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ORIGINAL ARTICLE

Weight Loss Percentage Prediction of Subsequent Neonatal Hyperbilirubinemia in Exclusively Breastfed Neonates

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Key Words
breastfeeding;
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Background: The incidence of neonatal hyperbilirubinemia in our hospital has increased since the implementation of breastfeeding promotion. Inadequate breastfeeding results in reduced calorie intake, weight loss and neonatal hyperbilirubinemia. Supplementary feeding is required if breastfeeding proves inadequate. However, the optimal weight loss cut-off value for supplementary feeding is unknown.

Methods: We collected records for all healthy neonates with a gestational age ≥35 weeks and birth body weight (BBW) above 2500 g, born between March 2002 and July 2005, from our nursery. A total of 1979 neonates were reviewed, 874 of whom were exclusively breastfed and subsequently enrolled in this study. Only infants who were breastfed exclusively were enrolled; 219 of these infants (25.1%) presented significant hyperbilirubinemia after 72 hours of age. Infants with early-onset (<48 hours) hyperbilirubinemia or any known risk factors for neonatal hyperbilirubinemia were excluded. We analyzed the association between weight loss percentage and hyperbilirubinemia and investigated the best weight loss percentage cut-off value for the prediction of subsequent hyperbilirubinemia before 2 weeks of age.

Results: Neonates with lower gestational age and greater weight loss percentage were associated with hyperbilirubinemia. By using weight loss ≥8% of BBW after 48 hours and weight loss ≥11% of BBW after 72 hours as the cut-off values for the prediction of subsequent hyperbilirubinemia, negative predictive values were 77.7% and 76.8%, respectively.

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Conclusion: This study documented the relationship between weight loss percentage and subsequent hyperbilirubinemia incidence. Our data provide a basis for determination of an optimal weight loss percentage cut-off value that indicates supplementary feeding.

1. Introduction

Breastfeeding is known to have advantages not only for infants but also mothers and families.[1,2] However, there is evidence that breastfeeding is associated with increased severe and/or early neonatal hyperbilirubinemia.[3–7] The mechanism behind this is unclear. Inadequate fluid and/or caloric intake, decreased hepatic excretion of bilirubin and an increase in intestinal absorption of bilirubin (enterohepatic circulation) have been suggested as mechanisms.[5,8,9] A large-scale population study has shown that increased weight loss percentage instead of breastfeeding *per se* is important in neonatal hyperbilirubinemia pathogenesis.[8]

Insufficient breastfeeding is not uncommon in the nursery, particularly for first-time mothers. Neonatal symptoms include low urine output, weight loss and hypernatremia. A growing body of evidence indicates that increased weight loss and/or breastfeeding are the risk factors for significant neonatal hyperbilirubinemia.[4,10–13] Supplementary feeding is usually recommended for infants who are not sufficiently nursed. However, what qualifies as insufficient has yet to be elucidated.

The present study investigated the best body weight (BW) loss cut-off value at 2 and 3 days of age for prediction of subsequent neonatal hyperbilirubinemia.

2. Materials and Methods

All neonates with a gestational age $\geq$35 weeks and birth body weight (BBW) above 2500 g, born between March 2002 and July 2005 at National Taiwan University Hospital were reviewed retrospectively. Those with risk factors for developing neonatal hyperbilirubinemia, such as evidence of hemolysis (positive Coombs' test), glucose-6-phosphate dehydrogenase deficiency, cephalohematoma, congenital infection, congenital hypothyroidism, perinatal asphyxia and major organ anomalies were excluded. Neonates with early-onset (i.e., <48 hours of age) neonatal hyperbilirubinemia were also not enrolled because we were interested in using 2nd and 3rd day BW loss as indicators. Medical records, including gestational age, BW, daily BW loss over the first 3 days [(birth body weight − daily body weight)/birth body weight × 100%)] and total serum bilirubin before phototherapy were reviewed. All neonates with serum bilirubin above 11 mg/dL (188.1 μmole/L) were scheduled for routine outpatient follow-up 2 days later. Serum microbilirubin was assessed using direct spectrophotometry of a microhematocrit tube (Leica Unistat bilirubinometer, Wetzlar, Germany). Significant hyperbilirubinemia and phototherapy criteria were defined according to the 2004 American Academy of Pediatrics guidelines for phototherapy.[14] However, we did start phototherapy for all infants whose serum bilirubin levels were above 15 mg/dL (256.5 μmol/L).

Breastfeeding was defined as infants who were exclusively breastfed without supplementation of formula at any time before or during development of hyperbilirubinemia. In our nursery, breastfeeding is encouraged, but supplementary formula will be given if it proves inadequate, as assessed by parents and clinicians. However, supplementary formula is routinely used if BW loss after birth is significant ($\geq$10%) unless the family refuses.

Statistical analysis was done using the independent *t* test for continuous variables or χ^2 test for categorical variables. Multiple logistic regression was used for identification of independent variables; a p value <0.05 was considered statistically significant.

3. Results

A total of 1979 neonates were reviewed; 310 met the exclusion criteria and 874 neonates were exclusively breastfed, leaving them available for inclusion in this study. The general characteristics of exclusively breastfed

Table 1 General characteristics of breastfed neonates.

Factors	Hyperbilirubinemia (n = 219)	No hyperbilirubinemia (n = 655)	p
GA*	38.73 ± 1.18	39.07 ± 1.16	<0.001
BBW (g)	3254.21 ± 384.34	3231.90 ± 331.22	0.408
Male (%)	116 (52.97%)	317 (48.40%)	0.241
Delivery as NSD (%)	152 (69.41%)	476 (72.67%)	0.352
Maximum BW loss percentage (%)*	8.96 ± 1.99	8.48 ± 2.13	0.002
2-d/o BW loss percentage (%)	7.66 ± 1.54	7.44 ± 1.66	0.069
3-d/o BW loss percentage (%)*	8.62 ± 2.12	7.97 ± 2.24	<0.001

Data are presented as mean ± SD or *n* (%).
BBW = birth body weight; BW = body weight; GA = gestational age; NSD = normal spontaneous delivery.
*$p < 0.05$.