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Original Research Article

Formula versus Donor Breast Milk for Feeding Preterm or Low Birth Weight Infants

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Abstract:

Introduction: Neonatal care in regions like India emphasizes breastfeeding's critical role in reducing neonatal morbidity and mortality, particularly for preterm and low birth weight infants. The choice between formula milk and donor breast milk is pivotal for healthcare providers, with formula offering standardized nutrition and ease of use. Donor breast milk offers immune support and morbidity prevention, but logistical and cost challenges remain.

Material and Methods: A prospective comparative study at SMIMER Medical College, Gujarat, explored outcomes of preterm or low birth weight infants fed formula milk or donor breast milk. The study included 90 preterm infants (<37 weeks) and low birth weight infants (<2,500 grams) admitted to the NICU. Demographic data, feeding details, clinical records, and anthropometric measurements were collected. Two groups were analyzed: Group 1 (formula-fed) and Group 2 (donor breast milk-fed). Descriptive statistics and appropriate tests were used for comparisons.

Results: No significant differences in mean weights were observed between Group 1 (1343g ± 655) and Group 2 (1326g ± 578) at birth ($p = 0.175$, $Z = 1.29$) or at discharge, with Group 1 at 2125g ± 152 and Group 2 at 2065g ± 232 ($p = 0.122$, $Z = 0.94$). Group 2 (formula feeding) exhibited significantly shorter feeding intolerance time ($p = 0.021$), reduced parenteral nutrition duration ($p = 0.024$), and a shorter NICU stay ($p = 0.012$) compared to Group 1 (donor breast milk). Additionally, Group 2 had a lower rate of sepsis ($p = 0.042$) but a higher incidence of hyperbilirubinemia ($p = 0.011$). No significant differences were observed in necrotizing enterocolitis, respiratory distress syndrome, hypoxic-ischemic encephalopathy, or mortality between the two groups ($p>0.05$).

Conclusion: In conclusion, our study showed no weight differences between preterm infants fed formula milk or donor breast milk. Formula-fed infants had shorter NICU stays and lower sepsis rates but a higher incidence of hyperbilirubinemia, with no differences in other morbidities or mortality.

Keywords: Donor Breast Milk, Formula Milk, Neonatal Morbidity, Mortality.

Introduction

Neonatal morbidity and mortality, particularly in countries like India, emphasize the importance of breastfeeding. [1] Feeding preterm or low birth weight infants is a critical aspect of neonatal care, impacting their immediate and long-term well-being. [2] As medical advancements continue to enhance the survival rates of these vulnerable neonates, healthcare providers are confronted with a pivotal decision: whether to provide infants with formula milk or donor breast milk. [3,4] Each option presents a unique set of advantages and challenges that necessitate careful consideration in the quest to optimize the care of these fragile infants. [5] Traditionally, formula feeding has been a cornerstone of neonatal care, offering the advantage of a standardized nutrient composition and ease of administration. [6] This approach has allowed for precise control over nutrient intake, which can be particularly important in managing the unique nutritional requirements of preterm or low birth weight infants. [7] However, in recent years, the nutritional and immunological benefits of human milk, especially donor breast milk, have garnered increasing attention. [8] Donor breast milk contains a rich and dynamic array of bioactive factors that contribute not only to essential nutrient

provision but also to immune system development and protection against a multitude of morbidities frequently encountered in preterm infants. [9]

Despite these well-documented advantages, the utilization of donor breast milk faces multifaceted challenges related to logistical considerations, supply constraints, and cost-effectiveness. [10] Our study embarks on a comprehensive journey through the intricate landscape of feeding strategies for preterm and low birth weight infants with goal to synthesize existing evidence, critically analyze clinical trials, and explore the pivotal factors that shape the decision-making process between formula and donor breast milk feeding.

Material and Methods

This prospective, comparative and observational study was conducted at SMIMER Medical College, Department of Pediatrics, Gujarat, with the aim of investigating and comparing the outcomes of preterm or low birth weight infants fed with either formula milk or donor breast milk. The study was carried out over a defined period, and data collection followed a predetermined protocol.

The study encompassed preterm infants (born before 37 weeks of gestation) and low birth weight infants (weighing less than 2,500 grams at birth) who were admitted to the neonatal intensive care unit (NICU) at SMIMER Medical College. Infants with congenital malformations or those for whom parental consent for participation was not granted were excluded from the study.

Demographic information, comprising gestational age, birth weight, gender, and maternal age, was gathered for each enrolled infant. Information pertaining to the feeding regimen was meticulously documented. This included whether the infant received formula milk or donor breast milk, the timing of feeding initiation, and the duration of exclusive breast milk or formula milk feeding. Clinical data, encompassing the incidence of conditions such as necrotizing enterocolitis (NEC), sepsis, respiratory distress syndrome (RDS), and other neonatal morbidities, were diligently monitored and recorded. Anthropometric measurements, encompassing weight, length, and head circumference, were routinely taken at specified intervals throughout the hospital stay. Nutritional intake, covering calorie and protein consumption, was meticulously calculated based on the type of milk and the volume ingested. Informed consent was obtained from the parents or legal guardians of all participating infants.

