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ORIGINAL ARTICLE

Fat Supplementation of Human Milk with MCT Oil for Promoting Weight Gain in Preterm Infants

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ABSTRACT

Background: The addition of medium chain triglycerides is preferable as they are more easily digested and quickly absorb in bloodstream than long chain fat and provide ready supply of energy by increasing fatty acid bioavailability. Modular products like micro lipids and medium-chain triglyceride (MCT) oils are now focused as a fat supplementation. The rate of weight gain with MCT is not well known, and there is very less research done in Pakistan.

Objective: To determine the effect of MCT oil supplemented human milk compared with un supplemented human milk fed to preterm infants on promoting weight gain.

Study Design: Randomized controlled trial

Study Setting: This study was conducted in Department of Neonatology, Children Hospital, PIMS, Islamabad, Pakistan from 20th August 2022 to 20th February 2023.

Methodology: The study conducted after approval from institutional ethical committee. A total of 160 preterm infants fulfilling the inclusion criteria and enrolled in the study after informed consent from parents. The patients were receiving enteral feeding of human milk within neonatology department of hospital was included and they were randomly assigned to Group NF (receiving 20 ml of human milk without MCT oil), Group F (receiving 20ml of human milk with 1 ml of MCT oil fat). Primary outcomes were including growth in term of weight gain at measured at 1st ,5th and 10th day of MCT oil intake after hospital admission. Secondary outcome included feeding intolerance, diarrhoea, sepsis and necrotising enterocolitis. All the data was collected in the form of a questionnaire. The statistical analysis was done by using SPSS version 20.

Results: One sixty very low birth weight infants were analyzed in this study. All infants were randomly divided into two groups: F and NF, the demographic details. The weight of infants was measured on first day, fifth day and tenth day and noted that the frequency of infants improved the weight gain after taking human milk without fat supplementation or human milk with fat supplementation. We found the gradually infants more increasing their weights in Group F as compared to Group NF. On tenth day 75% infants reaches between1400-1490 gm weight ($p<0.001$). The average daily gain in weight of Group F infants (g/kg). 12.2 Group A, 13.6 in group B were calculated on day first. The average daily weight was shifted in Group B from 13.6 to 14.9 on day fifth then it was further increased as 15.6 in Group C, and 15.8 in Group D.

Practical Implication: The fat in the milk of humans is a significant source of energy. In an underdeveloped State like Pakistan that is short on resources, (MCT) oil can be a useful substitute for MCT due to its high MCT content. Few research studies have been conducted into this area thus far. Previous studies have had a low number of participants and produced contradictory findings. Therefore, this study was carried out to compare the efficacy of feeding preterm infants human milk supplemented with MCT oil to that of feeding them human milk without the supplement.

Conclusion: Our study shows the average weight gain in those infants fed fat supplementation of MCT oil added in breast milk. The study provides data regarding the selection and use of fat supplemented human milk over non-supplemented human milk and this reduces the morbidity and mortality rate due to insufficiency of nutrients.

Keyword: Fat supplementation, MCT oil, breast milk, preterm infants, weight gain rate.

INTRODUCTION

Preterm is defined as any birth before 37 completed weeks of gestation.[1] Due to complications of preterm birth approximately one million children die every year.[2] Preterm infants are susceptible to postnatal nutritional deficits, including of fat as they don't experience rapid growth phase during third trimester of pregnancy.[3] Fat play pivotal roles in promoting growth of preterm infants by providing 50% of caloric need. It supports many metabolic and physiologic functions that are essential for growth and neurodevelopment. Therefore, preterm infants are in need of higher fat content compared with term counterparts.[4] Human milk is easily available source of food for infants.[5] It is rich source of long chain polyunsaturated essential fatty acid (LCPUFA), arachidonic acid (AA), docosahexaenoic acid (DHA) and eicospentaenoic acid (EPA), which is necessary for development of organs, tissues, nervous and immune system.[6] This shows importance of breast feeding during first two years of life as it provides numerous short and long term health benefits in newborns but fat content is not sufficient to meet the neurocognitive development and weight gain in this age group.[7] This might not meet the nutrition requirement of preterm babies therefore, fat supplementation of their milk is necessary along with other micro and macronutrient. For this purpose, commercially prepared fat mixture is added to 20 ml human milk as part of multinutrient fortification. The addition of extra fat to human milk ensures more nutrients intake and lead to better and faster growth.[3]

