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Assessing growth of infants with chylothorax receiving fortified skimmed human breast milk

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Abstract

Learning Outcome: To learn how skimmed human milk (SHM) can be used in infants with chylothorax to support adequate weight gain and nutrition while receiving human milk.

Background: Traditional nutrition management for chylothorax is to limit long chain triglycerides (LCT) and provide a diet high in medium chain triglycerides (MCT). Transition from human milk to formula has been required in order to provide the MCT/LCT ratio required to stop the accumulation of chyle. While SHM may provide the right fat content for a baby with chylothorax, previous studies have shown slow growth in infants receiving SHM.

Objective: Demonstrate that infants receiving SHM fortified with high MCT infant formula will have age appropriate growth without re-accumulation of chyle.

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Design/Methods: Between 2017–9, term infants with the diagnosis of chylothorax who were previously receiving human milk and transitioned to fortified SHM were monitored for growth and re-accumulation of chyle.

Results: The six infants who were prescribed fortified SHM with high MCT infant formula using standardized recipes did not show re-accumulation of chyle and showed positive weight gain in five of the six study patients. The infants gained a mean weight of 30.5 gm/day (±19.5) and their weight z scores improved by a mean of +0.29 (±0.33).

Conclusion: Fortified SHM is a safe treatment option which can provide adequate nutrition for the infant with chylothorax to gain weight appropriately for age.

Introduction

Skimmed Human Milk (SHM), formed after the removal of fat from human milk, can be provided for infants who require a diet largely devoid of long chain triglycerides (LCT).[1–3] Infants who may benefit from SHM are often recovering from cardiothoracic surgery or may have a metabolic defect which results in chylothorax, as chyle is formed in the digestion of LCT. [3–6] There are surgical and medical managements for infants with chylothorax.[5] Medical management may include using a high medium chain triglycerides (MCT) infant formula to provide nutritional support as MCTs are absorbed directly into the portal vein and do not lead to worsening of the chylothorax.[5] For this reason, infants with chylothorax are often transitioned to a high MCT fat/low LCT fat diet.[5] Although some infant formulas high in MCT fat meet the nutritional needs of infants with chylothorax, this strategy requires the discontinuation of human milk which is the gold standard for infant feeding and provides numerous health benefits that infant formula cannot provide.[7] These health benefits include providing antibodies, enzymes, and hormones, as well as, decreasing the risk of illness such as respiratory viruses.[7] SHM allows mother to continue to provide these benefits to infant while providing a high MCT/low LCT fat diet when fortified properly.

Previous studies have shown that while SHM is safe for infants and may help in the resolution of chylothorax, growth has been suboptimal.[1] In addition, complicated recipes are used to fortify SHM with multiple different additives.[2,4] Growth is important in all infants, but especially in infants with congenital heart disease. Infants with cardiac disease have an increased nutrition risk as their cardiac defects can affect their energy and protein needs, intake, and nutrient utilization.[5] Poor growth and inadequate nutrition during infancy in the pediatric cardiac population has been associated with adverse developmental outcomes and increased surgical risk, as well as increased hospital length of stay and increased susceptibility to fight infections.[5,8] Given the importance of growth in infants with congenital heart disease, SHM fortified with high MCT formula could provide an adequate alternative when human milk alone cannot be given. The purpose of this study was to assess growth and re-accumulation of chyle in infants requiring a high MCT/low LCT diet due to chylous effusion, using simple recipes to fortify SHM.

Design and methods

This is an observational prospective, cohort study approved by the hospital's IRB with parental informed consent obtained for participation. It was conducted between October 3, 2017-October 3, 2019 at Children's Wisconsin. Term or corrected-to-term infants ≥ 37 weeks gestational age who required a high MCT/low LCT diet with no known food allergies were recruited for the study from inpatient units that were serviced by the hospital milk kitchen. The steps taken to implement SHM have been previously described.[9] Enfamil Enfaport®[12] formula was the standard high MCT infant formula used at the research hospital during the study period and standardly comes as a 30 calorie per ounce liquid formula. Fortification using a liquid versus a powder is preferred in the intensive care units for safety (to decrease risk of infection).[10,11] The use of high MCT infant formula allowed for a single additive to keep the recipes uncomplicated while still meeting infant nutritional needs. Infants receiving fortified SHM required a mother providing human milk who wished to continue to provide human milk during treatment.

Mother's own human milk was skimmed using an Eppendorf Centrifuge 5702 R in the Human Milk Kitchen by milk technicians per hospital protocol which has been explained in detail previously.[9] Briefly, a centrifuge was used to separate the fat in the milk and a stylet pulled the milk away from the fat. A crematocrit was used to determine caloric density of skimmed human milk prior to fortification. SHM was initially fortified with high MCT infant formula to 20 calorie per ounce. Once the patient advanced to goal volume feeds, fortification of SHM was increased to 24 calorie per ounce as standard goal fortification unless the medical team determined that it was not appropriate based on medical needs in which case a different calorie level was used. Once at goal volume of feeds, a liquid infant multivitamin was supplemented daily. Throughout the hospital course, fortification could be modified to 20, 22, or 27 calorie per ounce based on growth needs and as determined by the medical team, including the dietitian. Fortification recipes are shown in Table 1. If an infant required > 27 calorie per ounce with continued need for high MCT/low LCT diet, the patient was transitioned to solely high MCT infant formula. Infants were transitioned off a SHM when ready for discharge or when a high MCT/low LCT diet was no longer needed. At discharge, if the infant still required a high MCT diet, the infant was transitioned off fortified SHM to high MCT infant formula alone since the research hospital does not provide SHM for home use.

