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RESEARCH ARTICLE

DETERMINING THE RELATION BETWEEN EXCESSIVE NEONATAL WEIGHT LOSS AND READMISSION DUE TO HYPERBILIRUBINEMIA

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ABSTRACT

Background: The first week of postnatal life is characterized typically by weight loss in neonates, which occurs due to loss of ECF. When there is increased production of breast milk, the neonates begin to gain weight. Alteration in the weight trend can lead to potential complications. Inadequate oral intake causes weight loss and increases the bilirubin enterohepatic circulation. **Objective:** To determine association between Hyperbilirubinemia and Neonatal weight loss. **Study design and study period:** A prospective observational study from January 2021 to march 2022. **Results:** Eighty four neonates were enrolled during the study period of which 52 were males and 32 were females, 10 neonates were SGA, 70 were AGA. Thirty one neonates were born to primi mother and 53 neonates were born to multigravida mothers and 35 (41.7%) neonates discharged on exclusive breastfeeding, 49 (58.3%) on mixed feeding. Maximum weight loss occurred by day 6. Twenty nine neonates had weight loss $\geq 7\%$, 12 neonates had weight loss $\geq 10\%$. 8 (9.5%) neonates were readmitted after birth hospitalization due to hyperbilirubinemia. The frequency of readmission for hyperbilirubinemia was significantly higher for neonates with excessive weight loss (75% vs. 25%). **Conclusions:** Greater than 10% weight loss may be considered as Excessive weight loss as there is more risk of neonatal jaundice and readmission. Excess weight loss could be a useful parameter for identification of neonates at risk for readmission due to Hyperbilirubinemia. It may be useful in settings where routine predischarge TSB is not yet implemented.

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INTRODUCTION

The first week of postnatal life is characterized typically by weight loss in neonates. This occurs mostly due to loss of Extracellular fluid (ECF) (1). Full term neonates may lose 5-10% of body weight by 4-6 days. When there is increased production of copious mature milk, the neonates begin to gain weight. Babies who are breast fed will regain their birth weight on an average, by 8.3 days (2). The excessive weight loss was defined by AAP as $>7\%$ in the breast-fed infants (3) But it is commonly observed that many neonates lose weight more than 7% (4). In the United Kingdom, the National Institute for Health and Care Excellence guidelines recommend 10% as the maximum acceptable weight loss in healthy term infants (5). In several studies, researchers identified new-borns who lost excess weight, which was defined differently by different authors. At 72 hours, Flaherman *et al.* (6) reported that 25% of newborns born by cesarean section had lost greater than or equal to 10% of their birth weight which were significantly higher than newborns born by normal vaginal delivery. As per the previous studies, taking $>7\%$ weight loss as significant weight loss has shown many number of infants will be classified as having excessive weight loss (7,8,9) compared to classified by $\geq 10\%$ weight loss (6) and may lead to excessive use of supplemental feeds and interfering with breast feeding (11).

A recent review quoted that up to 12% weight loss may not be associated with any complications (10). The incidence of neonates with excessive weight loss also depends on the mode of delivery (10, 12). Weight loss in the infant of greater than 7% from birth weight indicates possible breastfeeding problems (13). Hyperbilirubinemia and feeding difficulties with or without dehydration are the most frequent indications for readmission in the first 2 weeks of life (14,15) and strongly related each other due to inadequate oral intake, particularly in term infants (16-19). There are very few studies in our country that explore the excessive weight loss and its associated complications including Neonatal Hyperbilirubinemia. In this study, we planned to examine the neonatal weight trend in first 2 weeks of life and to determine the factors affecting it in healthy late preterm and term neonates. The objective of this study was to determine the overall readmission rate due to hyperbilirubinemia and to describe the association between total serum bilirubin (TSB) levels and excessive weight loss in healthy late preterm and term neonates during the first two weeks of life.

