Urine culture	126 (67.0%)	If clinically appropriate
Abdominal ultrasound	30 (16.0%)	No

APP: American Academy of Pediatrics; NICE: National Institute for Health and Care Excellence.

In total, 123 (65.4%) physicians stated having a transcutaneous bilirubin (TcB) measuring device at their clinic. Most of these, 75 (61.0%), stated that they perform the TcB test according to clinical jaundice; 18 (14.6%) performed the test at every first visit to the clinic, and 23 (18.7%) according to the bilirubin level at hospital discharge. Seven (5.7%) did not respond to this question. We asked the physicians to state the circumstances in which they perform a blood bilirubin test following a TcB test. Twenty-one (17.1%) stated not using a constant threshold, 27 (22.0%) used a low intermediate threshold, 17 (13.8%) used a high intermediate threshold, and 55 (44.7%) named specific values in the range of 10-15 mg/dL.

Sun exposure as a means of lowering bilirubin levels was recommended by 45 (24.0%) physicians. Adding milk formula to breastfeeding was recommended by 47 (25.0%). Twenty-six (13.8%) recommended temporary breastfeeding cessation to decrease bilirubin levels. Physicians with 10 or more years of experience, compared to those with less experience, were more likely to recommend breastfeeding cessation (18.9% vs. 8.2%, $p = 0.03$). Most physicians (76.1%) released the infant from routine jaundice follow-up when the bilirubin level decreased, even when the level did not reach a normal value.

Of the 188 respondents, 145 (77.1%) believed there should be a written protocol for neonatal jaundice. However, only 33 (17.6%) reported that a written protocol was available in their clinic. In total, 124 (66.0%) respondents stated that they were familiar with the current APP guidelines for neonatal jaundice. The use of a written protocol was not found to be significantly more prevalent among physicians who also worked at a hospital, worked in larger clinics, or had more than one physician at their clinic (data not shown).

Discussion

Only 66.0% of the physicians who responded to our questionnaire were familiar with the guidelines for neonatal jaundice that were current at the time. Most of the respondents stated that their clinic did not have a written protocol for neonatal jaundice. One-quarter of the respondents recommended adding milk formula to breastfeeding, and 13.8% recommended temporary breastfeeding cessation to decrease bilirubin levels.

The approach to neonatal jaundice is complex. Clinical decisions are based on many parameters, including the infant's age, the velocity of bilirubin increase, risk factors and socio-demographic issues. The APP and NICE guidelines focus on reducing the incidence of severe bilirubinaemia while minimizing risks, including unnecessary treatment, parental anxiety and decreased breastfeeding [4, 10]. A systematic review that compared 12 clinical practice guidelines for neonatal hyperbilirubinemia, including those of the AAP and NICE, demonstrated inconsistencies in their recommendations [11]. Moreover, a local survey in Malaysia showed that the diagnostic criteria and initial management of prolonged neonatal jaundice were not standardized. The development and implementation of a new protocol resulted in improved quality of care, better clinical assessment, and fewer laboratory investigations and patient visits [12].

Dehydration and low caloric intake, which are associated with inadequate breastfeeding, may contribute to hyperbilirubinemia. The AAP and NICE guidelines recommend providing appropriate advice to breastfeeding mothers and ensuring that adequate support is offered to all women who intend to breastfeed exclusively. The AAP recommends against routine supplementation with water for non-dehydrated breastfed infants [4]. Although most physicians in our study encouraged breastfeeding, some recommended adding formula and even ceasing to breastfeed to decrease bilirubin levels. This corroborates a recent Korean survey [13]. While most of the responding pediatricians in that survey expressed a positive outlook on breastfeeding, most did not provide breastfeeding counseling, and they stated neonatal jaundice as a main factor that led to breastfeeding cessation. Our findings highlight the importance of comprehensive education to medical personnel regarding the treatment of neonates with hyperbilirubinemia. This education should address the misconception that ceasing breastfeeding effectively lowers bilirubin levels.

Sun exposure as a means for lowering bilirubin levels was recommended by 24.0% of the respondents to our questionnaire. Although sunlight provides sufficient irradiance for phototherapy, the risk of exposing a naked newborn to the sun precludes the use of sunlight as a reliable therapeutic tool and is not recommended [4].

Clinical risk stratification is a suitable method for assessing the risk of severe hyperbilirubinemia. Notably, severe hyperbilirubinemia is rare, while each risk factor is quite common, thus limiting its utility [14]. **Tab. 4** lists the risk factors for severe hyperbilirubinemia as defined by the AAP. Notably,

Table 4. Risk factors for developing significant hyperbilirubinemia according to the guidelines of the American Academy of Pediatrics (AAP).

