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Original Article

Paediatrics Section

Comparing Abdominal Circumference to Gastric Residual Volume for Assessing Feed Intolerance in Low Birth Weight Infants: A Prospective Cohort Study

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ABSTRACT

Introduction: Babies with feed intolerance usually present with vomiting, abdominal distension and the presence of gastric residues. Feed intolerance can be clinically diagnosed through the assessment of prefeed Gastric Residual Volume (GRV), the colour of gastric aspirates, abdominal distension, emesis, bloody stools and increased apnoea and/or bradycardia.

Aim: To evaluate prefeed Abdominal Circumference (AC) and GRV for feed intolerance in low birth weight infants and also to assess the time taken to achieve 150 mL/kg full feeds.

Materials and Methods: This prospective cohort study was conducted in the Department of Paediatrics at the Kempegowda Institute of Medical Sciences, Bengaluru, Karnataka, India, from January 2021 to June 2022. A total of 100 neonates weighing less than 2.5 kg were included in the study. Group 1 was subjected to measurement of prefeed AC, while group 2 was subjected to measurement of prefeed gastric aspirate as a measure of feed intolerance. Inferential statistics such as the Chi-square test, t-test and other appropriate tests were used whenever applicable. A p-value of less than 0.05 was considered statistically significant.

Results: Between the two groups considered in the study, the mean age of infants in group 1 and group 2 were 34.48 days and 33.04 days, respectively, with a mean birth weight of 1.82 kg and 1.72 kg in group 1 and group 2, respectively. In the present study, nine infants were in group 1 and 14 infants were in group 2, both showing signs of feed intolerance. The mean time required to reach full feeds in infants of group 1 was 8.72 days, while in group 2, it was 10.88 days.

Conclusion: Both AC and GRV are useful indicators of feed intolerance; however, AC shows better results in terms of achieving full feeds, feed tolerance and the period of recovery. Nonetheless, the results obtained in the AC group are not statistically significant compared to the results obtained from the prefeed gastric aspirate group.

Keywords: Abdominal distension, Bilious vomiting, Bowel movement, Parenteral nutrition, Preterm

INTRODUCTION

The first 24 hours of extra-uterine life constitute a critical period during which the neonate adjusts to the new external environment. This adjustment involves numerous physiological changes essential for adaptation. It is estimated that, on average, about 65% of neonates die within the first year of life, with prematurity being the most common cause of death within the first month [1,2]. In cases of pre-term birth, complications such as immature bowel function, inability to suck or swallow, as well as Feeding Intolerance (FI), may result in nutritional deficits [3].

The FI is defined as "episodes involving either temporary discontinuation of feeding or delay in advancing feedings due to the inability of the neonate to perform normal digestive functions, attributable to immature bowel function and delayed gastric emptying" [4]. Patients with FI present with vomiting, abdominal distension and the presence of gastric residues. When there is an increase in the GRV, there is a higher risk of gastrointestinal complications, such as Necrotising Enterocolitis [4].

Very Low Birth Weight (VLBW) infants (weighing 1000-1500 g) are at an increased risk of feed intolerance due to extended retention of gastric residues, which is attributed to delayed gastric emptying. Consequently, VLBW infants face a heightened risk of Necrotising Enterocolitis (NEC) [5,6]. Feed intolerance can be clinically diagnosed by assessing prefeed GRVs, the colour of gastric aspirates, abdominal distension, emesis, bloody stools and increased apnoea and/or bradycardia [5,6].

The prefeed aspirate indicates the tolerance level of feeds for the neonate and aids in adjusting the feed dosage accordingly. However, repeated aspirations may damage the gastric mucosa, leading to inflammation and making the subject susceptible to stress, intolerance, regurgitation, ulcers and sepsis [5,6].

Furthermore, the assessment of prefeed aspirates results in the postponement of enteral feeds, thereby delaying the adaptation to feeds. As an alternative, the measurement of prefeed AC may serve as a reliable method for assessing feed intolerance [7].

In light of this background, the present study was conducted to evaluate prefeed AC and GRV for feed intolerance in Low Birth Weight infants and to assess the time taken to achieve 150 mL/kg full feeds.

MATERIALS AND METHODS

The present prospective cohort study was conducted in the Department of Paediatrics at Kempegowda Institute of Medical Sciences, Bengaluru, Karnataka, India, from January 2021 to June 2022. The study was approved by the Institutional Ethical Committee (IEC) (KIMS/IEC/D023/M/2021) and informed written consent was obtained from the parents of each participant.

Inclusion criteria: All infants weighing less than 2.5 kg were included in the study.

Exclusion criteria: Infants with congenital anomalies, absent or reversed end-diastolic flow and an APGAR score of less than 5 at five minutes were excluded from the study.

Sample size calculation: The sample size was calculated using Open Epi software. Considering the time to reach full feeds in the

groups and assuming a power of 90% and a significance level of 0.05, the sample size was determined to be 41. This was rounded up to 50 in each group.