So, in this regard c. Modular products like micro lipids and medium-chain triglyceride (MCT) oils are available on the market for use as enteral fat supplements.[8] Blends of multiple oils, including high-fat polyunsaturated fatty acid (HF-PUFA)[9], and multicomponent products like liquid human milk fortifiers (LHMF)[10], are also on the market. Once preterm newborns are able to accept breast milk feeding, the formula is combined with human milk and given orally. As lipid emulsions, several of these supplements may also be administered intravenously.[2] The addition of medium chain triglycerides is more preferable as they are more easily digested and quickly absorb in bloodstream than long chain fatty and provide ready supply of energy by increasing fatty acid bioavailability. Modular products like micro lipids and medium-chain triglyceride (MCT) oils are now focused as a fat supplementation.[11]

But it should be used cautiously as they lead to deficiency of fat-soluble vitamins and unsaturated fatty acids if they are used for longer time and they also provide less calories with high osmolality.[1, 12] They enter portal circulation without producing chylomicrons, making absorption easier independent of bile acid content. Its high absorption rate has made it a valuable component

of enteral nutrition. Few studies have been conducted in Pakistan on the rate of weight gain with MCT oil, therefore very less information is known about it. Therefore, we suggested this research to investigate the effects of enteral MCT supplementation on growth indices and body composition.

Objective: To determine the effect of MCT oil supplemented human milk compared with un supplemented human milk fed to preterm infants on promoting weight gain.

MATERIAL AND METHODS

Study Design and Setting: This was a Randomized controlled trial conducted in the Department of Neonatology, Children Hospital, PIMS, Islamabad, Pakistan from20th August 2022 to 20th February 2023.

Sample Size: Sample size was calculated through sample size calculation for comparing proportions where cconfidence interval was equal to 95 % with 5% level of significance taking 80% power of study.

Mean difference in Group A (human milk without fat supplementation) = 26.56 ± 2.21 g/day

Mean difference in Group B (human milk with fat supplementation) = 25.64 ±1.92 g/day

The 160 total sample size was calculated, so we selected 80 infants in each group.

Inclusion and Exclusion criteria: In this study, baby born before 34 weeks of gestation, both male and female gender, very low birth weight infants <1500g and those babies who can tolerate 50% of daily requirement of calories by milk were included in this study. However, baby born after 34 week of gestation, baby allergic to fortified human milk, presence of congenital diseases and co-morbid conditions, preterm infants who require respiratory or cardiac support, babies who cannot tolerate 50% of daily requirement of calories by milk, and haemodynamically unstable were excluded from the study.[26,27]

Data collection Procedure: The study conducted after approval from institutional ethical committee. A total of 160 preterm infants fulfilling the inclusion criteria and enrolled in the study after informed consent from parents. Baseline demographic characteristics including age, gender (male / female), weight, head circumference and length were recorded. The patients were receiving enteral feeding of human milk within neonatology department of hospital was included and they were randomly assigned to Group NF (receiving 20 ml of human milk without MCT oil), Group F (receiving 20ml of human milk with 1 ml of MCT oil fat). In the group the patients were divided through lottery method. The researcher was blind to the group of new-born. The milk was collected from mother and store in separate storage room. Nurses added MCT oil in the milk and then it was given to each group randomly. Primary outcomes were including growth in term of weight gain at measured at 1st ,5th and 10th day of MCT oil intake after hospital admission. Secondary outcome included feeding intolerance, diarrhoea, sepsis and necrotising enterocolitis. All the data was collected in the form of a questionnaire.

Data Analysis procedure: The data was collected and analysis through SPSS version 23. The qualitative data were calculated as frequency and percentages. Effectiveness between the groups compared through chi-square test and p-value ≤ 0.05 was taken as significant.

