



Influence of hyperbilirubinemia on neonatal sucking



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ABSTRACT

Background: Mothers of hyperbilirubinemic newborns frequently report to us that their infant is feeding poorly. As poor feeding in an extremely hyperbilirubinemic newborn may be an early sign of bilirubin encephalopathy, we hypothesized that neonatal hyperbilirubinemia would suppress the volume of feed ingested and diminish sucking parameters in comparison with minimally jaundiced neonates.

Objective: To determine whether hyperbilirubinemia does diminish feeding and sucking in neonates.

Study design: Neonates in a well-baby nursery with serum total bilirubin (STB) ≥ 15.0 mg/dL were compared with those with transcutaneous bilirubin ≤ 10 mg/dL. Neonur, a modification of Krohn's Nutritive Sucking Apparatus, was used to quantify sucking parameters. Measurements during a 5 min feeding period included volume ingested (measured manually), number of sucks, average maximum sucking pressure, number of bursts, average burst duration, pause between bursts duration, number of sucks per burst, and average intersuck interval. Outcome measures were volume ingested and, presuming decreased volume, sucking parameter analysis would determine the component affected by hyperbilirubinemia.

Results: 17 hyperbilirubinemic newborns (STB 17.8 ± 1.6 mg/dL) were compared with 24 controls, all with transcutaneous bilirubin < 10.0 mg/dL. The volume of feed ingested was similar between the hyperbilirubinemic newborns and controls (30.00 [20.00–42.50] ml vs. 25.00 [15.00–30.00] ml, $p = 0.2$) (median [95% confidence interval]). No significant differences were noted in any of the other sucking parameters measured.

Conclusions: At concentrations of STB in the range of 15–20 mg/dL, hyperbilirubinemia did not diminish feed volume or sucking parameters in term newborns. Poor feeding in moderately hyperbilirubinemic newborns cannot be attributed to the level of bilirubin per se.

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Neonatal jaundice is common, usually harmless, and transient. Breast milk jaundice may lead to lethargy and poor feeding [1] while in the rare, extremely hyperbilirubinemic newborn who had previously been nursing and feeding well, poor feeding may be an early sign of bilirubin neurotoxicity [2,3,4]. In our neonatal service, mothers of hyperbilirubinemic neonates frequently report their infant is nursing and feeding less well than before the jaundice became apparent. It is not known whether this maternal observation, if substantiated, may be a precursor of the poor feeding associated with bilirubin encephalopathy.

The objective of this study was to determine the effect, if any, of neonatal hyperbilirubinemia on newborns' feeding, by quantitatively comparing sucking parameters between those hyperbilirubinemic and those with minimal, or clinically insignificant, jaundice. Based on

maternal accounts, we hypothesized that hyperbilirubinemic neonates would feed a lesser amount during the study period. Should this be substantiated, the device used would enable us to determine which of the sucking components was responsible for the decreased volume ingested. (See description of device below) To our knowledge, few studies of this nature have been previously reported.

1. Methods

The study was approved by the Institutional Review Board of the Shaare Zedek Medical Center. Signed informed consent was obtained prior to enrollment.

This was a convenience study of otherwise healthy, term and late preterm (>36 weeks gestation) neonates, some of whom developed hyperbilirubinemia. As there are no previously published data on the subject, we could not estimate the size of the study and control groups necessary. Newborns with any medical condition requiring admission to the NICU, major congenital abnormality, sepsis, or respiratory distress, were ineligible for enrollment. During birth hospitalization, daily

Abbreviations: STB, serum total bilirubin; TcB, transcutaneous bilirubin.

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transcutaneous bilirubin (TcB) was measured routinely in all and the results plotted on the Bhutani et al. nomogram [5]. Serum total bilirubin (STB) was determined in those with TcB readings >75th percentile, or >50th percentile in the presence of risk factors including gestational age < 37 weeks, glucose-6-phosphate dehydrogenase deficiency, ABO blood group incompatibility with positive direct agglutination titer, cephalhematoma or clinically significant echymoses, as previously described [6]. Breast feeding was encouraged in all.

Transcutaneous bilirubin testing was performed using a JM-103 bilirubinometer (Drager, Lübeck, Germany). STB was determined routinely on heparinized, centrifuged capillary tube samples by absorbance of bilirubin at 455 nm (Bilimeter 3; Pfaff Medical, Germany). Phototherapy was instituted in accordance of the hyperbilirubinemia guidelines of the Israel Neonatal Society [7] which in turn are based on and similar to those of the American Academy of Pediatrics (2004) [8].

1.1. Study procedure

For the purpose of the study, parents of appropriate babies were approached to request enrollment in the study. The hyperbilirubinemic group was studied either during birth hospitalization or when readmitted for hyperbilirubinemia, in both situations prior to the onset of phototherapy. The control group was selected from babies during birth hospitalization, also on a convenience basis, from the identical pool of neonates but who did not meet the criteria for clinically significant jaundice. Apart from the study procedure, there was no interference in the regular daily nursery routine. Study measurements were performed using either expressed breast milk from that specific infant's mother, when available, or formula. Infants were held, swaddled, and brought to a quiet alert state, in almost all cases by the mother, before sucking measurements were performed. Parameters were tested over a 5 minute recording period at the beginning of a feed. After the measurement was completed, the infants continued routine breast or bottle feeding till completion of the feed.

