

Beyond Phototherapy: Monitoring Serum Bilirubin Levels, Massaging Babies, and Using a Bilirubinometer

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ABSTRACT

Jaundice - also known as neonatal hyperbilirubinemia - is as common today as it was half a century ago, only with newer advances being suggested left and right alongside the gold standards of treatment that already exist and that have helped modulate its existence within the clinical setting. In this review, we will be highlighting three evident examples from literature of helpful methods for the evaluation and management of neonatal hyperbilirubinemia beyond just the treatment of afflicted infants with phototherapy. This review will refer to two studies and one idea from another study all related to the levels of bilirubin. Namely, whether or not bilirubin levels can affect feeding and sucking, how massaging babies can help reduce bilirubin levels and increase stool frequency, and finally what a bilirubinometer can offer as a method of early detection.

keywords

Jaundice, hyperbilirubinemia, Patients.

Introduction

Jaundice is the clinical condition characterized by elevated levels of bilirubin in the blood, termed as 'hyperbilirubinemia'. It is manifested by yellowish discoloration of the skin, eyes, and sclera, particularly. As common as it is, no harm is ever really evident unless proven otherwise by rigorous evaluation and testing.

In the first few days of life, the hemoglobin that was present in the fetal bloodstream begins to break down into fragments, each circulating to be filtered. These fragments are derived from the breakdown of red blood cells (RBCs) and end up forming none other than the yellowish-green material known as bilirubin, that usually accumulates in the neonatal period due to a lack of the enzyme that should conjugate it in order to allow it to be excreted further.

In newborns, jaundice is labelled physiological when it appears in the first few days of life and disappears slowly with time, thereby highlighting how transient these cases are. On the other hand, it is deemed pathological when it appears on the first day of life with the serum total bilirubin rising to more than 12 mg/dL (in a full-term infant); continuing to be present for more than 2 weeks. This

is where extreme consideration by physicians is taken to exclude the probable causes of pathological jaundice characterized by further increased levels of conjugated bilirubin, such as gallbladder disorders (cholestasis), therefore ruling out potential causes such as infection, hemolysis, or enzymatic defects of the RBC surface [1].

There at times is suspicion as to whether or not the feeding is relative or even affected further, leading hesitant mothers of newborns with hyperbilirubinemia to report that the nursing and feeding is not as effective as it was before the appearance of the jaundice [2]. This brings about differentials to consider and rule out.

Breast-milk jaundice is not always a direct entity, but is worth ruling out in cases of prolonged jaundice, apace with other conditions that could persist beyond two weeks such as infections, sepsis, Gilbert's syndrome, G6PD, or cholestasis [1].

Nevertheless, phototherapy exists today as the necessary and beneficial treatment of jaundice, which helps conjugate the forms of bilirubin that run within the bloodstream and further excrete it out of the body. This is all usually reserved for a small proportion of patients, when considering both the nearly 60% full-term newborns and the nearly 80% preterm infants affected [3].

Our main concern above all else, is the development of 'kernicterus', an underlying neurological condition characterized by the deposition of the unconjugated forms of bilirubin in the brain, specifically the basal ganglia, which helps regulate and modulate our motor skills. In this manner, a line of management beyond phototherapy will be necessary appearing in the form of exchange transfusion [1].

Evidence I

It has been reported that poor feeding could exist due to many underlying issues; the worst being bilirubin encephalopathy. As hypothesized by R. Bromiker et al., neonatal hyperbilirubinemia would suppress the volume of feed that was ingested by an afflicted newborn and certain parameters of sucking when compared to newborns who were less jaundiced. This inquiry was ascertained by including neonates that had moderately elevated yet clinically significant bilirubin levels, found to be above 15 mg/dL, in order to determine any type of effect on the newborn's feed. Some of the parameters they were interested in assessing included the number of sucks per feed and the average number of sucking pressures [2].

R. Bromiker et al. studied 17 newborns diagnosed with neonatal hyperbilirubinemia and compared them to 24 controls whose levels of assumed bilirubin were measured daily as transcutaneous and were less than 10 mg/dL (as well as serum total bilirubin). One helpful parameter pertaining to feeding was that of the volume of feed ingested; it was similar between both groups (30 mL vs. 25 mL), but no other differences were identified.

The measurements were conducted by using different forms of the milk - whether it was expressed from the infant's mother or formula - over a recorded period of five minutes at the start of each feed and when concluded; then allowing for the infants to continue their feed. Out of 41 newborns, an average volume of 30 mL was recorded for the jaundiced babies in comparison to 25 mL in the non-jaundiced babies. Furthermore, 97 sucks over five minutes was recorded for the jaundiced babies, whilst 81 sucks over five minutes was recorded for the controls [2].