AAP 2004 guidelines	AAP 2022 guidelines	
Significant hyperbilirubinemia risk factors	**Significant hyperbilirubinemia risk factors**	**Hyperbilirubinemia neurotoxicity risk factor**
Major • Predischarge bilirubin level in the high-risk zone • Jaundice observed in the first 24 hours • Blood group incompatibility with positive direct antiglobulin test • G6PD deficiency • Gestational age 35-36 weeks • Previous sibling receiving phototherapy • Exclusive breastfeeding, particularly if breastfeeding is not going well and weight loss is excessive **Minor** • Predischarge bilirubin level is in the high intermediate risk zone • Jaundice observed before discharge • Gestational age 37-38 weeks • Previous sibling with jaundice • Macrosomic infant of diabetic mother • Maternal age > 25 years • Male gender	• Predischarge TcB or TSB concentration close to the phototherapy threshold • Jaundice in the first 24 hours after birth • Hemolysis from any cause • Family history or genetic ancestry suggestive of inherited red blood cell disorders, including G6PD deficiency • Lower gestational age • Parent or sibling requiring phototherapy or exchange transfusion • Exclusive breastfeeding with suboptimal intake • Scalp hematoma or significant bruising • Phototherapy before discharge • Down syndrome • Macrosomic infant of a diabetic mother	• Gestational age < 38 weeks • Albumin < 3.0 g/dL • Isoimmune hemolytic disease (i.e., positive direct antiglobulin test), G6PD deficiency, or other hemolytic conditions • Sepsis • Significant clinical instability in the previous 24 hours

AAP: American Academy of Pediatrics; G6PD: glucose-6-phosphate dehydrogenase; TcB: transcutaneous bilirubin; TSB: total serum bilirubin.

exclusive breastfeeding is considered a risk factor, especially when breastfeeding does not progress well and weight loss is excessive. An infant of a mother with diabetes is considered at risk only if the infant is also macrosomic.

Non-invasive TcB measurements can provide valid and reliable estimates of serum bilirubin levels [4]. We report considerable variability regarding the use and interpretation of TcB levels. Additional studies are needed regarding the use of TcB and whether TcB measurements can be plotted on the standard nomogram or if TcB-specific nomograms are needed [15]. Physicians should be aware of the limitations of TcB. BiliChek (Respironics, USA) and JM-103 (Drager Medical Inc, USA) bilirubinometers significantly overestimate serum bilirubin in Black African neonates and may result in unnecessary or excessive treatments [16]. A systematic review and meta-analysis by Nagar et al. found a moderate correlation between TcB and serum bilirubin during and after phototherapy. Physicians should be careful when basing therapeutic decisions on TcB values in infants after phototherapy [17]. The AAP defines prolonged jaundice as 2 weeks for formula-fed infants and 3 weeks or longer for breastfed infants [4]. The North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition and the European Society for Paediatric Gastroenterology, Hepatology and Nutrition define prolonged jaundice as 2 weeks [18]. No specific bilirubin level is attached to this definition, and the statements generally refer to "clinical jaundice." The AAP and NICE suggest testing total and direct bilirubin in all infants with prolonged jaundice and reviewing all the results for newborn thyroid and galactosemia screen. G6PD deficiency should be tested, and urine cultures should be taken when clinically appropriate [4, 10].

Our work had a number of limitations. The questionnaire was distributed in the central region of Israel, primarily to pediatricians. The responses may not fully represent the practices and knowledge of pediatricians in other regions or countries. This possible geographical bias could limit the generalizability of the findings to a broader population, including family physicians and general practitioners. Secondly, the study relied on self-reported data from the participating pediatricians, which may be subject to recall bias or social desirability bias. Participants might have provided responses they believed were expected rather than reflecting their actual practices or knowledge. Some

questions regarding TcB interpretation are not addressed in the guidelines, and thus, the correct answers to these questions are not absolute. Certain questions, such as those addressing weight loss and breastfeeding assessments, were general in nature and lacked reference to age-specific factors. Finally, the relevant AAP guideline was updated in 2022, and the NICE guideline was updated in 2023 after the distribution of the questionnaire. However, the recommendations for the topics discussed in this report were not updated in the current guidelines.

Conclusions

Our findings highlight significant gaps in the knowledge of paediatricians involved in primary care regarding neonatal hyperbilirubinemia. We report that only two-thirds of the physicians who responded to our question were familiar with the current guidelines for neonatal jaundice. Adding milk formula to breastfeeding was recommended by 47 (25.0%), and 26 (13.8%) recommended temporary breastfeeding cessation to decrease bilirubin levels. It is important that physicians who treat children be familiar with the current guidelines for neonatal jaundice. The primary objective of this work is to encourage relevant authorities to implement targeted training programs aimed at improving the care and outcomes of newborns discharged with hyperbilirubinemia. In this context, studies focusing on developing specific guidelines tailored to the Israeli population – considering the prevalence of jaundice and the particularities of the Israeli healthcare system – would be extremely valuable. These guidelines, while based on international data, would offer greater relevance and applicability to the local context, ultimately leading to more effective management and better outcomes.

Abbreviations

APP: American Academy of Pediatrics
G6PD: glucose-6-phosphate dehydrogenase
NICE: National Institute for Health and Care Excellence
TcB: transcutaneus bilirubin
TSB: total serum bilirubin

Declaration of interest

The Authors declare that there is no conflict of interest. There is no funding or financial support to declare.

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