1.1.1. Investigational apparatus and parameters tested

The Neonur is an advanced-model mobile nutritive sucking device (Fig. 1). The system employs a 'bottle unit' with signal processing and storage functionality, and a computer with software for data analysis, display, and report generation. The signal processor (electronics component in the figure) gathers and digitizes the data from the pressure sensor every 5 msec and stores it on-board in a flash memory. At test completion, the data are downloaded to a PC through a standard cable and further data processing is carried out on the PC with specially designed MATLAB® software (MathWorks, Natick, Massachusetts, U.S.A). The software analyzes the varying pressures generated during a sucking bout using temporal and pressure threshold criteria, capable of distinguishing true sucks from non-sucking movements or other artifacts. The initial output is a graph of the sucking record followed by an Excel spreadsheet of the sucking parameters including: a. total number of sucks per 5-minute session, b. sucking duration (interval from first to last suck in session), c. number of bursts (a 2-s pause defines the separation of 2 bursts), d. mean burst duration, e. total burst time as percent of bout, f. within-burst suck frequency, and g. mean peak sucking pressure for each participant. The ingested volume was manually recorded.

1.1.2. Definitions

For the purpose of the study, clinically significant hyperbilirubinemia was defined as those with STB ≥ 15 mg/dL, equivalent to 95th percentile at 60 postnatal hours. Neonates with TcB readings ≤ 10 mg/dL, or who had a STB determination which fell in the ≤ 10 mg/dL range were regarded as not hyperbilirubinemic and served as controls.

1.1.3. Statistical analysis

Data were incorporated into an Excel file (Microsoft Corp). The mean and standard deviation, or median and interquartile range, as

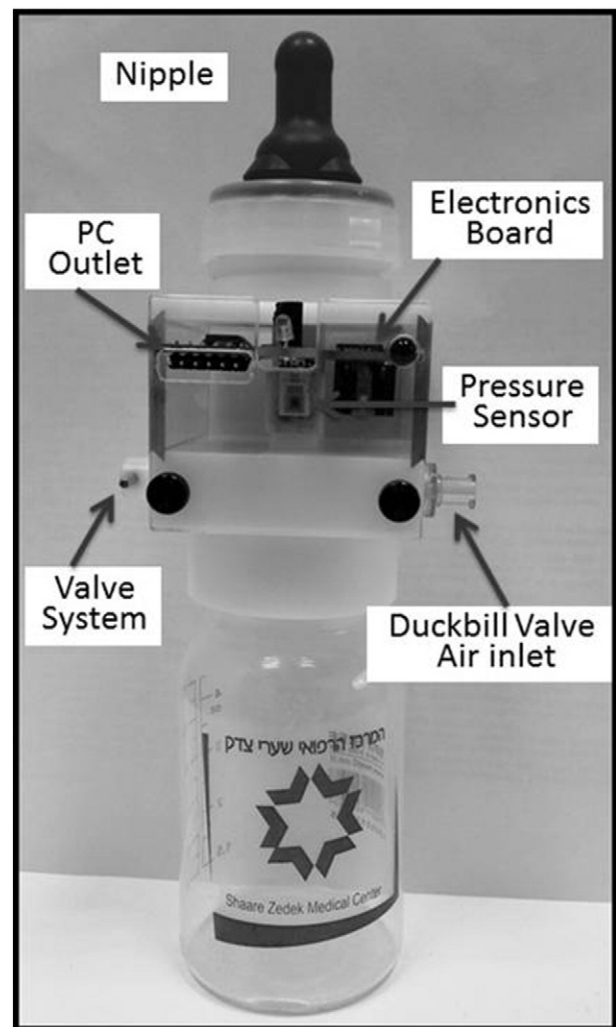


Fig. 1. Photograph of the Neonur nutritive sucking device.

appropriate for value sets with a normal or non-parametric distribution, respectively, was calculated for each of the sucking measurements over the 5 min test period. Continuous values were compared using Student's *t*-test or the Mann-Whitney test, as appropriate for normal or non-parametric distribution, and categorical values using chi-square analysis. A *p* value <0.05 was regarded as statistically significant.

2. Results

A total of 41 newborns was studied, of whom 17 were designated hyperbilirubinemic (mean [SD]) bilirubin immediately prior to the study test 17.8 ± 1.6 , range 15.0–20.2 mg/dL) and 24 non-jaundiced, all with TcB measurements <10.0 mg/dL immediately prior to the study. Age at testing was 2.9 ± 2.6 days in the jaundiced group and 2.8 ± 1.6 days in the control group (*P* = 0.8).

Demographic data are summarized in Table 1 and feeding and sucking parameters are compared between the groups in Table 2. No significant differences were noted between any of the demographic data or in sucking measurements between the hyperbilirubinemic and non-hyperbilirubinemic groups.

3. Discussion

Neonatal jaundice is a common occurrence in the first postnatal week [9,10]. Usually the jaundice is transient, but occasionally

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