Section: Paediatric

Original Research Article

PERCENTAGE WEIGHT LOSS AS A PREDICTOR OF NEONATAL HYPERBILIRUBINEMIA IN TERM NEWBORNS

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ABSTRACT

Background: Newborns usually loss up to 5-7% of its birth weight during the first week of life, however, excessive weight loss may be associated with complications such as jaundice. About 60% of term infants and 80% of preterm infants exhibit jaundice in the first week following delivery. Present study aims to assess percentage weight loss as a predictor of neonatal hyperbilirubinemia in term newborns.

Materials and Methods: Total 52 term newborns between (37wks – 41 wks 6 days) of gestation, appropriate for gestational age and birth weight more than 2500 gms were included in the study. The birth weight and weight at 24hrs, 48hrs, 72hrs was recorded. All babies were assessed for clinical appearance of jaundice according to Kramer staging. The infants were also divided into two groups based upon the value of TSB according to Bhutani nomogram risk chart into significant hyperbilirubinemia group h and the non-significant hyperbilirubinemia group. The association between birth weight loss and the serum bilirubin was assessed.

Results: The mean percent birth weight loss within 24 hours was 3.95 ± 0.98%. The mean percent birth weight loss was further increase to 5.68 ± 1.21% in 48 hours and 6.87 ± 1.56% in 72 hours. The mean TSB was 13.89 ± 2.58 mg/dl. Significant hyperbilirubinemia was recorded in 36.5% cases whereas rest of 63.5% cases were presented with non-significant hyperbilirubinemia. The percentage birth weight loss>7% was found to be significantly associated with the significant hyperbilirubinemia at 48 hours and 72 hours. A significant positive correlation between the percent birth weight loss and hyperbilirubinemia and percent birth weight loss was found to be significant predictor of hyperbilirubinemia.

Conclusion: The ideal birth weight loss cut-off percentages for the first three days following delivery that were shown in this study could be used to predict hyperbilirubinemia and signal the need for additional feeding. The optimum cut-off value could vary by race or nation, much like the requirements for phototherapy for neonatal hyperbilirubinemia.

Keywords: Birth weight loss, hyperbilirubinemia, jaundice, neonate, Kramer staging.

INTRODUCTION

The neonatal phase is referred to the first 28 days following birth. After delivery, newborns need to immediately adjust to the extra uterine environment.[1] Physiological weight loss is the term used to describe the normalcy of a newborn losing up to 5-7% of its birth weight during the first week of life. The primary cause of weight loss is the reduction in the fluid in neonates. Additionally, a higher birth weight is associated with late cord clamping, resulted in a larger weight loss. The fact that neonates use

adipose tissue as a source of energy also contributes to their weight loss.[2] Excessive weight loss is associated with complications such as jaundice, hypoglycaemia, and dehydration, which cause renal failure, thrombosis, hypovolemic shock, and seizures.[2] The mechanism that link the weight loss and hyperbilirubinemia is unclear but is has been proposed that the processes of reduced hepatic excretion of bilirubin, increased intestine absorption of bilirubin (enterohepatic circulation), and inadequate fluid and/or calorie intake may have a role in hyperbilirubinemia induced by weight loss.[3]

Hyperbilirubinemia is a common complication in neonates. About 60% of term infants and 80% of preterm infants exhibit jaundice in the first week following delivery. Under normal physiological conditions, indirect bilirubin levels in umbilical cord serum typically range from 1-3 mg/dL and increase at a rate of less than 5 mg/dL per 24 hours. As a result, jaundice typically appears on the second or third day after birth, peaking at 5–6 mg/dL between the second and fourth days and falling to less than 2 mg/dL between the fifth and seventh days.[4]

Hyperbilirubinemia thought to be caused by a temporary inhibition in the ability of liver of immature newborn to conjugate bilirubin, as well as an increase in bilirubin synthesis from the breakdown of fetal RBCs. The build up of unconjugated, nonpolar, lipid-soluble bilirubin pigment in the skin is often what gives the skin its yellow color. This unconjugated bilirubin, which is classified as indirect-acting due to the van den Bergh reaction, is the final result of heme-protein degradation in reticulo endothelial cells. It is produced via a sequence of enzymatic events involving heme-oxygenase, biliverdin reductase, and non-enzymatic reducing agents.[5] Additionally, it could be partially brought on by the pigmentation of conjugated bilirubin, which is the result of indirect, unconjugated bilirubin that has been conjugated in the liver cell microsome by the uridine diphospho glucuronic acid (UDP)–glucuronyl transferase enzyme to form the polar, water-soluble bilirubin glucuronide (direct-reacting).[5]