Data collection included admission diagnosis, birth gestational age, date of diagnosis of chylous effusion, age at beginning of use of SHM and when transitioned off SHM, any reason to transition off SHM, and changes in weight, length, head circumference and weight for length utilizing z scores. The number of days on high MCT/low LCT diet, nutrition information (including diet order prior to need for high MCT/low LCT diet, diet order when reached goal and any changes in diet order to be able to determine calories and protein intake) was collected. In addition, data regarding any re-accumulation of chylous effusion was determined by physician assessment based on standard criteria and any changes in nutrition intervention needed during the high MCT/low LCT diet were also collected.

Results

Six patients (3 males, 3 females) who met criteria were enrolled in the study and received fortified SHM. Four of these children had congenital heart disease, one infant had a congenital diaphragmatic hernia, and one infant had trachea-esophageal fistula. Four infants were born term and two infants were born prematurely but corrected ≥ 37 weeks gestational age when SHM was initiated. The median birth gestational age amongst the patients was 37 weeks (Interquartile range 0.75). The median age was 40.5 days of life (DOL) when SHM started (Interquartile range 41). Table 2 shows details on each of the patients including total days on SHM, highest fortification required, average change in weight in grams/day, and change in weight-for-age z score. The infants gained a mean weight of 30.5 gm/day (±19.5) and their weight z scores improved by a mean of +0.29 (±0.33). None of the patients on SHM in this study had re-accumulation of chyle. Also, none of the patients had feeding intolerance or required a transition in formula due to a medical or nutritional reason. Patients were transitioned off SHM due to discharge or no longer medically necessary.

Discussion:

This study demonstrates that SHM fortified with a high MCT infant formula is tolerated and not associated with re-accumulation of chyle in infants with chylothrax. SHM fortified with a high MCT infant formula resulted in weight gain in the majority of infants. Five of six infants showed positive weight gain on formula, with one showing no change in weight for age z score. None of the patients in this study had feeding intolerance or re-accumulation of chyle requiring a transition off fortified SHM. The patient who did not have weight gain had a medical situation where caloric density could not advance per protocol to 24 calories per ounce.

SHM alone does not meet the nutrition requirements of an infant and without fortification, an infant would quickly become malnourished and fatty acid deficient.[13] Fortified SHM with high MCT formula has been shown in the literature to be a safe and effective treatment for chylothorax and a way to continue the use of a human milk. This study supports previous findings. [1–5] Literature suggests that in hospital setting, giving formula feeds to human fed infants is associated with shorter duration of human feeding and there are benefits to even small amounts of human milk.[14,15] The option to continue feeding any amount of human milk to the infant with chylothorax was received positively by mothers as a way to continue to be part of the medical care of their infant.

The use of our simple recipes using a single, liquid fortifier with the addition of an infant multivitamin supplementation met the nutrition needs of this age group and supported appropriate weight gain.

Limitations of this study included the small number of subjects that required a high MCT/low LCT diet during the study period and the inconsistent anthropometric measurements obtained in the intensive care setting. While change in length and head circumference had been identified as key data points to obtain and assess, length was not consistently measured. Difficulties included that serial length measurements were not obtained or length was measured with the wrong technique. Inappropriate technique included measurement of length without a length board due to patient medical status and a length board could not be used. This resulted in data that was not accurate and length change was unable to be assessed accurately. Serial measurements of head circumference were not consistently measured and therefore head circumference change during treatment was not available. The use of diuretics in this population has an effect on growth and fluid status. The one infant that gained no weight while on fortified SHM started on diuretics during treatment which could have skewed the growth data.

Additional research is needed with a larger cohort of patients and future research could include additional populations such as the premature infant with chylothorax and long-chain 3-hodroxyacyl-CoA dehydrogenase (LCHAD).

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Table 1.

Recipes for Skimmed Human Milk fortified with high MCT infant fomula to different Calorie Levels[12,16]

Calorie Level	Recipe Description
20 calories/ounce	40 mL Enfaport® added to 60 ml skimmed human milk
22 calories/ounce	50 mL Enfaport® added to 50 ml skimmed human milk
24 calories/ounce	65 mL Enfaport® added to 35 ml skimmed human milk
27 calories/ounce	80 mL Enfaport® added to 20 ml skimmed human milk

Table 2:

Growth changes in patients in the study on fortified Skimmed Human Milk (SHM) with high MCT infant formula

Patient	Day of life at start of SHM	Total days on SHM	Highest Fortification (calories/oz)	Average change in weight (grams/day)	Change in weight-for-age z score
1	25	22	27	37	0.68
2	104	49	24	57	0.48
3	55	10	22	0	−0.21
4	21	21	27	40	0.39
5	70	7	24	19	0
6	26	14	24	30	0.39