METHODOLOGY

This prospective observational study was performed on healthy late preterm and term neonates who were born in Kamineni hospitals, Hyderabad from January 2021 to march 2022.

Eligible neonates daily weights were assessed on electronic digital weighing scales. Weights were recorded daily during the hospital stay and later on daily till 14 days of life. Parents were provided the weighing scales from investigating team through hospital at discharge after taking the consent for participating in the study. Parents were trained in checking the weight properly and the precautions to be taken while checking weight. The principle investigator supervised the weight checking at home through video or photos daily through a smart phone dedicated to the study. After 12 days the weighing machines were taken back from the parents and were provided to the participants in the next study. Relevant antenatal factors, perinatal factors, and postnatal factors were noted. Neonatal hyperbilirubinemia workup was done as per unit protocol. Daily weight loss, maximum weight loss, weight loss within 48 and 72 hours, weight loss within 1 week, weight loss and gain pattern in 2 weeks, time to reach birth weight, neonatal admissions and admissions for hyperbilirubinemia were assessed. Anthropometric measurements were taken using same methods as used to obtain WHO Child Growth Standards. Weight measurements were taken with a portable, calibrated electronic weighing scale after adjusting to zero before each measurement (Image:1)



Image 1. weighing scale

The measurements were analyzed by WHO ANTHRO software downloaded from WHO official website. The Z- scores and percentiles for Weight for age were calculated according to WHO growth standards 2006.

Statistical analysis: All the data which is recorded will be entered into the Microsoft xl sheet. The Categorical variables will be compared by Chi square test or Fisher's Exact test. Mean \pm SD of normally distributed numeric variables will be compared by unpaired-t test. Median and interquartile range (IQR) of non-normally distributed numeric variables will be compared using Mann Whitney U test.

RESULTS

In our study 84 neonates were enrolled during the study period. The mean birth weight was 2842 \pm 374 grams. There were 52 (61.9%) males and 32 (38.1%) females, and 10 neonates (11.9%) were Small for Gestational Age (SGA), 70 (83.3%) were Appropriate for gestational age (AGA) and 4 (4.8%) were Large for gestational age (LGA) (Table 1).

Table 1. Baseline neonatal characteristics

Character	Number	Percentage
Males	52	61.9%
Females	32	38.1%
SGA	10	11.9%
AGA	70	83.3%
LGA	4	4.8%
Term \geq 37 weeks	66	78.6%

Thirty one neonates were born to primi mother and 53 neonates were born to multigravida mothers. Thirty two neonates (38.1%) delivered by normal vaginal delivery(NVD) , 52 (61.9%)were delivered by caesarean section. Eighteen mothers (21.4%) had medical morbidities like gestational diabetes mellitus (GDM), pregnancy induced hypertension (PIH), COVID-19 infection and 47 (56%) had previous

Table 2. Baseline maternal characteristics

Character	Number	Percentage
Primi	31	36.9%
NVD	32	38.1%
Medical morbidities	18	21.4%
Previous breastfeeding experience	47	56%
Higher Education (>10 th std)	81	96.4%
Breast anatomical issues	19	22.6%

Table 3. Neonatal characteristics

Character	Number	Percentage
Skin to skin contact at birth	30	35.7%
Formula feed in hospital	51	60.7%
Discharged on exclusive breast feeds	35	41.7%
Median time of discharge in hours (IQR)	87 (46.5-90)	
Median day of maximum weight loss , in days (IQR)	6 (5-7)	
Regained birthweight by day 14	48	57.1%
Weight loss \geq 7%	29	34.5%
Weight loss \geq 10%	12	14.2%

Table 4. Maximum Total serum bilirubin recorded in the study population

TOTAL SERUM BILIRUBIN	NUMBER OF NEONATES (N)	IN PERCENTAGE
1.0-5.0	4	4.7%
5.1-10.0	50	59.5%
10.1-15.0	29	34.5%
>15.0	1	1.1%

