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ORIGINAL RESEARCH

Time to Attain Full Enteral Feeding and Its Predictors among Very Low Birth Weight (VLBW) Neonates Admitted to the Neonatal Intensive Care Unit: Experience of a Tertiary Care Centre

Dr. Samiksha Sharma[1], Dr. Khodaija Mahvish[2*], Dr. Girijanand Jha[3], Dr (Prof) Alka Singh[4], Dr (Prof) Binod Kumar Singh[5]

[1]Senior Resident, Department of Pediatrics, N.M.C.H, Patna, Bihar, India
[*2]Senior Resident, Department of Pediatrics, N.M.C.H, Patna, Bihar, India
[3]Senior Resident, Department of Pediatrics, N.M.C.H, Patna, Bihar, India
[4]Professor & HOD, Department of Pediatrics, NMCH, Patna, Bihar, India.
[5]Professor, Department of Pediatrics, NMCH, Patna, Bihar, India.

Corresponding Author
Dr. Khodaija Mahvish
Senior Resident, Department of Pediatrics, N.M.C.H, Patna, Bihar, India

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ABSTRACT

Background and Objectives: Full enteral feeding (FEF) is defined as the time when newborn infants receive all of their prescribed nutrition (120–150 ml/kg/day) as milk feeds (human milk or formula) and do not receive any supplemental parenteral fluids or nutrition after birth. Based on the available experience, expected time to achieve FEF is 7 days for infants born 1–1.5 kg and 14 days for infants born < 1 kg. Early introduction of enteral feeds and rapid achievement of FEF are the cornerstone of nutritional management of VLBW neonates to reduce the need for central venous catheters, risk of infection, liver problems, persistent gut immaturity and duration of hospital stay. The present study was conducted to study the time to attain full enteral feeds (FEF) and its predictors among VLBW neonates admitted to the NICU of our hospital. **Methods:** This hospital based prospective observational study was conducted over a period of 2 years from January 2020 to December 2021 at NICU of department of Pediatrics of N.M.C.H, Patna including consecutively admitted preterm neonates of birth weight 1000 gram to <1500 gram with age less than 24 hours at our NICU. **Result:** Over the two years study period, 191 neonates were studied. Mean weight of the study population was 1.261± 134 grams and mean gestational age was 32+3 ± 1+5 weeks. First feeds were started before 24 hours in 36 (18.8%), between 24-48 hours in 42 (22%), between 72 hours in 61 (31.9%) and after 72 hours in the rest 52 (27.2%) neonates. Only 44 (23%) neonates could be started on expressed breast milk (EBM) exclusively and the rest needed preterm formula milk. Median time to achieve FEF among neonates with GA 32–37 weeks was 11 days (IQR of 10–12 days), which was significantly shorter as compared to those with <32 weeks of GA (median 14 days; IQR: 12–15). Median time of EFF among neonates without NEC was 9 days (IQR of 8–10 days), which was significantly shorter as compared to those with NEC (median 14 days; IQR: 13–15). Similarly, the median time of full enteral feeding among VLBW neonates who were fed formula milk was 12 days (IQR of 11–12 days), which was significantly longer as compared to those who were fed with expressed breast milk (median 9 days; IQR: 9–10). **Conclusion:** Necrotizing enterocolitis, GA at birth, type of enteral feeds and birth outcome were significantly associated with time to FEF among VLBW neonates admitted to our NICU.

Key words: Full enteral feeds, VLBW neonates, Necrotising enterocolitis, NICU.

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INTRODUCTION

According to the World Health Organization, very low birth weight (VLBW) baby is defined as a neonate having birth weight 1000 to less than 1500 gram and a preterm birth is defined as any birth occurring before 37 completed weeks of gestation.[1] Very low birth weight is a major cause of morbidity and mortality and accounts for about 60% of all neonatal deaths.[2] Full enteral feeding (FEF) is defined as the time when newborn infants receive all of their

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prescribed nutrition (120–150 ml/kg/day) as milk feeds (human milk or formula) and do not receive any supplemental parenteral fluids or nutrition after birth.[3] Based on the available experience, expected time to achieve FEF is 7 days for infants born 1–1.5 kg and 14 days for infants born < 1 kg.[4]