Elevations of indirect, unconjugated bilirubin have the potential to be neurotoxic, despite the fact that bilirubin may have a physiological function as an antioxidant. Elevated levels of bilirubin are also detrimental to the growing CNS and can result in long-term neurological damage. Other complications associated with weight loss are dehydration, hypoglycemia and seizures.[6] The greatest risk associated with indirect hyperbilirubinemia is the development of bilirubin-induced neurologic dysfunction, which typically occurs with high indirect bilirubin levels. Neonatal hyperbilirubinemia is commonly responsible for longer hospital stays and readmissions during early neonatal period.

According to the clinical practice recommendation of the American Academy of Pediatrics (AAP), all newborns should have their risk of developing substantial neonatal hyperbilirubinemia evaluated before being discharged. Peak bilirubin levels typically reach between days 4 and 6 of life (7). Present study aims to assess percentage weight loss as a predictor of neonatal hyperbilirubinemia in term newborns.

MATERIALS AND METHODS

Study design: Present study was a prospective observational study was done on normal term newborns who was delivered at Adesh Medical College and Hospital Shahbad Haryana. Total 52 term newborns between (37wks – 41 wks 6 days) of gestation, appropriate for gestational age and birth weight more than 2500 gms were included in the study. Critically ill newborns, ABO and Rh incompatibility cases, babies with congenital anomalies, birth Trauma, cephal-haematoma, subgaleal haemorrhage and conjugated hyperbilirubinemia were excluded from the study.

Birth weight: The birth weight and weight at 24hrs, 48hrs, 72hrs was recorded. Weight was recorded on same time daily before feed with no clothing on same weighing scale. Weighing scale to be used is CROWN Baby Scale CR 2032 baby weighing scale with 5g deviation. Daily errors were checked, and standardization was done in the machine before recording weight of babies.

Total Serum Bilirubin (TSB): All babies were assessed for clinical appearance of jaundice according to Kramer staging. Blood sample (2ml) for total serum bilirubin was collected at 3rd day of life (at 72 hrs of life). Blood samples was sent to be processed in the Adesh Medical College and Hospital Shahbad, Haryana, Biochemistry laboratory for analysis on the fully auto analyzer ERBA Manhem EM-360 Fully Automatic. Total Serum Bilirubin (TSB) levels was considered as hyperbilirubinemia as per norms according to AAP (American academy of pediatrics) hyperbilirubinemia charts.

Study groups: Neonates weight loss cutoff was taken as 7% based upon the Kramer Staging. The neonates are divided into two groups: weight loss <7% and >7%. The infants were also divided into two groups based upon the value of TSB according to Bhutani nomogram risk chart. The significant hyperbilirubinemia group having the TSB≥15 mg/dL and the non-significant hyperbilirubinemia group having TSB ≤ 15 mg/dL 72 hours after birth). The association between birth weight loss and the serum bilirubin was assessed. The linear correlation analysis was done.

Statistical analysis: The data obtained was entered in spreadsheet and then analysis was done using latest SPSS software version available. Categorical variables were presented in number and percentage (%) and continuous variables was presented as mean ± Standard Deviation and median according to the distribution of data. Chi-Square test was used to explore association between percentage birth weight loss and neonatal hyperbilirubinemia. The Karl

Pearson correlation coefficient and (r) was estimated to know correlation between birth weight loss and neonatal hyperbilirubinemia. A p value of <0.05 was considered statistically significant.

RESULTS

There were 51.9% male neonates in the present study indicating a male dominance in neonate gender. There were 48.1% female neonates. A lower segment caesarean section (LSCS) was performed in majority of cases (65.4%) whereas normal vaginal delivery (NVD) was done in 34.6% cases. The mean birth weight of the neonates was 2.88 ± 0.22 kg. Most of the neonates have the birth weight <3 kg (73.1%) whereas birth weight was >3kg in 26.9% neonates. The gestation age in most of the cases (42.3%) was 37-37+6 weeks followed by 38-38+6 weeks in 34.6% cases, 39-39+6 weeks in 21.2% cases and 40-40+6 weeks in 1.9% cases [Table 1].

