RESEARCH PAPER

Breastfeeding and Readmission for Hyperbilirubinemia in Late Preterm and Term Infants in Beirut, Lebanon

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Objective: To determine whether exclusive breastfeeding is associated with readmission of jaundiced newborns. **Methods**: We retrieved medical records of 51 consecutive neonates >35 weeks with jaundice who were readmitted to the hospital, and compared to 164 controls. Data on gender, gestational age, birth weight, mode of delivery, feeding, bilirubin levels and breastfeeding counseling were analyzed. **Results**: 24% babies were readmitted for hyperbilirubinemia reaching phototherapy level. Early term infants had significantly higher risk for readmission compared to term [OR (95% CI) 2.12 (0.99-4.53); *P*= 0.05]. The risk of readmission was lower amongst subjects receiving mixed/formula feeding [OR (95% CI) 0.51 (0.26-0.98); *P*=0.046] odds of readmission decreased for those feeding >8 times per day (OR (95% CI) 0.46 (0.23-0.91); *P*=0.016], and those who stayed in hospital for more than 2 days after birth [OR (95% CI) 0.95(0.93-0.97); *P*<0.001]. **Conclusions**: Ensuring feeding at least 8 times per day and keeping newborns beyond the first 24 hours decreases the chance of readmission.

Keywords: *Breastfeeding frequency, Breastfeeding initiation, Hospital stay, Management.*

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Indirect hyperbilirubinemia is a commonly encountered problem leading to hospital readmission in the first week after birth. Reports suggest that 28% of neonates are readmitted within the first 30 days after birth [1]. Major risk factors for hospital readmission for neonatal hyperbilirubinemia are neonatal hemolysis, first time mothers, and early hospital discharge [2, 3]. Exclusive breastfeeding is reported as another identified risk factor for readmission due to hyperbilirubinemia [4]. In a multicenter study from Lebanon, exclusive breastfeeding and discharge at less than 48 hours were found to be associated with readmission for hyperbilirubinemia [5]. Since exclusive breastfeeding has major benefits in decreasing morbidity and mortality [4], therefore, to reinforce the practice of exclusive breastfeeding, the present study was planned with the objective to investigate the incidence of readmitted late preterm and term infants due to hyperbilirubinemia, and to examine the association between exclusive breastfeeding and readmission to hospital for jaundice.

METHODS

This study of hospital records was conducted at three university hospitals for the period between January, 2010 and December, 2019. Medical records at birth as well as at readmission of all infants born at 35 weeks of gestation or more, diagnosed with hyperbilirubinemia and readmitted for phototherapy within the first 28 days were reviewed as cases. Hyper-bilirubinemia cases were those requiring phototherapy based on a total serum bilirubin level at or above the threshold for phototherapy, considering the gestational age, risk factors and chronological age in hours. Control population of non-readmitted infants for each hospital was chosen by gestational age. Those were infants who developed hyperbilirubinemia (defined as total serum bilirubin level above 8mg/dL) but their level stayed below the threshold for phototherapy). Each of the cases was then matched for gestational age to 3 controls. Neonates admitted to the neonatal intensive care unit (NICU) immediately after birth or readmitted for reasons other than hyperbilirubinemia, had liver disease, or congenital abnormalities were excluded from the study.

Data like gestational age, birthweight, gender, length of stay in the hospital at the time of birth, postnatal age, maternal age, maternal education level, parity, mode of delivery, blood group, mother's blood group, ABO incompatibility and percentage of weight loss were

retrieved from the health record. On the basis of gestational age, the infants were divided into three groups, late preterm (34-36 weeks), early term (37-38 weeks) and term (38-42 weeks), as defined by the World Health Organization [6]. Three resident doctors were trained to collect data from the three sites, all medical records were screened and data was filled in pre-defined formats. For the purpose of the study, variables that were reviewed included feeding methods (exclusively breastfed, exclusively formula fed, or mixed feeding), number of feeds per 24 hours, duration of feed, counseling on breast-feeding (number of counseling notes, presence of lactation consultant), bilirubin levels before and after readmission, and duration of phototherapy, if any. The diagnosis and treatment of hyperbilirubinemia as defined above was determined by the treating physician. Consent from the parents was not required because of the retrospective nature of this study. This study was approved by the Institutional Review Board at each study center.