Early introduction of enteral feeds and rapid achievement of FEF are the cornerstone of nutritional management of VLBW neonates to reduce the need for central venous catheters, risk of infection, liver problems, persistent gut immaturity and duration of hospital stay.[5] Moreover, early enteral feeding is considered to be associated with better later cognitive function and a healthy cardiovascular and renal system.[6,7] In most resource-limited countries, including India, introduction of enteral feeding for VLBW neonates is frequently delayed after birth because of complications from clinical conditions. This delay in FEF has the potential to diminish functional adaptation of the gastrointestinal tract and disruption of the patterns of microbial colonization because gastrointestinal hormone secretion and motility are stimulated by milk feeds.[8] Additionally, such a condition also leads to prolonged hospital stays, higher hospital expenditures, and increased risk of hospital-acquired infections, which ultimately leads to poor health outcomes. The situation is different in developed countries, where the morbidity and mortality of VLBW neonates has been substantially reduced by optimizing early enteral feeding, particularly the timing of early introduction of milk feeds.[9] Over the last few years, some progress has been made to address the poor practice of late initiation of enteral nutrition among neonates in India. But available data suggests that still a considerable number of neonates are kept NPO in the first few days after birth.

Attaining early full enteral feeding in VLBW neonates is considered an important clinical parameter index target for good quality care practices. So, identifying predictors of time to achieve full enteral feeding has significant clinical significance and will help the healthcare providers practice evidence-based medicine, set priorities and allocate resources within the health sector, especially in a resource limited setting like ours. However, there are limited studies in India assessing the time to FEF and its predictors among VLBW neonates admitted to the Neonatal Intensive Care Unit (NICU). Based on this background, the present study was conducted at our tertiary care level teaching hospital.

Aim and Objectives

To study the time to attain full enteral feeds and its predictors among VLBW neonates admitted to the NICU of our hospital.

MATERIALS AND METHODS

Study Setting: N.I.C.U of deptt of Paediatrics N.M.C.H Patna

Study duration: 2 years, from Jan 2020 to December 2021.

Study design: Hospital based prospective observational study.

Inclusion criteria: We included consecutively admitted preterm babies of birth weight 1000 gram to <1500 gram with age less than 24 hours at our NICU.

Exclusion criteria: Neonates with major congenital malformations and who could not be started on enteral feeds because of their clinical conditions (GI surgical interventions) and incomplete data for the outcome variable and time variable were not included.

Study technique: After obtaining written informed consent, we enrolled cases in this study. All such neonates were subjected to thorough physical examination and focused history taking from guardians to document pertinent maternal and neonatal factors. Information so obtained and data regarding baseline characteristics, admission diagnosis and lab investigation reports was recorded in a structured proforma. Full enteral feed was defined as the point when the newborn received all of their prescribed nutrition as milk feeds. During the hospital stay, treatment and laboratory related variables were also recorded and further analysed.

Statistical analysis: Pertaining data was first entered in Microsoft excel sheet and then analysed by SPSS version 20 software. Results were presented as mean, median, interquartile range, standard deviation or percentage as appropriate. Dichotomous events were compared by Chi-Square test and continuous variables were compared by Student t-test. P value less than 0.05 was considered significant.

RESULT

Over the study period, 317 VLBW neonates were admitted to our NICU. Of these, 126 were excluded. So, final analysis was done on 191 neonates. Mean weight of the study population was 1.261± 134 grams and mean gestational age was 32+3 ± 1+5 weeks. Mean age of the mothers was 24.6± 4.3 years and mean weight was 56.4± 8.9 Kg. Table 1 depicts the maternal characteristics of the study population. As expected, young females (<20 years age) and elderly females (>35 years age) were more likely to give birth to a VLBW baby. Majority of these mothers (>90%) had undergone atleast one antenatal check-up.