Table 5. Admissions in the study population in relation to weight loss

MAXIMUM WEIGHT LOSS IN STUDY POPULATION (NUMBER OF NEONATES)	NUMBER OF NEONATES READMITTED FOR PHOTOTHERAPY (N)	IN PERCENTAGE (%)
0-3.5%(11)	0	-
3.5-7%(44)	1	12.5%
7-10% (17)	1	12.5%
>10%(12)	6	75.0%
TOTAL(84)	8	100%

breastfeeding experience, and 19 (22.6%) had breast anatomical concerns. Majority of the mothers i.e 81 (96.4%) did graduation and 59 mothers (70.2%) came from lower middle class family. (Table :2)Thirty neonates (35.7%) received skin to skin contact at birth, 51 (60.7%) neonates received formula feeds before discharge , 35 (41.7%) neonates discharged on exclusive breastfeeding, 49 (58.3%) on mixed feeding. Seven neonates (8.3%) were admitted for phototherapy due to Hyperbilirubinemia. The median time of discharge was 87 hours (46.5-90) and maximum weight loss occurred by day 6 (IQR 5-7). Forty eight (57.1%) neonates reached birth weight by day 14 of life. Twenty nine infants (34.5%) had weight loss \geq 7%, 12 infants (14.2%) had weight loss \geq 10% (Table :3). Among the 84 study neonates, 8 neonates were readmitted after discharge from birth hospitalisation. All the readmissions done were for phototherapy .Among 8 neonates admitted for phototherapy ,12.5% (1) neonate had maximum weight loss in range of 3.5-7% , 12.5%(1) neonate had maximum weight loss in range of 7-10% , 75.0%(6) neonates had maximum weight loss of more than 10%.The frequency of readmission for hyperbilirubinemia was significantly higher for neonates with excessive weight loss (75% vs. 25%).

DISCUSSION

In this study, we have evaluated the association between excessive weight loss and Neonatal hyperbilirubinemia in the first two weeks of

life in cohort of 84 neonates. Macdonald *et al.*(20) found that in first 2-3wks of life, median weight loss in breast fed infants was substantially greater than for formula fed infants (median: 6.6% v 3.5%, p, 0.0001). Breast fed babies took longer to regain their birth weight than formula fed infants (median: 8.3 v 6.5 days, p, 0.0001). In our study we found that ,in the first week of life ,median weight loss in breast fed babies is lesser than those on formula feed and though the median maximum weight loss is higher in breast fed neonates, majority of them reached birth weight early than formula fed neonates. Demarzo *et al.*(21) report that 8.7% of infants lost more than 7% of their birth weight whereas in our study , 34.5% infants lost more than 7% of their birth weight while 14.2% infants lost more than 10% weight loss. In the present study, Among the 84 study neonates ,8 neonates were readmitted after discharge from birth hospitalisation. Total of 8 (9.5%) neonates are admitted due to neonatal jaundice,1(12.5%)of them had 7-10% weight loss , 6(75%)had greater than 10% weight loss . In comparison to a study done by Salas *et al.* ,(22) which suggested a weak correlation between TSB levels and percent of weight loss was identified ($r = 0.20$; $p < 0.05$). This maybe explained as Weight loss of greater than 7% from birth weight indicates possible feeding problems. Inadequate oral intake causes weight loss and increases the bilirubin enterohepatic circulation.

CONCLUSION

Greater than 10% weight loss may be considered as Excessive weight loss as there is more risk of neonatal jaundice and readmission. Excessive weight loss may be used as a parameter to identify neonates at risk for readmission due to hyperbilirubinemia particularly in settings where predischarge TSB was not yet implemented as a routine. Among the study neonates ,4 neonates had maximum TSB measured in range of 1.0-5.0, 50 neonates had maximum TSB measured in range of 5.1-10.0 , 29 neonates had maximum TSB measured in range of 10.1-15.0, 1 neonate had maximum TSB measured >15%.

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