ORIGINAL RESEARCH

Safety of Full Enteral Feedings Initiated Soon after Birth Instead of Parenteral Fluids in Clinically Stable 30–34 Weeks Gestation Premature Infants

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Abstract

Background: Many neonatal intensive care units use feeding protocols where infants born at 30–34 weeks' gestation are maintained exclusively on parenteral fluids for variable periods without enteral feedings, until there is confirmed hemodynamic stability without any doubt. In addition to the pain and discomfort, intravenous infusions are associated with an increased risk of hospital-acquired infections, which makes it an undesirable practice if not essential.

Objective: In this quality improvement (QI) effort, we tested the safety and efficacy of enteral feedings starting within the first 2 hours after birth in infants born at 30–34 weeks' gestation.

Materials and methods: Instead of intravenous fluids, we initiated fluid management in infants born at 30–34 weeks' gestation using oral/nasogastric milk feedings at 70–80 mL/kg/day divided every 3 hours, with 5 mL increments every 12–24 hours until 200 mL/kg/day was achieved. We compared the utilization of parenteral fluids, the incidence of infection, and growth before and after initiation of this new feeding policy.

Results: In our experience, these infants tolerated and utilized enteral feedings well with stable growth and biochemical parameters. They also tolerated daily volume increments in the enteral feedings. We did not find any hypoglycemic events as the first enteral feeding was administered within 2 hours after birth. The enterally fed group showed a similar safety profile with similar weight at discharge and weight Z-scores. We report that infants born as early as 30 weeks gestation can safely tolerate ab initio full enteral feedings.

Conclusion: Enteral feedings beginning within 2 hours after birth are a safe and efficacious strategy for fluid management in premature infants born at 30–34 weeks gestation. Routine use of parenteral fluids is not necessary in the initial management of these infants.

Keywords: Central venous lines, Early oral feeds, Hospital-acquired infections, Late premature infants, Newborn, Neonate, Nutrition, Parenteral fluids, Umbilical lines, Z-score.

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Keypoints

- In most neonatal intensive care units (NICUs) across the world, premature infants born at gestational ages higher than 34 weeks of gestation receive full enteral feedings. However, those born at 30–34 weeks' gestation typically receive intravenous fluids and if stable, some trophic feedings.
- In our NICU, we have treated clinically stable premature infants born at 30–34 gestation also with full enteral feedings starting soon after birth.
- We typically start at total fluid volumes of 70–80 mL/kg/day divided every 3 hours, with 5 mL increments every 12–24 hours until we achieve a total volume of 200 mL/kg/day. Mothers own milk (MOM) is always our first choice.
- Here, we report two periods where we used this full enteral feeding protocol. Both periods showed safety; the weight at discharge and the change in weight Z-scores were the same in both groups. We report that infants born as early as 30 weeks' gestation can safely tolerate full enteral feedings.

Introduction

Many clinical practices in neonatal care are rooted in tradition and have not been critically examined for safety. One example is the initial "clinical stabilization" of premature infants where these infants first receive parenteral (intravenous) fluids during the first week and are started on enteral feedings only when they prove hemodynamic stability beyond doubt.[1–3] There is now some acceptance of enteral feedings ab initio in infants born at or beyond 34 weeks of gestation. However, there is continuing hesitation in enteral feeding in infants born at 30–34 weeks of gestation who might have mild-to-moderate respiratory distress; the fluid administration protocols

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for these infants in many neonatal intensive care units (NICUs) are largely based on parenteral fluids. The use of excess fluids in the first week of life is also not uncommon. We have been concerned that in addition to the pain and discomfort, intravenous infusions are associated with an increased risk of hospital-acquired infections, which makes it an undesirable practice if not essential.[4–7] Some NICUs have started providing trophic feedings (≤20 mL/kg) to a subset of infants who are perceived as most stable.

In this study, we describe our experience with enteric administration of fluids starting on the first 2 hours after birth in infants born at 30–34 weeks of gestation.[8] Similar practices have also been tried elsewhere; they concluded that early and exclusive enteral nutrition increases the number of full enteral feeding days. This feeding practice also appears to improve fat-free mass accretion, increase length, and reduce hospitalization costs.[9] In 2024, a similar quality improvement (QI) effort was performed in India.[10] The clinicians there noted that early total enteral feeding in sick 27–32 weeks gestation preterm neonates led to early attainment of full feeds and birth weight, shorter hospital stay, and reduced incidence of bronchopulmonary dysplasia (BPD) as well as retinopathy of prematurity (ROP). They did not observe any increase in feeding intolerance, necrotizing enterocolitis (NEC), sepsis, or mortality.