The data were categorized into two distinct groups for comparative analysis: Group 1 (Formula Milk): Infants in this group received formula milk. Group 2 (Donor Breast Milk): Infants in this group were exclusively fed donor breast milk.

Descriptive statistics were applied to summarize demographic and clinical data. Continuous variables were expressed as mean ± standard deviation or median (interquartile range), contingent upon data distribution. Categorical variables were presented as frequencies and percentages.

To assess and compare clinical outcomes and growth parameters between the two groups (formula-fed vs. donor breast milk-fed), suitable statistical tests such as chi-square tests, t-tests, or non-parametric tests were employed as deemed appropriately.

Results

During the study period, 90 eligible infants admitted to our neonatal intensive care unit were enrolled in our study. In our study, we compared two groups (Group 1 and Group 2) of preterm infants. We found no significant differences between the groups in terms of gender, birth weight, birth circumference, length at birth, gestational age, Apgar scores at 5 minutes, or prenatal steroid use ($p>0.05$). Both the groups were comparable in terms of these important characteristics. (Table 1)

Table 1: Demographic and clinical parameters among both groups

Measurement	Group 1 (n=45)	Group 2 (n=45)	P value
Male sex	23	22	0.862
Birth weight (gm)	1343±655	1326±578	0.329
Birth circumference (cm)	28.2 ± 3.1	28.8 ± 2.7	0.308
Length at birth (cm)	37.9 ± 3.5	38.3 ± 2.9	0.671
Gestational age (week)	29 ± 3.9	30 ± 3.3	0.221
Apgar score <7 at 5 min	29	26	0.178
Prenatal steroid use	119	121	0.182

At birth, there was no significant difference in mean weights between Group 1 (1343g, SD: 655) and Group 2 (1326g, SD: 578) ($p = 0.175$, $Z = 1.29$). Similarly, at discharge, no significant difference was found, with Group 1 at 2125g (SD: 152) and Group 2 at 2065g (SD: 232) ($p = 0.122$, $Z = 0.94$).

Table 2: Weight at birth and discharge in Group 1 and Group 2

Weight (gm)	Group 1(n=45) Mean±SD	Group 2(n=45) Mean±SD	Z	P value
At Birth	1343±655	1326±578	1.29	0.175
At Discharge	2125 ± 152	2065 ± 232	0.94	0.122

In our study, group 2 (formula feeding) had a significantly shorter feeding intolerance time (p = 0.021), a reduced duration of parenteral nutrition (p = 0.024), and a shorter NICU stay (p = 0.012) compared to Group 1 (donor breast milk). Additionally, Group 2 had a lower rate of sepsis (p = 0.042) but a higher incidence of hyperbilirubinemia (p = 0.011). There were no significant differences in necrotizing enterocolitis, respiratory distress syndrome, hypoxic ischemic encephalopathy, or mortality between the two groups (p>0.05). (Table 3)

Table 3: Distribution of cases according to morbidity and mortality

Measurement	Group 1 (n=45) (Mean ± SD)	Group 2 (n=45) (Mean ± SD)	p-value
Feeding Intolerance Time (days)	6.6 ± 3.2	4.2 ± 3.8	0.021
Duration of Parenteral Nutrition (days)	17.3 ± 2.4	13.6 ± 4.1	0.024
Duration of Stay at the NICU (days)	34.5 ± 6.3	29.5 ± 7.7	0.012
Sepsis	7(15.5%)	3 (6.66%)	0.042
Necrotizing Entercolitis (NEC)	1 (2.22%)	1 (2.22%)	0.651
Hyperbilirubinemia	12 (26.66%)	19 (42.22%)	0.011
Respiratory distress syndrome (RDS)	14 (31.11%)	17 (37.77%)	0.645
Hypoxic Ischemic Encephalopathy (HIE)	00	1 (2.22%)	0.124
Mortality	3 (6.66%)	4 (8.88%)	0.165

Discussion

In our study, we examined the weight gain of preterm infants in two groups, Group 1 and Group 2, at birth and at discharge. We found no statistically significant differences in mean weights between these two group at either time point, indicating that their initial and discharge weights were comparable. Several other studies have explored factors influencing preterm infant weight gain. Fang et al. [11] did not find a significant effect of donor milk (DM) on daily weight gain, while Madore LS et al. [12] suggested that a predominantly DM diet might impede early weight gain and potentially lead to cognitive delays. The discrepancy in results between these studies and ours might be attributed to variations in DM source and handling. Mane et al. [13] found that infants receiving pasteurized donor human milk (PDHM) had higher birth and discharge weights compared to those not receiving PDHM, supporting the idea that DM source influences weight outcomes. Additionally, Schanler et al. [14] observed short-term benefits of both mother's milk and donor's milk over preterm formula, highlighting the advantages of human milk. However, a survey of U.S. neonatal intensive care units revealed that exclusive human milk usage for very low birth weight infants remains limited, emphasizing the need for further research and interventions to promote human milk utilization in neonatal care. [15]

Our study yielded significant insights into the outcomes of preterm infants fed with donor breast milk (DM) compared to formula-fed infants (PF). Notably, we observed a lower incidence of sepsis in the DM group (6.66%) compared to the PF group (15.5%). In the study conducted by Mane et al. [13], it was noted that there was a statistically significant difference (P < 0.05) in the incidence of sepsis between the pasteurized donor human milk (PDHM) and non-PDHM groups. Specifically, 30% of neonates in the PDHM group developed sepsis compared to 54% in the non-PDHM group. The lower incidence of sepsis in our study group of donor breast milk may be attributed to the immunological benefits of human milk and the enhanced hygiene practices implemented in the NICU.