Study Procedure

The LBW infants who fulfilled the inclusion criteria were randomised using a block randomisation technique with various blocks. Concealment of the allocation was ensured by using sequentially numbered opaque sealed envelopes. The neonates were divided into two groups using the block randomisation technique. All enrolled LBW infants received parenteral nutrition. Once the infants were haemodynamically stable, feeds (either human milk or formula) were started and advanced, with a maximum of 150 mL/kg/day administered.

In group 1, AC measurement was performed before each feed using a standard, disposable, non stretchable paper tape. An increase in prefeed AC of more than 2 cm was considered a sign of feed intolerance [7].

In group 2, gastric aspirates were measured before each feed. Feed intolerance in group 2 was indicated by the presence of one or more of the following:

a. Bilious or haemorrhagic aspirates

b. A volume of the aspirate that was 50% of the previous feed or 3 mL, whichever was larger. If the aspirate was between 30% and 50% of the previous feed, feeds were continued without daily increment. Feeds were advanced according to protocol if the aspirate was 30% of the previous feeds [7].

Infants in both groups who showed signs of intolerance were kept Nil Per Os (NPO) for 24 hours and parenteral nutrition was initiated.

STATISTICAL ANALYSIS

Data were entered into Microsoft Excel. Descriptive statistics such as mean, Standard Deviation (SD), median and proportion were utilised. Inferential statistics, including the Chi-square test and t-test, were applied. A p-value of less than 0.05 was considered statistically significant.

RESULTS

In the present study, the number of males and females in group 1 was 26 and 24, respectively. In group 2, the number of males and females was also 26 and 24, respectively.

The auhors recorded 9 and 14 patients with feed intolerance in group 1 and group 2, respectively, with the mean duration of NPO being 48 and 53.14 hours, respectively [Table/Fig-1]. The time required to reach full feeds for patients with a gestational age of 28 to 32 weeks was longer in group 1 than in group 2, which was found to be statistically significant. The time required to reach full feeds for patients with a birth weight of less than 1 kg in Groups 1 and 2 was found to be 34.33 and 30 days, respectively, which was also statistically significant [Table/Fig-2].

Feed intolerance	Group 1	Group 2
n	41	39
NPO Mean	2.902	2.769
NPO SD	2.310	2.182
p-value (t-test)	0.7919	

[Table/Fig-1]: Feed intolerance amongst the groups.

Between the two groups considered in the study, the mean age of infants in group 1 and group 2 was 35.08±3.92 days and 36.44±3.1 days, respectively, with a mean birth weight of 1.73±0.42 kg in group 1 and 1.83±0.37 kg in group 2. The mean time required to reach full feeds in infants of group 1 was 11.08±9.55 days, while in group 2, it was 8.72±6.34 days [Table/Fig-3].

Gestational age (weeks)	Group 1 n=50	Group 2 n=50	p-value (t-test)
Less than 28 (3)	34±14.42	0	-
28-32 (10)	17.43±11.41	9.33±4.04	0.0001**
33-36 (48)	10.33±5.15	10.81±7.02	0.6975
37-42 (35)	5.88±3.85	5.94±4.53	0.9433
More than 43 (4)	2±0	5±4	0.0001**
ANOVA (p-value)	0.0001	0.0001	
Birth weight (kg)	**Group 1 n=50**	**Group 2 n=50**	**p-value**
<1 kg (4)	34.33±13.87	30±0	0.02961
1-1.5 kg (73)	7.85±5.44	7.21±5.43	0.5574
1.5 – 2 kg (23)	13.92±9.01	12.5±4.22	0.3154
ANOVA (p-value)	0.0001	0.0001	

[Table/Fig-2]: Association of gestational age and birth weight against time to reach full feeds.
ANOVA: Analysis of variance

Variables	Group 1 (mean) n=50	Group 2 (mean) n=50	p-value (t-test)
Gestational age (weeks)	35.08±3.92	36.44±3.1	0.05723
Birth weight (kg)	1.73±0.42	1.83±0.37	0.2085
Duration of parenteral nutrition (days)	2.9±2.31	2.77±2.18	0.7729
Day of start of feed	3.32±2.27	3.04±2.14	0.5271
Day of reach of full feeds	11.08±9.55	8.72±6.34	0.1486
Duration of hospital stay (days)	17.16±15.26	12.64±10.44	0.08703
Discharge weight (kg)	1.74±0.38	1.78±0.34	0.5804

[Table/Fig-3]: Outcome of enrolled subjects.

DISCUSSION

In the present study, the authors assessed feed intolerance among low birth weight infants by measuring AC in group 1 and GRV in group 2. The auhors recorded the mean gestational age in group 1 and group 2 to be 34.48 and 33.04 weeks, respectively. A similar period of gestation was reported by Yadav A et al., who found the mean gestation period to be 32.3 weeks in the 2-hourly feeding group and 32.5 weeks in the 3-hourly feeding group [8]. However, Dubey SP found the mean gestation period to be 31 weeks in both the Parenteral (PA) and oral (AG) groups, where the assessment parameters were nearly the same as in the present study, aside from the consideration of the feeding interval [9].