Table 1: Maternal characteristics of the neonates

Variable	Number	Percentage
Age of the mother in years (n=191)		
<20	47	24.6%

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20-25	36	18.8%
25-30	31	16.2%
30-35	63	33.0%
>35	14	7.3%
Antenatal check-up visit(s) (n=191)		
Yes	176	92.1%
No	15	7.9%
Number of ANC visits (n=176)		
<2 visits	19	10.8%
>2 visits	157	89.2%
Mode of delivery (n=191)		
VD	124	64.9%
LSCS	67	35.1%
Pre-eclampsia	38	19.9%
Diabetes Mellitus	24	12.6%
PROM	47	24.6%
Chorioamnionitis	19	9.9%
Multiple gestation	16	8.4%

(ANC: antenatal check-up, LSCS: lower segment Cessarian section, PROM: premature rupture of membrane, VD: vaginal delivery)

As depicted in table 2 below, proportion of inborn and outborn neonates was nearly equal. Males outnumbered females with male: female ratio of 1.25:1. Majority of the neonates were >28 weeks of age (90.6%). Incidence of MAS, HMD, NEC and sepsis was 6.8%, 17.3%, 24.6% and 29.8% respectively.

Table 2: Baby related characteristics of the study population

Variable	Number	Percentage
Place of birth		
Inborn	94	49.2%
Outborn	97	50.8%
Sex		
Male	106	55.5%
Female	85	44.5%
Gestational age at birth		
<28 weeks	18	9.4%
28-32 weeks	81	42.4%
>32 weeks	92	48.2%
Perinatal Asphyxia		
Yes	22	11.5%
No	169	88.5%
Necrotising enterocolitis		
Yes	47	24.6%
No	144	75.4%
Sepsis		
Yes	57	29.8%
No	134	70.2%
Hyaline membrane disease		
Yes	33	17.3%
No	158	82.7%
Meconium aspiration syndrome		
Yes	13	6.8%
No	178	93.2%
Hospital acquired infection		
Yes	21	11.0%
No	170	89.0%
Central venous catheter		
Yes	104	54.4%
No	87	45.6%

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Management and outcome: First feeds were started before 24 hours in 36 (18.8%), between 24-48 hours in 42 (22%), between 48-72 hours in 61 (31.9%) and after 72 hours in the rest 52 (27.2%) neonates. Only 44 (23%) neonates could be started on expressed breast milk (EBM) exclusively and the rest needed preterm formula milk. 137 (71.7%) required supplemental oxygen support and 74 (38.7%) required antibiotic therapy. Time to reach full enteral feeds was 6.2±2.7 days (minimum 4 days, maximum 19 days, median 10 days). Overall, 149 (78.01%) neonates could achieve full enteral feeds. Unfortunately, 34 (17.8%) died and 8 (4.2%) were referred to another centre for surgical intervention.

Table 3: Treatment related variables of the study population

Variable	Number	Percentage
Timing of enteral feeds initiation:		
Early (before 72 hours)	139	72.8%
Late (after 72 hours)	52	27.2%
Type of initial milk given		
Only EBM	44	23.1%
Only formula feeds	104	54.4%
Mixed feeds	43	22.5%
Type of milk on reaching full enteral feeds		
Only EBM	47	24.6%
Only formula feeds	54	28.3%
Mixed feeds	90	47.1%
Feeding frequency per day on FEF		
8 times/day	77	40.3%
>8 times/day	114	59.7%
Type of respiratory support		
Oxygen alone	47	24.6%
NCPAP support	94	49.2%
Mechanical ventilator support	50	26.2%
Duration of antibiotic therapy		
<7 days	86	45.1%
<7 days	105	54.9%

In Kaplan-Meier survival estimate, median time to achieve full enteral feeding among VLBW neonates whose GA was 32–37 weeks was 11 days (IQR of 10–12 days), which is shorter as compared to those who were less than 32 weeks of GA (14 days; IQR: 12–15) with a p-value<0.001. Median time of full enteral feeding among VLBW neonates without NEC was 9 days (IQR of 8–10 days), which is shorter as compared to those with NEC (14 days; IQR: 13–15) with a p-value <0.001. We also found that median time of full enteral feeding among VLBW neonates who were fed with formula feeding was 12 days (IQR of 11–12 days), which is longer as compared to those who were fed with expressed breast milk (9 days; IQR: 9–10) with a p-value of 0.003. Not surprisingly, this study also found that median time of full enteral feeding among VLBW neonates born to singleton gestation was 10 days (IQR of 9–10 days), which is shorter as compared to those with multiple birth outcomes (14 days; IQR: 12-15) with a p-value<0.01.