Table 1: Maternal and neonate parameters.

Variable	Domain	Number	Percentage
Neonate gender	Male	27	51.9
	Female	25	48.1
Mode of delivery	LSCS	34	65.4
	NVD	18	34.6
Birth weight	<3 Kg	38	73.1
	>3 Kg	14	26.9
Gestational age	37-37+6 weeks	22	42.3
	38-38+6 weeks	18	34.6
	39-39+6 weeks	11	21.2
	40-40+6 weeks	1	1.9

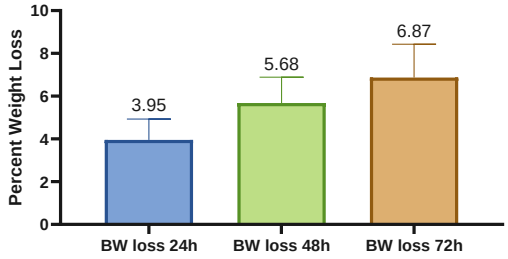

Figure 1: Mean percent birth weight loss.

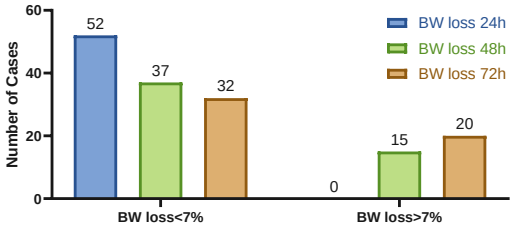

Figure 2: Percent birth weight loss.

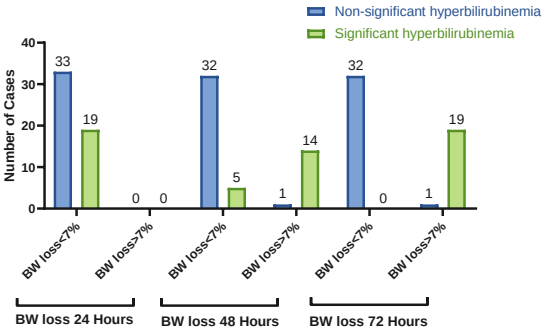

Figure 3: Association between percentage birth weight loss and neonatal hyperbilirubinemia.

The mean percent birth weight loss within 24 hours was 3.95 ± 0.98%. The mean percent birth weight loss was further increase to 5.68 ± 1.21% in 48 hours and 6.87 ± 1.56% in 72 hours. There was a significant increase in percent birth weight loss from 24 hours to 72 hours [Figure 1].

Within first 24 hours, the percent birth weight loss was <7% in all cases. In 48 hours, the percent birth weight loss was <7% in 71.2% cases and >7% in 28.8% cases. In 72 hours, the percent birth weight loss was <7% in 61.5% cases and >7% in 38.5% cases. There was a significant increase in percent birth weight loss from 24 hours to 72 hours [Figure 2].

The mean TSB was 13.89 ± 2.58 mg/dl. Significant hyperbilirubinemia was recorded in 36.5% cases whereas rest of 63.5% cases were presented with non-significant hyperbilirubinemia. The percentage birth weight loss>7% was found to be significantly associated with the significant hyperbilirubinemia at 48 hours and 72 hours [Figure 3].

Correlation analysis between percent birth weight loss and neonatal hyperbilirubinemia indicate a significant positive correlation between the percent birth weight loss and hyperbilirubinemia at 24 hours (r=0.719), 48 hours (r=0.727) and 72 hours (r=0.758) [Figure 4].

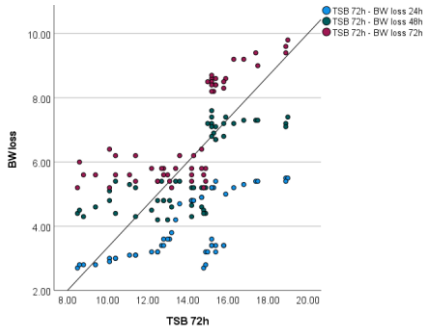

Figure 4: Correlation between percent birth weight loss and neonatal hyperbilirubinemia.