In our study, hyperbilirubinemia was more prevalent in the donor milk group (42.22%) compared to the formula feed group (26.66%), which resonates with Mane et al.'s [13] observation of higher hyperbilirubinemia rates in the non-PDHM group. Furthermore, a significant difference (P < 0.05) in the occurrence of hyperbilirubinemia was observed, with a 20% lower incidence in the PDHM group compared to the non-PDHM group in Mane et al. [13] study.

This finding is consistent with a study by Chang et al. [16], which suggested that supplementing with human milk can help prevent severe weight loss associated with hyperbilirubinemia. It is important to note that while breastfed infants may have a relatively higher risk of severe hyperbilirubinemia compared to formula-fed infants, the well-documented advantages of breastfeeding outweigh the minimal risks of acute bilirubin encephalopathy. Effective support and education for breastfeeding mothers, coupled with tailored feeding regimens based on the baby's weight, may

contribute to the reduction of hyperbilirubinemia in the donor breast milk group.

However, a study by Costa et al. [17] presented differing results, particularly regarding sepsis, necrotizing enterocolitis (NEC), and respiratory distress syndrome (RDS). Their study found no significant differences in sepsis or NEC between the PF and PDHM groups, contrasting with our lower sepsis rates in the donor breast milk group. Additionally, RDS incidence was higher in the PDHM group in their study, while we did not find a significant difference in RDS rates between our groups. Corpeleijn et al. [18] conducted a large multi-center trial in the Netherlands, reporting no protective effect of DM against infection and NEC. Notably, their study provided DM for only the first 10 days after birth, with a high proportion of human milk in both DM and formula groups, possibly biasing the comparison. These disparities may stem from variations in study methodologies, including the timing and duration of DM provision and the proportion of human milk consumed.

In our study, Group 2 (formula feeding) showed significant benefits over Group 1 (donor breast milk) with shorter feeding intolerance time, reduced duration of parenteral nutrition (PN), and a shorter NICU stay**.** Similarly, Fang et al. [11] also found reduced feeding intolerance in the donor milk (DM) group compared to the preterm formula (PF) group, aligning with your study's observation of shorter feeding intolerance time in formula-fed infants. Both studies highlight the potential advantages of using human milk-based diets. Another study by Cristofalo et al. [19] observed that extremely preterm infants fed an exclusive pasteurized donor human milk (PDHM) diet required fewer days of PN than PF-fed infants, mirroring your findings of reduced PN duration in the formula-fed group. These results support the use of human milk-based diets for improved feeding tolerance outcomes. Sullivan et al. [20] found no significant differences in PN duration between infants fed exclusively human milk (HM)-based diets and those receiving HM-based diets with bovine milk-based products, contrasting with your study where formula-fed infants had a shorter PN duration. Differences could stem from variations in diet composition. These studies collectively suggest that human milk-based diets can positively impact feeding tolerance and PN duration in preterm infants.

In our study, no significant differences in mortality were observed between the two groups, indicating that the choice of feeding regimen did not appear to influence mortality outcomes. However, in Mane et al. [13] reported a notable decrease in mortality within the pasteurized donor human milk (PDHM) group compared to another group, which contrasts with your study's results. Similarly, a study by Katke and Saraogi [21] did not find statistically significant differences in mortality, possibly due to a small sample size, aligning with your study's findings. Corpeleijn et al.'s [18] randomized controlled study also found no significant effect of PDHM on mortality, consistent with your results. Adhisivam et al. [22] reported a slight decrease in neonatal mortality post-introduction of human milk banking (HMB), although this reduction was not statistically significant.

Our study has several limitations. Firstly, it was conducted at a single medical college, potentially limiting the generalizability of our findings. The relatively short duration of observation may not capture long-term outcomes. Retrospective data collection introduced the possibility of recall bias, and the exclusion of certain infants could introduce selection bias. Variability in donor breast milk composition was not considered, and long-term follow-up beyond the neonatal period was lacking. Additionally, we did not analyze the detailed composition of milk types used, and unaccounted confounding factors may influence outcomes.

Conclusion

In conclusion, our study revealed that there were no significant differences in weight gain between preterm infants fed donor breast milk and formula. However, we did observe variations in other health outcomes, such as lower sepsis rates but higher hyperbilirubinemia in the donor milk group, while formula-fed infants experienced advantages in terms of feeding tolerance and reduced NICU stay. Mortality outcomes showed no significant disparities. These findings emphasize the complexity of the relationship between feeding regimens and preterm infant health, underscoring the need to carefully consider the choice of feeding approach based on individual patient characteristics and clinical considerations.

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