RESULTS

One sixty very low birth weight infants were analyzed in this study. All infants were randomly divided into two groups: F and NF, the demographic details shown in Table I. Infants averaged between 1100 and 1490 grams at birth. Birth weight between 1100-1190 gm as 60% and 80% in NF and F respectively. The male infant population predominated in both the groups (55.05%). There were around 45.05% females present. Most infants were born at a gestational age of 32 weeks or less varied from 31 to 33 ±7 days. Overall, 58.5% of infants were born at or below 32 weeks of gestation, while 41.5% were born at or above this mark.

Table 1: Demographic Details of Infants.

Groups	NF n (%)	F n (%)
Birth Weight		
<1	37 (46.3)	54 (67.5)
1-1.5	43 (53.8)	26 (32.5)
Gender		
Male	43 (53.8)	45 (56.3)
Female	37 (46.3)	35 (43.8)
Age		
1-7	23 (28.8)	34 (42.5)
8-14	39 (48.8)	35 (43.8)
15-21	18 (22.5)	11 (13.8)

For this research, we separated our groups into four other groups based on their starting weights: Group A (weights between 1100 and 1190 gm), Group B (weights between 1200 and 1290 gm), Group C (weights between 1300 and 1490 gm), and Group D (weights between 1400 and 1490 gm). The weight of infants was measured on first day, fifth day and tenth day and noted that the frequency of infants improved the weight gain after taking human milk without fat supplementation or human milk with fat supplementation. We found the gradually infants more increasing their weights in Group F as compared to Group NF shown is Table II. On tenth day 75% infants reaches between1400-1490 gm weight (p<0.001).

Table 2: Frequency of Weight Gain Rate Between NF and F Group

Days of Measure Weight		Groups NF n (%)	F n(%)	P Value
First Day	1100-1190 gm	48 (60)	64 (80)	<0.001
	1200-1290 gm	32 (40)	16 (20)	
	1300-1390 gm	0	0	
	1400-1490 gm	0	0	
Fifth Day	1100-1190 gm	48 (60)	0	<0.001
	1200-1290 gm	32 (40)	33 (41)	
	1300-1390 gm	0	47 (59)	
	1400-1490 gm	0	0	
Tenth Day	1100-1190 gm	48 (60)	0	<0.001
	1200-1290 gm	28 (35)	0	
	1300-1390 gm	4 (5)	20 (25)	
	1400-1490 gm	0	60 (75)	

Figure 1 shows the average daily gain in weight of Group F infants (g/kg). 12.2 Group A, 13.6 in group B were calculated on day first. The average daily weight was shifted in Group B from 13.6 to 14.9 on day fifth then it was further increased as 15.6 in Group C, and 15.8 in Group D.