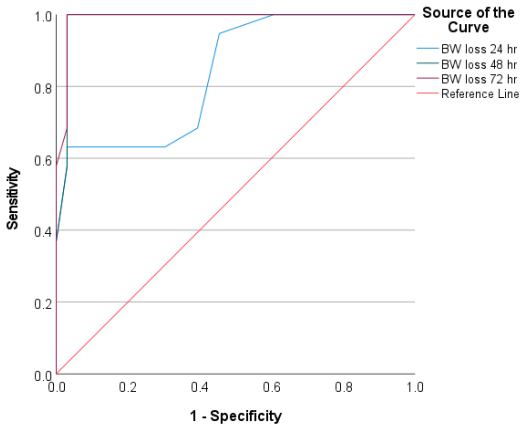

Figure 5: Percentage birth weight loss as a predictor of significant hyperbilirubinemia.

At the cutoff of ≥3.50%, the percent weight loss at 24 hours can predict the significant hyperbilirubinemia with and accuracy of 83% (AUC 0.837), sensitivity of 68% and specificity of 39% with p value being significant (p=0.000*). At the cutoff of ≥4.62%, the percent weight loss at 48 hours can predict the significant hyperbilirubinemia with and accuracy of 98% (AUC 0.984), sensitivity of 100% and specificity of 63% with p value being significant (p=0.000*). At the cutoff of ≥5.30%, the percent weight loss at 72 hours can predict the significant hyperbilirubinemia with and accuracy of 98% (AUC 0.989), sensitivity of 100% and specificity of 87% with p value being significant (p=0.000*) [Figure 5].

DISCUSSION

In order to prevent severe hyperbilirubinemia, there are differing views on what is considered normal neonatal birth weight loss and when supplemental feeding should be taken into consideration. In order to predict neonatal hyperbilirubinemia 72 hours after birth, the study objective was to determine the ideal cutoff values for birth weight loss percentages in the first three days following delivery. In our study, there were 51.9% male neonates in the present study indicating a male dominance in neonate gender. In the study by Pulmamidi and Yendamuri, 58.1% were males and 41.8% were females which is in line with current study (8). In their study, Salas et al. included 79 newborns, 64.6% of whom were male.[9]

In this study, LSCS was performed in majority of cases (65.4%) whereas NVD was done in 34.6% cases. In Boskabadi et al. study, there were 53.9% NVD cases and 46.1% were LSCS cases.[10] According to a different study, 41.9% of jaundiced newborns were born via LSCS and 58.1% were born via NVD.[11] In current study, the mean birth weight of the neonates was 2.88 ± 0.22 kg. Most of the neonates have the birth weight <3 kg (73.1%) whereas birth weight was >3kg in 26.9% neonates. The mean percent birth weight loss in our study within 24 hours was 3.95 ± 0.98%. The mean percent birth weight loss was further increase to 5.68 ± 1.21% in 48 hours and 6.87 ± 1.56% in 72 hours. There was a significant increase in percent birth weight loss from 24 hours to 72 hours in present study. The results of this study are consistent with Chang et al. findings, which showed weight loss of roughly 8% after 48 hours and 11% after 72 hours of delivery.[3]

The mean TSB was 13.89 ± 2.58 mg/dl. Significant hyperbilirubinemia was recorded in 36.5% cases whereas rest of 63.5% cases were presented with non-significant hyperbilirubinemia. In the Yang et al. study, 115 (33.5%) newborns showed signs of severe hyperbilirubinemia 72 hours after birth.[12] The percentage birth weight loss >7% in our study was found to be associated with the significant hyperbilirubinemia at 48 hours and 72 hours. Correlation analysis between percent birth weight loss and neonatal hyperbilirubinemia indicate a significant positive correlation between the percent birth weight loss and hyperbilirubinemia at 24 hours (r=0.719), 48 hours (r=0.727) and 72 hours (r=0.758). According to a study by Indriyani et al., the TSB level on the third day of birth and the percentage of birth weight loss had a weak but significant linear correlation (r=0.39).[13]