In the end of 2017, we developed a feeding protocol to rationalize the use of parenteral fluids in infants born at 30–34 weeks gestation in the Neonatal Unit of the Clínica del Country. We started using oral/nasogastric milk feedings, not intravenous fluids at 70–80 mL/kg/day divided every 3 hours, with 5 mL increments every 12–24 hours until 200 mL/kg/day was achieved.[11–13] In stable infants with no respiratory distress, these feedings were administered orally. In patients with mild-moderate respiratory distress, the feedings were administered using an oro-/nasogastric tube. We did not administer parenteral fluids unless the patient could not tolerate the oral feeds or had another serious pathology requiring us to not start feedings. Intravenous lines were placed only if needed to administer medications. Whenever possible, mothers' own milk (MOM) was the fluid of choice; it was fortified per our protocols (>=100 mL/kg/day). We do not have access to a human milk (HM) bank or HM-derived HM fortifiers.

In this study, we compared the utilization of parenteral fluids, the incidence of infection, and growth before and after initiation of this new feeding policy. Both periods showed safety with similar weight at discharge and weight Z-scores. We report that infants born as early as at 30 weeks of gestation can safely tolerate ab initio full enteral feedings.

Materials and Methods

The present study reports the results of a quality-of-care effort; this is a cohort study before and after an intervention. This study was carried out using the EpicLatino data collection instrument in our unit that has authorization from the ethics committee with the exception of informed consent because it uses data from unidentified clinical records. Our goal was to compare the clinical outcomes prior to and after the adoption of these new feeding protocols.

We reviewed the medical records of all premature infants born at 30–34 weeks' gestation in two time periods, the first from 01/01/2010 to 12/31/2017 and the second, after satisfactory acceptance of the feeding protocols, from 01/01/2018 to 08/15/2022. Babies born in another institution prior to transfer were excluded.

Demographic characteristics, prenatal variables, such as intrauterine growth restriction (IUGR) and suspected chorioamnionitis, and postnatal variables such as the possibility of infection and respiratory distress of infants were noted.[14–16] The variables were presented in absolute or relative proportions, or in medians and interquartile ranges according to the nature of the variable. The number of cases with and without parenteral fluids, the incidence of infection defined by positive blood or cerebrospinal fluid cultures and the weight on admission and discharge. To assess the adequacy of nutrition, we compared changes in weight *Z*-scores between birth and discharge.[17]

Appropriate parametric and nonparametric statistical methods were used; the Chi-squared test with Pearson or Fisher's exact techniques for numerical, and the Wilcoxon rank tests were used for nonparametric variables, respectively.[18–20] For continuous variables that did not show a normal distribution, the Mann–Whiteney *U* or Kruskal–Wallis *H* tests were used.[21] A p-value < 0.05 was considered significant after due consideration.[22]

Table 1: Demographic and anthropometric characteristics of patients before and after policy implementation

	Before 2018		*After 2018*		
Gestational age	*n*	*%*	*n*	*%*	*p**
30	45	9	28	7	0.860
31	60	12	46	11	
32	85	16	62	15	
33	129	25	102	25	
34	199	38	164	41	
Total	518		402		
Birth weight					
500–749	1	0.2	0	0.0	0.891
750–999	10	1.9	7	0.8	
1000–1249	25	4.8	20	2.2	
1250–1499	70	13.5	46	5.0	
1500–2499	383	73.9	302	32.8	
2500–4499	29	5.6	27	2.9	
Total	518		402		
Sex					
Male	274	52.9	209	52.0	0.629
Suspected chorio[¥]	11	1.2	13	1.4	0.534
Destination					
Death	10	2.0	10	2.6	0.123
Home	487	94	382	95	
Congenital anomalies	29	5.6	25	6.2	0.436
NEC/perforation[β]	6	1.2	3	0.7	0,739

*Fisher's exact test; [¥]Suspected chorioamnionitis; [β]All 9 cases received parenteral fluids from birth since they were high-risk cases

Results

We identified 920 cases born at 30–34 weeks of gestation. The groups in the periods prior to and after the initiation of these QI efforts did not show any significant differences in demographic characteristics (Table 1). There was a signification reduction in the number of patients who received parenteral fluids from the first to the second study period from 425 (82%) before to 297 (26.2%) after implementation ($p < 0.0001$). The number of days of administration of intravenous fluids also decreased from a median (interquartile range) of 3 (4) to 0 (1); $p = 0.0001$. The weight at discharge and the