The sample size for this study was calculated by considering a baseline rate of exclusive breast feeding as 50%. Thus, to detect an 18% difference among the readmitted group, alpha error of 0.05 and power of 80%, a sample size of 120 newborns in each group was calculated.

Statistical analysis: Continuous variables were checked for normal distribution using Shapiro-Wilk test. Comparisons were made using the chi-square test for categorical variables and the Student *t* test or Mann Whitney *U* test for continuous variables. Logistic regression models were used to identify risk factors of readmission and Wald test was done to test the significance of the maternal age and gestational age. The goodness of fit of the models were tested using the Hosmer-Lemeshow test. Multivariate conditional logistic regression model was computed and *P* value <0.05 was considered statistically significant. Statistical Package for Social Sciences (SPSS) version 25.0 was used for analysis.

RESULTS

Out of the 215 neonates with neonatal jaundice, 51 (23.7%) were readmitted within 28 days of discharge; their median (IQR) age of readmission was 126 (94-177) hours and the youngest age of readmission was 1.25 days (**Table I**). Among the readmitted subjects, 32 (62.7%) were full term; 14 (27.5%) were early term and 5 out of 51 (9.8%) were late preterm.

Table I Characteristics of Infants Readmitted Within 28 Days (*N*=51)

Variable	*At initial discharge*	*At readmission*
Age (h)[a]	49.0 (41-66)	126 (94-177)
Weight (g)	3118.9 (353.4)	3104 (365.6)
%weight loss[a]	4.8 (1.4-7.3)	4.5 (2.0-6.2)
Bilirubin level[b]	8.55 (2.8)	11.33 (2.1)

Data represent mean (SD) or [a]median (IQR). [b]prior to discharge.

Bivariate analysis showed that the gestational age, mode of feeding, serum bilirubin level at first discharge, and length of stay following birth were all significant risk factors for readmission (**Table II**). Early term infants had significantly higher risk for readmission compared to term infants. More than half of those readmitted were exclusively breastfed compared to controls (56.9% vs 40.9%; *P*=0.04). Almost 80% of the readmitted subjects were reported to have fed less than 8 times per 24 hours (*P*=0.019). Only one center had a formal lactation consultant. Each additional day of stay was associated with a significantly reduced odds for readmission [OR (95% CI) = 0.96 (0.94-0.97); *P*<0.001]. Hospital stay of more than 5 days after birth was protective for readmission for jaundice [OR (95% CI) = 0.09 (0.03-0.21); *P*<0.001].

On multivariate analysis, duration of hospital stay [OR (95% CI) = 0.95 (0.93-0.97); *P*<0.001] and mixed or formula milk feeding were significantly associated with lower risk of readmission compared to breastfeeding [OR (95% CI) = 0.51 (0.26-0.98); *P*=0.046]. A statistically significant association was seen between delivery mode and number of feeds per 24 hours. Each additional feed per 24 hours was associated with a significantly reduced odds for readmission [OR (95% CI) = 0.46 (0.23-0.91); *P*=0.016]; however, this association was only observed for infants born by vaginal delivery.

DISCUSSION

This retrospective multicenter data showed that lower gestational age, exclusive breastfeeding and shorter LOS after birth are all risk factors associated with readmission for jaundice. Protective factors are mixed feeding (formula and breastfeeding) and frequent breastfeeding. We found that infants who fed more than 8 times per day and those whose mothers received breastfeeding support from nurses or lactation consultants were less likely to be readmitted for hyperbilirubinemia. This is in line with the American Academy of Pediatrics (AAP) reports of increased rates of severe hyperbilirubinemia in exclusively breastfed infants [7], and emphasizes the need for providing specific instructions at discharge that encourages frequent breastfeeding to promote weight gain and decrease hyperbilirubinemia and readmission [8]. Similarly, Kankaew, et al. [9] reported that in 116 neonates, breastfeeding for less than 8 times daily was associated with neonatal jaundice, stressing the importance of recommending breastfeeding every 1 to 2 hours in the first 24 hours after birth [10]. This may be challenging for mothers who