Additionally, Bertini et al. discovered that on the third day, birth weight loss was substantially correlated with hyperbilirubinemia and that term babies with hyperbilirubinemia had a considerable birth weight loss of 1764.49 ± 74 gm, in comparison to the loss for all research participants.[14] Ding et al. multicentric study revealed a strong correlation between term neonates birth weight loss and their TSB level throughout the first week of life.[15] Gale et al. conducted a case control study in Israel on term babies and discovered a strong correlation between a high percentage of birth weight loss and a high level of TSB.[16] In healthy term neonates, Salariya and Robertson also discovered a strong correlation between hyperbilirubinemia and birth weight reduction in the early neonatal stage. The second day following delivery saw the greatest birth weight decrease, while the fifth day saw the greatest birth weight gain.[17]

In present study, at the cutoff of ≥5.30%, the percent weight loss at 72 hours can predict the significant hyperbilirubinemia with and accuracy of 98% (AUC 0.989), sensitivity of 100% and specificity of 87% with p value being significant (p=0.000*). According to the Yang et al. study ROC analysis results, neonates with a birth weight loss percentage of less than 0.43% on day 1 did not develop significant hyperbilirubinemia 72 hours later, whereas those with a BWL percentage of more than 10.23% on day 1 did.[7] Since it is difficult to predict substantial hyperbilirubinemia 72 hours after birth in these patients, primary care doctors should focus more on those in the undetermined zone. In order to stop future dehydration-induced severe hyperbilirubinemia 72 hours after birth, the doctors should also try to convince family members to improve the oral intake for these newborns.

Our findings showed that substantial hyperbilirubinemia 72 hours after birth may be predicted using birth weight loss percentage cutoff values of 3.50% on day 1, 4.62% on day 2, and 5.30% on day 3. According to the Yang et al. study, substantial hyperbilirubinemia 72 hours after birth could be predicted with the help of birth weight loss percentage threshold values of 4.48% on day 1, 7.60% on day 2, and 8.15% on day 3.[12] Under ROC analysis, the optimal cutoff birth weight losspercentage at 2 days of age for predicting hyperbilirubinemia in the study by Prachukthum et al., would be having a birth weight losspercentage≥5%.[18] In the first three days following birth, we think this could be a useful clinical tool for assessing infants who are physically dehydrated. Since the goal was to stop more severe hyperbilirubinemia, the cutoff values we suggest are based on higher specificity and larger positive likelihood ratio. Therefore, even while birth weight loss might not be the best indicator of severe hyperbilirubinemia, the findings could help parents and doctors decide when to give more feedings.

Hyperbilirubinemia in the first week of life is associated with a number of additional variables, such as intake, delayed meconium evacuation, or prolonged meconium transit time. Indriyani et al. research demonstrated that hyperbilirubinemia is unrelated to meconium transit time, intake type, or frequency.[13] Bertini et al. discovered that as compared to other forms of intake, babies that received supplemental feeding (breastfeeding plus formula) experienced a more notable birth weight reduction.[14] Another study found a significant difference of intake type and meconium transit time, while Yamaguchi and Yamanouchi found that frequent feeding had a significant relationship with meconium evacuation frequency, weight loss and hyperbilirubinemia on the sixth day afterbirth.[17,19]

The current study has several limitations. Firstly, risk variables for hyperbilirubinemia in mothers and newborns (such as the time of cord clamping, mothers with diabetes, information on the order of delivery in each group, prior siblings with severe jaundice, and preterm children) were not addressed. Second, the varied timing of switching to mixed feeding and the challenge of determining the appropriate intake during breastfeeding were not examined. Third, the fact that we did not recruit more patients for the trial might have been the primary limitation. Lastly, because the study was conducted in a northern part of India, the cutoff values might not be universally relevant.

CONCLUSION

In addition to being a risk factor for newborn hyperbilirubinemia, weight within the first three days of life may also assist avoid severe hyperbilirubinemia within 72 hours after birth. Present study was conducted to assess percentage weight loss as a predictor of neonatal hyperbilirubinemia in term newborns. The correlation analysis between percentage birth weight loss and neonatal hyperbilirubinemia in term newborns indicate a significant positive correlation. According to our findings, significant hyperbilirubinemia 72 hours after birth may be predicted with the help of birth weight loss percentage cutoff values of 3.50% on day 1, 4.62% on day 2, and 5.30% on day 3. The ideal birth weight loss cutoff percentages for the first three days following delivery that were shown in this study could be used to predict hyperbilirubinemia and signal the need for additional feeding. The optimum cut-off value could vary by race or nation, much like the requirements for phototherapy for neonatal hyperbilirubinemia.

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