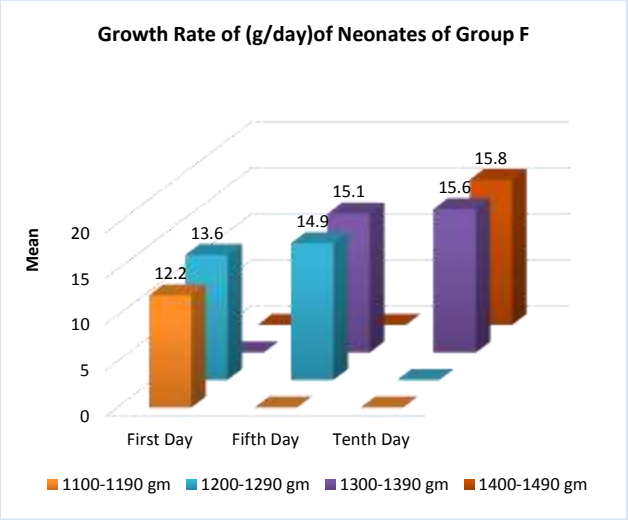

Figure 1: Growth Rate of (g/day) of Neonates of Group F

DISCUSSION

Preterm newborns have a high fat intake need per kg body weight, but they also face special problems that make it difficult to provide them with fat.[13] Fat digestion, micelle production, and fat absorption, all of which are typically accomplished by the pancreatic lipase and bile salt-stimulated lipase, are impaired in preterm newborns.[14] Maldigestion and malabsorption of enteral fats are risk factors for intestinal inflammation and damage, energy loss, and insufficient fat store buildup in premature newborns.[15] Lipase in human milk is activated by bile salts, making milk fat easier to digest and absorb.[16] This primary objective of this research focused on the weight gain after adding MCT as a fat supplement in the breast milk compared with no any addition in breast milk. Eighty infants were examined in each group. Human breast milk has many protective properties, making it the ideal food for preterm infants. However, most preterm newborns need supplemental (fortified) nutrition since human milk does not deliver appropriate levels of these nutrients.[17] There has been a steady increase in the number of children delivered prematurely, at a tiny gestational age, and with a low birthweight, and doctors have struggled to meet their nutritional needs[18]. Breast milk fortifiers have been shown to boost short-term development.[7] Energy and the majority of nutrients may be found in fortifiers which are selling commercially. Human milk serves a dual purpose for premature infants, bolstering their growing immune systems and giving them essential nutrients for growth and development. However, according to the European Milk Bank Association (EMBA) demonstrated that human milk is insufficient as a source of nutrition, hence fortification is required.[17] Expressed breast milk may be supplemented in many ways done by Azad Meghan B[19], Quigley Maria et al.[20] Numerous research were done to determine the efficacy of fortifiers after their introduction in the 1980s hence the fortifiers were shown to increase development and many indices of nutritional quality in research done between 1987 and 1999.[21] By increasing the amount of a fat relative to the amount of energy in a food, fortification works to ensure that dietary requirements are always satisfied. Milk fortification enhances milk's calorie density, which in turn reduces the need for feedings.[22]

According to the results of the current research, infants fed MCT-fortified breast milk gained an average weight per kilogram per day and on tenth day 15.8 of average weight gain in Group D amongst MCT added infants. Preterm infants weighing less than 1500 g at birth and given either human milk or fortified human milk until they reached 1,800 g were studied by Martins EC et al, who examined their growth and the incidence of clinical problems. Forty children born prematurely (birth weight 1,500 g; gestational age 34 weeks) participated in a prospective, double-blind, randomized controlled experiment. [23] We examined dietary factors and clinical problems, as well as daily weight increase and weekly growth rates. The frequency of weight gaining is significantly increased in Group F as compared to NF ($p<0.001$). No serious clinical problems were noted. Human milk fortification was investigated by Ranjan and Rajesh, who compared the effects on short-term growth and biochemical parameters in preterm very low birth weight (VLBW), appropriate for gestation (AGA), and small for gestation (SGA) infants. Primary outcome measures were short-term development up to discharge or 2 Kg in weight gain (measured by daily weight, length, and head circumference (HC) measurements). Babies born prematurely with very low birth weight who were given a fortified diet grew faster than those in the control group.[23] The findings of the current study are consistent with this previous research. Fat added to human milk is thought to improve fatty acid absorption and correct a fat deficit in the diet. It is anticipated that treatment effects would be improved by the distinctive qualities of the various formulations of fat supplements.[17] Merritt J Lawrence et al suggested that MCTs, for instance, are a fast and easily accessible source of energy because, unlike long-chain fatty acids, they do not need carnitine to reach the mitochondria and are therefore oxidized swiftly to ketone bodies. Fatty acid absorption is also affected by chain length and saturation.[24] Hence this study shows that newborns with poor digestion and absorption of fat, such as premature newborns, may benefit from consuming MCTs since their breakdown is independent of the availability of bile and lipase.[25]

It was extremely challenging to keep mothers in a hospital setting with sufficient maternal milk for manual expression throughout the entire hospital stay; in the present study, this was made possible by providing mothers with housing and nutritional and psychological support throughout the entirety of the study. The small size of our sample was one of the limitations of this research. Further confirmation of findings requires a research large sample size in a multi research center.

CONCLUSION

The study provides data regarding the selection and use of fat supplemented human milk over non-supplemented human milk and this reduces the morbidity and mortality rate and shortens length of stay in neonatal intensive care units. Our study shows the average weight gain in those infants fed fat supplementation milk. It helps to evaluate its beneficial effect on weight gain. It is effective in reducing the risk of necrotizing enter colitis and sepsis in hospitalized patients. It enables healthcare providers to determine the right composition and amount to prescribe in daily practice.

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