DISCUSSION

Delay in achieving full enteral feeding is a common problem in VLBW neonates. Delayed time to full enteral feeding is believed to directly impact postnatal growth and long-term neurodevelopmental outcomes. In the present study time to full enteral feeding and its predictors among VLBW neonates admitted to the NICU was assessed.

In this study, median time to full enteral feeding was 10 (95% CI: 10–11) days. This is somewhat higher than a multicentre prospective follow-up study in Ethiopia[10] but lower than some studies done in India.[11] This can be partly attributed to the difference in the study population. For instance, the mean gestational age of neonates in the current study was lower than the study conducted in Ethiopia and the study from Netherlands was done on preterm neonates with NEC which delayed the achievement of full enteral feeding due to its devastating effect on the gastrointestinal tract. Whereas the present study included all VLBW neonates admitted to our NICU and so the study population was more heterogenous. Standard NICU guidelines recommend early initiation and gradual advancement of enteral nutrition so as to achieve full enteral feeding by 7 days for neonates born 1–1.5 kg and 14 days for neonates born<1 kg.[12] But, the results in our study were little higher. This difference might be attributed to the differences in population studied, illness severity, skilled manpower available, medical equipment, laboratory investigations etc, which directly relate to the quality of services that can be provided in the NICU.

Keeping other variables constant, VLBW neonates who received a formula feeding were less

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likely to have full enteral feeding by 31% as compared with neonates who were fed breast milk. This finding was also supported by a study conducted in Italy.[13] It is believed that human breast milk promotes the maturation of the gut microbiome, which in turn promotes immune modulation, digestion, and the metabolism of nutrients. Additionally, bacterial contamination during formula preparation and/or feeding thereby exposing them to infections and gut dysmodulation. This reinforces our usual practice of giving only breastmilk to premies as far as possible. In this study, neonates with gestational age of 32–37 weeks were 1.5 times more likely to have earlier full enteral feeding as compared with those with a gestational age of less than 32 weeks. This finding is supported by studies done in developing countries like India[14] and Indonesia[15] where researchers found that a higher gestational age was associated with an earlier achievement of full enteral feeding. Some larger studies have revealed that as GA increases by one week, the time to achieve full enteral feeding decreases by 15-20%. As gestational age increases, gut maturity also increases which in turn reduces the time neonates need to spend on trophic feeding. As a result, they tend to reach full feeds earlier and have shorter hospital stay than those who are born at lesser GA. There is also evidence that with lower gestational age, there is gastrointestinal and neuromotor immaturity and a deficit in sucking-swallowing coordination, which lead to feeding intolerance or other feeding problems causing enteral feeding to be delayed and the time needed to reach full enteral feeding to become longer.

In this study, VLBW neonates without NEC were about 2.5 times more likely to be early fully enterally fed as compared with their counterparts. This finding is supported by numerous studies both in developed as well as developing countries where it was reported that neonates who had NEC or feeding intolerance achieved full enteral feeding as much as 1 week later than those who did not.[16] This could be due to failure in the early initiation or progression of enteral nutrition resulting from poor gut development and maturation. The clinical signs and management of NEC necessitate interruption or discontinuation of feeding. In addition, prolonged antibiotic therapy and/or surgical intervention delays the achievement of full enteral feeding in these unfortunate neonates. Achievement of full enteral feeds was significantly delayed in neonates with multiple births as compared to singleton pregnancy. This can be explained by the fact that multiple gestational births are more likely to be associated with prematurity, lower birth weight or small for gestational age, increased risk of feeding intolerance, NEC, and infections. This implies that VLBW neonates with multiple gestations need a critical evaluation and adjustment of feeding practices based on their level of tolerance.

CONCLUSION

In the present study, achievement of full enteral feeding took a longer time (median 10 days) than that recommended by the WHO in this regard (7 days) for VLBW neonates. Necrotizing enterocolitis, GA at birth, type of enteral feeds and birth outcome were significantly associated with time to FEF among VLBW neonates admitted to our NICU. Considering its devastating effects, it is important to focus on prevention and timely management of NEC among VLBW neonates.

Limitations

First limitation is inherent in the study design that this is a single centre study. Second, long term follow-up of these neonates was not done. Third limitation is related to the relatively smaller sample size.

Conflict of Interest: None

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