Table 2: Results

	Before 2018		*After 2018*		
Parenteral fluids	*n*	*%*	*n*	*%*	*p**
No	93	18.0	105	73.8	<0.00001
Yes	425	82.0	297	26.2	
Total	518		402		
Infection**					
No	509		400		0.129
Yes	9	2.1	2	0.5	
Total	518		402		
Days with parenteral fluids					
Median (IQR)	3 (4)		0 (1)		0.0001***
Change in Z-score between birth and discharge					
p50	−0.56		−0.55		0.910***
p25	−0.82		−0.83		
p75	−0.25		−0.23		
IQR	1.1		1.1		
Weight at discharge/ death					
500–749	1	0.2	0	0.0	0.5338***
750–999	3	0.6	2	0.5	
1000–1249	3	0.6	1	0.2	
1250–1499	2	0.4	6	1.5	
1500–2499	418	80.7	310	77.3	
2500–4499	90	17.4	82	20.4	
≥4500	1	0.2	0	0.0	
Unknown	0	0.0$	1	0.0	
Total	518		402		

IQR, Interquartile ranges; *Fisher's exact test; **Infection is defined as positive blood or spinal fluid culture; ***Kruskal–Wallis equality-of-populations rank test

change in weight Z-score were similar in both groups (Table 2). The number of infants with hospital-acquired infections (late-onset sepsis) decreased from 9 in the first period to 2 cases in the second period; this difference was statistically not different. There were no complications due to less use of parenteral fluids.

During the second period, the use of parenteral fluids decreased in all gestational ages, as follows: at 30 weeks from 93 to 68%, at 31 weeks from 95 to 54%, at 32 weeks from 89 to 31%, at 33 weeks from 82 to 22%, and at 34 weeks from 72 to 12%. There were no complications due to withholding parenteral fluids. No cases of persistent hypoglycemia requiring parenteral fluids were reported. There were fewer patients who developed sepsis; 9 cases in the 1st period vs 2 in the 2nd, but this difference was not statistically significant. The number of infants with NEC in the two groups was 6 (1.2%) and 3 (0.7%), respectively; all 9 had received parenteral fluids since birth as they were perceived to be at a higher risk. The three cases during the intervention period with NEC included two perforations in babies <1000 gms on postnatal day 6 with parenteral fluids since birth. The 3rd infant was one of a twin pair born with a birth weight of 1500 gms at 30 weeks of gestation. He had a high acuity of illness since birth and therefore, received a traditional parenteral fluid regimen. He developed NEC with perforation on postnatal day 7.

Discussion

This quality improvement study in our NICU showed that premature infants born at 30–34 weeks of gestation safely tolerated full enteral nutrition within the first two hours of birth. Even though the evidence for any benefits of enteral fasting is missing, many NICUs have treated IUGR "high risk" preterm infants NPO (nil per os) with intravenous fluids for a variable number of days; enteral feedings are then initiated and increased over a variable period.[23–25] Some units even suggest a 3–5 period of trophic feedings[26,27] but the effects have not been consistent.[28] In our NICU, we found that initiation with full-volume enteral feedings was safe. Since the adoption of this universal enteral feeding protocol, there has been a signification reduction in both the number of patients who received and the number of days of parenteral fluids, and there was no change in the weight at discharge.

The variability in feeding practices in premature infants continues in many NICUs even though advantages of early exposure to colostrum both in terms of immunological development and establishment of protective microflora, and in mother-infant bonding are now receiving attention.[29–32] In surveys in our EpicLatino group, many healthcare providers have expressed concerns about the possibility of complications, such as spontaneous intestinal perforation and/or NEC, even though epidemiological data now show decreased and delayed occurrence of intestinal complications such as spontaneous perforations/NEC. Most of the cases of NEC are anyways seen after the first week.[11,33–35] The antecedents/precipitants of NEC also might be changing.[35–37] There is a need for continuing medical education.

In our experience, preterm infants of 30–34 weeks of gestation tolerated and utilized enteral feedings well, as is apparent in their stable growth and biochemical parameters. They also tolerated daily volume increments in the enteral feedings. Notably, we did not find any hypoglycemic events as the first enteral feeding was administered 2 hours after birth. There were fewer systemic infections in the absence of intravenous lines, which is plausible and can likely be proven in a cohort of adequate size. In terms of the adequacy of nutrition, the two groups showed no difference in the weights at discharge. Consistent with these data, the *Z*-scores computed at birth and discharge were also not different. These figures suggest that the protocol-based advancement of enteral feedings is adequate for good growth in this population.

Conclusion

This QI study confirms that routine use of parenteral fluids is not necessary for initial management of preterm infants born at 30–34 weeks' gestation. Most of these infants can be managed with oral feeding started soon after birth. The value of oral/enteral nutrition is well-established; the composition of enteral feedings over that of intravenous fluids does not require major explanations. Early establishment of full enteral nutrition can shorten the length of hospital stay.[38–40] These effects have been correlated with improved weight gain, linear growth, brain growth,[41] neuromotor integrity, and even optimized neurodevelopment.[42] A larger sample size may confirm the differences in adverse events such as hospital-acquired infections.

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