The auhors had an even distribution of the newborns across both study groups. However, there was a slight male predominance in both groups, with 26 (52%) males and 24 (48%) females recorded across the two groups. Yadav A et al., also reported male predominance, accounting for 104 (59.4%) male newborns [8].

In Low Birth Weight (LBW) and pre-term infants, there is less development of motor skills, making it difficult for them to suck milk effectively due to poor muscle coordination, which also leads to delayed gastric emptying of the consumed food [10]. Parenteral feeding, enteral feeding, or a combination of both is provided to deliver nutrition to such infants and GRV is used to assess the volume, frequency and feeding tolerance of the infant [11,12].

The mean birth weights of subjects in group 1 and group 2 were found to be 1.83 kg and 1.73 kg, respectively. Approximately 75% or more of the study subjects recorded a good birth weight of 1.5 kg or above, which is a favourable indicator for predicting outcomes related to the growth and development of the newborn. Dubey SP found the mean birth weights to be 1.23 kg and 1.28 kg in the PA and AG groups, respectively. Very Low Birth Weight (VLBW) infants (weighing 1000-1500 g) present more severe challenges due to increased feed intolerance and gastric residue retention secondary to delayed gastric emptying, which raises the risk of Necrotising Enterocolitis (NE) [9]. Prompt action with minimal enteral feeding of the mother's own milk helps prevent atrophy of the gastric mucosa

and increases the capacity of the neonate to tolerate larger amounts of feed until normal feed levels are achieved [8].

The Gastrointestinal Tract (GIT) among premature neonates is often found to be incompetent due to the early interruption of gestation. Consequently, there is a disrupted array in the normal metabolism of the GIT that must be corrected while ensuring proper nutrition during this phase [4]. Feeding Intolerance (FI) is common among pre-term neonates and most experience episodes that require either temporary discontinuation of feeding or delays in advancing feedings, indicated by signs such as the presence of gastric residuals, abdominal distension and vomiting [4].

Moreover, high GRV may be associated with an increased incidence of other Gastrointestinal (GI) complications, such as Necrotising Enterocolitis (NEC). Therefore, it is recommended that, in such cases, early postnatal enteral feeding with small amounts of human milk or formula may improve the development of the GIT, promote gut hormone release and enhance gut motility. Minimal enteral feeding can help reduce the time to commence full enteral feeding and the length of hospitalisation without increasing the risk of NEC [13].

The mean duration to reach full feeds in Groups 1 and 2 was found to be 8.72 days and 10.88 days, respectively, which was statistically insignificant. This finding is in agreement with Kaur A who recorded the mean time to reach full feeds as 10 days in the AC group and 14 days in the GRV group. Dubey SP also found the mean time to reach full feeds in the PA and AC groups to be 12 days and 8.5 days, respectively [7,9].

The authors found that patients assessed using AC reached full feeds earlier than those in the GRV group, with similar results observed by Kaur A who reported the median (interquartile range) time to achieve full feeds as 10 (9-13) days versus 14 (12-17.5) days in the AC and GRV groups, respectively. This observation was further supported by Thomas S et al., who found that infants in the AG group reached full feeds earlier than those in the GRV group (6 days versus 9.5 days) [7,14].

The mean duration of hospital stay among neonates in Groups 1 and 2 was found to be 12.64 days and 17.16 days, respectively, which was statistically significant. There is a shorter time frame to reach full feeds in the group assessed by AC compared to the GRV group, indicating faster recovery and earlier discharge in the former group.

All these parameters suggest that neonates assessed using AC had better recovery compared to those assessed by GRV; however, none of these findings were statistically significant. In group 1, the authors identified 8 (16%) cases of Mild Infection Syndrome (MIS-N), 6 (12%) of respiratory distress syndrome and 5 (10%) of neonatal sepsis. In group 2, the authors recorded 7 (14%) cases of neonatal sepsis, 6 (12%) of MIS-N, thick Meconium-Stained Amniotic Fluid (MSAF) and 5 (10%) of respiratory distress syndrome. Kaur A reported sepsis in 7 (17.5%) and 12 (30%) patients among the AC and GRV groups, respectively, while Noting Neonatal Necrotising Enterocolitis (NEC) in 0 and 1 (2.5%) patients. Dubey SP found sepsis in 7 (23.3%) and 8 (26.7%) patients in the PA and AG groups, with hypocalcaemia in 5 (16.7%) patients in both groups [7,9].

The authors recorded 9 and 14 patients with feed intolerance in Groups 1 and 2, respectively, with the mean duration of NPO being 48 and 53.14 hours. There were more neonates with feed intolerance in the GRV group than in the AC group. The present study evaluated the effectiveness of both AC and GRV; further extensive research is required regarding their outcomes.

Limitation(s)

A smaller sample size was also a limitation, as many subjects could not be recruited within the study duration.

CONCLUSION(S)

Both AC and GRV are useful indicators of feed intolerance; however, AC shows better results in terms of achieving full feeds, feed intolerance and the period of recovery. Nevertheless, the results obtained from the AC group are not statistically significant compared to those from the prefeed gastric aspirate group. Further studies with an increased sample size and conducted at a multicentric level are required to yield more reliable results.

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