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ORIGINAL ARTICLE

The use of fat-free human milk in infants with chylous pleural effusion

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Objective: The purpose of this study is to describe the processing of human milk to remove its fat content and its use in seven infants with chylothorax.

Study design: The mother's milk was centrifuged at 3000 r.p.m. for 15 min at 2°C. After centrifugation, the milk separated into a solidified-fat top layer and a lower liquid portion. The fat-free liquid portion was then poured into collection cups and frozen for the patient's use at a later date. A sample of the mother's milk before and after processing was stored and analyzed for fat, sodium, potassium, calcium and zinc.

Results: The mean fat removed was 5±1 g/dl (mean±s.d.), which was the same as the pre-fat content of the mother's milk. Seven infants with chylous pleural effusions used the fat-free human milk. All infants started on the fat-free milk after a month of age for an average of 16 days duration (7 to 34 days range). There was no reaccumulation of the chylous pleural effusions with the use of the fat-free mother's milk. Mother's milk electrolytes were similar before and after processing.

Conclusion: Fat-free human milk may be an important additional dietary therapy for infants with chylothorax and may add the immunologic properties of human milk that other feedings cannot provide.

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Introduction

Chylous pleural effusion is the extravasation of lymph into the pleural space. The accumulation of chyle in the pleural space may be congenital or acquired.[1] Congenital chylothorax is one part of the spectrum of anomalies that result from intrauterine obstruction of the thoracic duct.[2,3] It may occur alone or in combination with other lymphatic anomalies. The lymph-flow obstruction results in the development of fistulas between the thoracic duct and the pleural space or in the rupture of the thoracic duct. Congenital chylothorax occurs more commonly in males than in females (2:1), and it occurs more commonly on the right side (right, 53%; left, 35%; bilateral, 12%).[4] Acquired chylothorax results from damage to the thoracic duct. It has been reported as a surgical complication of the repair of the diaphragmatic hernia, tracheoesophageal fistula and a variety of congenital heart disorders.

Treatment of chylothorax may require repeated thoracenteses or thoracostomy tube drainage to prevent respiratory failure.[5] Once drainage is accomplished, infants are placed on formulas containing medium-chain triglycerides, rather than long-chain fats, to reduce thoracic duct lymph flow and the rate of reaccumulation of chyle.[6–8] Human milk has not been used with infants with chylothorax because of its high long-chain fatty acid content.[9] However, infants with chylothorax may benefit from using human milk because of its immunologic qualities that are not present in cow's milk-based formulas.

The removal of fat from cow's milk has been used in the dairy industry.[10] But this process has not been used in human milk. The purpose of this study was to describe the processing of human milk to remove its fat content and its use in seven infants with chylothorax.

Materials and methods

After obtaining consent from the mother and the medical team, the mother's milk was poured into clean 240 ml plastic containers. The milk was then centrifuged at 3000 r.p.m. for 15 min at 2°C in a Beckman J2-21 High Speed Floor Model Centrifuge. After centrifugation, the milk separated into a solidified-fat top layer and a lower liquid portion. The fat-free liquid portion was then poured into clean collection cups and frozen for the patient's use at a later date.

A sample of the mother's milk before and after processing was stored and analyzed for fat, sodium, potassium, calcium and zinc. The total fat content was analyzed by the creamatocrit method[11] and the electrolytes by atomic absorption.[12] The accuracy of the creamatocrit to total lipids in human milk has been shown to be almost 90%.[13,14]

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Results

The mean pre-fat content was 5 g/dl. The mean fat removed was 5±1 g/dl (mean±s.d.). Total recovery of the milk was 95±2%. For 1000 ml of milk, the processing time was about 45 min.

The majority of the infants in this study were term infants with either congenital or acquired chylothoraces from surgeries for congenital heart or diaphragmatic hernias. All infants started on the fat-free milk (FFM) after a month of age for an average of 16 days duration (range 7 to 34 days). The use of fat-free mother's milk resulted in no reaccumulation of the chylous pleural effusion. The addition of supplements was to provide adequate calories, fats and vitamins for the infant. This was determined daily by a neonatal dietitian. Supplements to the FFM included standard formulas with medium-chain triglycerides (Pregestimil and Portagen), glucose polymers, medium-chain triglycerides and protein (Promod). Two infants required no supplements except for total parenteral nutrition (TPN) and Intralipids. The infants were later transitioned to their own mother's milk over 2 to 4 weeks. The clinical summary of the patients is shown in Table 1.

Comparison of the electrolytes in the human milk before and after the fat removal is shown in Table 2.

Discussion

Human milk with mostly long-chain triglycerides has not been recommended for infants with chylothorax.[9] However, both governmental and medical professional organizations have strongly recommended human milk for all infants for its nutritional, immunologic and psychosocial advantages.[15,16]

Centrifugal separation of the fat from milk, also known as creaming, has long been used in the dairy industry, but has not been used in human milk.[10] In this study, the removal of the fat from human milk involved cold centrifugation at low speeds in a clean environment. This method removes all of the long-chain fatty triglycerides that stimulate lymphatic flow.[17] A refrigerated centrifuge is required for this purpose and is commonly used in most hospital labs. The time requirement is less than 1 h to process a liter of milk.

About 80% of infants with chylothorax will respond to conservative dietary management.[6–9] Dietary management of infants with chylothorax has included TPN to a low-fat (or medium-chain triglycerides), high-protein diet. Special cow-based formulas with medium-chain triglycerides such as Pregestimil and Portagen have been used. Salt restriction and diuresis may be necessary.[1] From our experience of seven infants, fat-free human milk was successfully used in infants with chylous pleural effusion. The electrolyte content of fat-free human milk was similar to mature human milk. However, with the removal of the fat, the FFM becomes deficient in calories, essential fatty acids and fat-soluble vitamins.[18] This milk should be supplemented with additional calories, fats and fat-soluble vitamins. This can be accomplished by supplementing with formulas with medium-chain triglycerides, vitamins or glucose polymers.

In conclusion, fat-free human milk may be an important additional dietary therapy for infants with chylothorax. Human milk is beneficial for the infant because of its immunologic qualities. The immunologic qualities of FFM have not been tested, but the non-fat protective components of the milk such as lactoferrin, lysozyme and IgA are probably not affected by cold centrifugation and the removal of the lipid portion.[19,20]

Table 2 Composition of human milk before and after fat removal (mean±s.d.)

	After	*Before*
Fat, g/dl	0	5±1
Sodium, meq/l	42±9	40±9
Potassium, meq/l	14±2	15±3
Calcium, mg/dl	27±2	25±4
Zinc, μg/dl	385±130	294±135
Total volume, ml	95±1	100±1

Table 1 Clinical summary of infants with chylothorax

Patient	*Gestation (weeks)*	*Birth weight*	*Diagnosis*	*Age of FFM started*	*Duration of FFM*	*Supplements used*
1	37	2780	Congenital	5 wks	11 days	Pregestimil
2	31	1681	Congenital	5 months	34 days	Pregestimil MCT
3	36	2050	Acquired CHD repair	7 wks	14 days	TPN+Intralipid
4	40	3040	Acquired CHD repair	8 months	21 days	Portagen Promod
5	39	3430	Acquired CDH repair	2 months	11 days	MCT glucose polymers
6	33	2750	Congenital	2 months	7 days	MCT glucose polymers
7	39	3293	Acquired CDH repair	1 month	14 days	TPN+Intralipid

Abbreviations: CDH, congenital diaphramatic hernia; CHD, congenital heart disorder; FFM, fat-free milk; MCT, medium-chain triglycerides; TPN, total parenteral nutrition; wks, weeks.

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