The lack of demonstrating any sucking impairment in this study was probably due to the moderate elevation of the serum total bilirubin [2]. On the upside however, the poor feeding was concluded to not necessarily be the direct cause of the jaundice. Ergo, parental concern is vital when this particular dilemma develops.

They concluded that when serum total bilirubin was measured between 15-20 mg/dL and found to be moderately elevated in affected patients it does not decrease the volume of feed or even certain sucking parameters. Therefore, it is not so easy to immediately relate poor feeding to bilirubin levels [2].

Evidence II

Now we come to the understanding of a particular physical method to help alleviate neonatal hyperbilirubinemia, amongst many interventions that exist today. It is without a doubt, that separation between a mother and her infant could lead to emotional distress

and not improve the prognosis at hand. Yet this is where baby massage comes in as a helpful tool and method of prevention, while allowing for the ultimate goal to help excrete the bilirubin via defecation. Many promising outcomes have been observed clinically over the years thanks to baby massage; including adequate weight gain, improved sleep, and reduced cases of colic. This one-year study by Dalili, H. et al. helped clarify the effects of massaging a full-term healthy baby with jaundice that was not undergoing phototherapy [3].

Touch Therapy [4], was explained and taught by a specialized midwife to the mothers of the enrolled cases. For a period of 15-20 minutes, a frequency of 3 times daily, and from day 1 of life to day 4, the following series of maneuvers were applied to each baby:

- Gently touching the skin (after hand washing & applying baby oil).
- Applying minor 2 finger pressure on the forehead, cheeks, & orbital regions.
- Side by side sliding of two fingers horizontally across the chest.
- Circular movements around the abdomen in a clockwise manner.
- Vertical movements down limbs, applying flexion, & extending adjacent joints.
- Massaging the backside by gentle pressure across the vertebral canal.
- Downward sliding lateral to each of the vertebrae.

After applying the aforementioned set of movements, the frequency of stools for each newborn would be measured daily, as well as the transcutaneous bilirubin levels on day 4 for both groups. The respective results revealed steadily increased stool frequencies for both parties, with only a significant difference on day 1 (2.4 defecations for the control group and 1.8 defecations for the massaged group; $p < 0.042$) and similar averages for the remaining three days. The transcutaneous bilirubin level was found to be much lower in the treatment group by an increment of 2 (11.0 in the control and 9.2 in the massaged group) [3].

Despite having a limited sample size and not detecting the levels of the bilirubin on day 1, Dalili H, et al. were able to conclude that baby massage serves as a safe intervention to help prevent severe hyperbilirubinemia in full-term healthy infants; whereby the steadily increased stool frequency clarified the lower levels of transcutaneous bilirubin [3].

Evidence III

Generally, the aim of early detection should always help prevent the worst-case scenario of any handled condition. In this case, bilirubin level evaluation will help to prevent kernicterus; such that an incidence of severity will be reduced down the line [4-6].

Ramachandran A, illustrated the points at which transcutaneous bilirubinometry can be helpful as a non-invasive approach to estimate bilirubin levels in those at more than 35 weeks of gestation, less than 2 weeks old, and not previously provided

with phototherapy. In generating signals to a microprocessor, the bilirubin in its absorbable level can be quantified appropriately. As evidenced by the ABMU Health Board in Wales in 2015, the bilirubinometer has been found to be helpful in predicting the need for admission and furthermore phototherapy. Trained community nurses who are well-equipped with this device can help reduce the rates of hospital referrals, therefore providing a safer and reassuring platform for patient centered care [6].

Discussion

With regards to kernicterus (or bilirubin encephalopathy), some studies have gone as far as to say that the feeding provided is not quite relevant to the development of kernicterus, as is evident in the work of Murki et al., wherein kernicterus - afflicted newborns who were fed exclusive breast milk were found to be less in amount as compared to babies without - kernicterus (57% vs. 80%) [7].

In the matter of dehydration, the methods of feeding are inarguable tools to help continue to provide the best hydration possible, whether it's via the mother independently, or hospital/community nurses providing support. Assisting in breastfeeding mothers in such regard cannot be denied and can serve as the first step before attempting the nasogastric approach or intravenous hydration; when there is more than 12% weight loss in the first 2 weeks of life [6].

Summary

In this day and age, pediatricians are grateful for having such a thorough knowledge and understanding of jaundice; the principle ranges from the simple physiological explanation all the way to the many available clinical options of management.

Only time will tell if there could be a revolutionary tool to help us further ease treatment altogether, but as far as things go, the phototherapy is a saving grace along with available transfusions - if needed.

We now can understand from existing literature the relation between total serum bilirubin levels and poor feeding evident within the clinical setting. Applying helpful physical maneuvers, such as baby massage and considering a technological instrument can finally help assure families and patients early on.

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