Table II Characteristics of Infants With Hyperbilirubinemia at Discharge

Characteristic	*Not re-admitted (n=164)*	*Readmitted (n=51)*	*AOR (95% CI)*
Gestational age (wk)[b]	39.0 (37-40)	38.00 (37-39)	0.79 (0.64-0.96)
Gestation			
Full term	121 (73.8)	32 (62.7)	-
Early term	25 (15.2)	14 (27.5)	2.12 (0.99-4.53)
Late preterm	18 (11.0)	5 (9.8)	1.05 (0.36-3.05)
Birthweight (g)[a]	3155 (442.51)	3241 (490.0)	1.01(1.00-1.01)
Male	87 (53.0)	26 (51.0)	1.09 (0.58-2.04)
Formula and mixed feeding	97 (59.1)	22 (43.1)	0.53 (0.28-0.99)
<8 feeds/24 hr	62 (37.8)	10 (19.6)	2.49 (1.16-5.32)
Bilirubin level at first discharge (mg/dL)[a]	9.84 (3.65)	8.56 (5.30)	0.83 (0.74-0.94)
ABO incompatibility	110 (67.1)	27 (52.9)	1.81 (0.95-3.43)
Length of stay (h)[b,c]	80.0 (55-118.5)	48.0 (43-67)	0.96 (0.94-0.97)
Length of stay following birth (d)			
1-2	26 (16.0)	26 (51.0)	-
3-4	41 (25.3)	17 (33.3)	0.42 (0.19-0.91)
>5	95 (58.6)	8 (15.7)	0.09 (0.03-0.21)

Data present as no. (%), [a]mean (SD), and [b]median (IQR). [c]Coefficient represents crude OR for each additional day in LOS.

undergo cesarian section delivery, as studies reported that women who delivered by planned section were less likely to breastfeed or were less motivated to initiate and continue breastfeeding [11]. We found that each additional feed per 24 hours reduces the risk of readmission among those infants who were born vaginally. This may be explained by the fact that most infants born by cesarean section received frequent mixed feeding in the first 24 hours after birth.

Lower gestational age as a risk factor corroborates with prior studies [12]. This could be because majority of early-term infants were less likely to be breastfed and mothers less likely to maintain breastfeeding for a long duration [13]. This highlights the need to factor in GA, feeding practices and breastfeeding support when planning discharge and follow up. A combination pre-discharge screening of risk factor scoring and universal screening seems to be the most effective method for identifying infants at risk of hyperbilirubinemia.

Table III Multivariate Logistic Regression Model for Hyperbilirubinemia Readmissions (*N*=215)

Variable	*aOR (95%CI)*	*P value*
Weight (g)[a]	1.0 (1.0-1.0)	0.013
Bilirubin level at first discharge (mg/dL)	0.84 (0.72-0.95)	0.004
Formula and mixed feeding	0.51 (0.26-0.98)	0.046
Feeds/24 h[b]	-	0.02
Vaginal delivery	0.46 (0.23-0.91)	0.016
Length of stay (h)[c]	0.95 (0.93-0.97)	<0.001

Study design adjusts for gestational age, maternal age, and birth hospital. [a]Coefficient represents adjusted OR (aOR) for every increase in 100 g. [b]Interaction between number of feeds per 24 hours and delivery. Coefficient represents aOR for each additional feed per 24 hours. [c]Length of stay following birth.

Prolonged hospital stay after birth was another protective factor found to reduce the risk of readmission. This was similar to previous studies demonstrating decreased readmission risk for those infants who stayed ≥3 days compared to those who were discharged in their first 2 days after birth [10,14]. This is important to address as physiologic jaundice and feeding problems were found to be the leading preventable causes for hospital admission in the neonatal period [15].

Our study has several limitations, covariates in our regression models were purposefully constrained like the contribution of G6PD-deficiency based on the relatively small number of readmissions, which was lower than anticipated and did not reach the needed sample size. Recall bias could not be ruled out due to the retrospective nature of the study. Finally, the results may have limited generalizability as they reflect findings from university hospitals situated in the same city.

To conclude, we found that the readmission risk for neonatal hyperbilirubinemia is independently associated with gestational age, shorter length of stay and inadequate breastfeeding method after vaginal delivery. Identifying infants with these risk factors are crucial first steps in effectively managing infants with or at risk for severe hyperbilirubinemia. Further research is needed to examine

WHAT THIS STUDY ADDS ?

- Insufficient exclusive breastfeeding, along with a shorter hospital stay after vaginal delivery, represent preventable factors of readmission within 28 days after birth for neonates diagnosed with hyperbilirubinemia.

other modifiable determinants of neonatal readmission, and policies are needed to capture admissions to hospitals other than the birth hospital.

Ethics approval: Institutional Review Board at the American University of Beirut; No. PED.LC.12, dated March 14, 2017.
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