6-2019

Comparison of Macronutrient Loss from Human Milk Based onTube Feeding Method in the NICU Population: A Pilot Study

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June 20, 2019

Background

Early infancy is a period of rapid growth and development particularly vulnerable to the effects of poor nutrition. Preterm infants are especially at risk, with multiple studies supporting a link between poor growth and suboptimal neurodevelopmental outcomes (Chien, 2018; Ong, 2015). Many factors make it difficult to adequately nourish a preterm infant during the Neonatal Intensive Care Unit (NICU) stay, including the extended period of time when oral feeding is unsafe related to immature oral-motor coordination, which necessitates several days to months of tube feeding.

Human milk provides many health benefits and is the recommended feeding for preterm infants. It is a dynamic, non-homogenized fluid. The most variable component is the fat content, which separates out when milk is allowed to sit (Jones, 2011). Fat from human milk appears to adhere to the plastic syringe/bag and plastic tubing products used to administer tube feedings. Previous investigators have reported significant nutrient losses during tube feeding, especially of fat and calories (Rogers, 2010; Vieira, 2011; Brooks, 2013). Gaps in the existing literature notably include the lack of evaluation of the effect of syringe tip position with present-day tube feeding pumps.

As a preliminary survey of NICU practices, a query was sent out in November 2018 via email to NICUs in the Vermont Oxford Network and to NICUs in Providence St. Joseph Health. Several responding centers used pumps for all tube feedings. The remaining centers favored gravity-controlled feeds if tolerated or had no standard practice. Syringe tip position for pump feedings varied between centers. These query responses suggest that, despite the existing literature, tube feeding practices in NICUs remain widely disparate.

Below: Note the bright yellow fat accumulating on the syringe during infusion with syringe tip horizontal.

Purpose

To identify best practices for tube feeding preterm infants to minimize nutrient loss during administration.

Aims: (1) Identify best syringe position for tube feeding pump infusion; (2) Compare nutrient losses between different lengths of time for infusion; (3) Determine nutrient loss with present-day infusion pump and tube feeding equipment products, compared to products used in older studies.

Hypothesis: Fat, protein and calorie loss will vary by means of the method of administration. Lactose loss will not be significant.

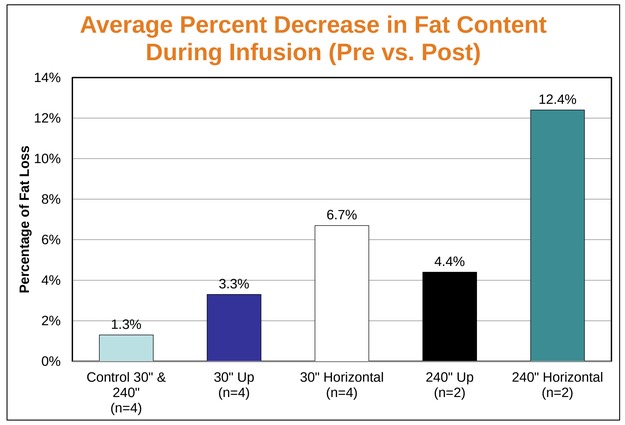
Methods

A comparative, descriptive laboratory study was conducted to investigate the effect of different tube feeding methods on the macronutrient content of human milk. Expressed human milk samples donated to Northwest Mothers Milk Bank (NWMMB) were used for this study. Tube feeding equipment and supplies were provided by the Providence St. Vincent NICU. The study was conducted at NWMMB. The study was approved by the Providence Institutional Review Board (IRB).

Donated milk met criteria for inclusion if it had been designated for research purposes only per NWMMB procedure and was less than 6 months old. Only unpasteurized (raw) frozen milk was used for this pilot study. Each milk sample was de-identified of donor information, thawed, and pooled. The pooled milk was divided into paired aliquots, with one 60 ml "pre" and one 60 ml "post" sample drawn at the same time for each individual tube feeding scenario test and control.

"Pre" milk samples were poured into glass jars and analyzed for baseline data. "Post" milk samples were drawn into syringes and either run through simulated tube feeding method scenarios or used as controls. Scenarios were performed in a randomized order. Control "post" samples were left undisturbed adjacent to the pumps during testing. For each feeding pump scenario, the syringe was connected to extension tubing, and milk was collected into a glass jar. For some 30 minute tests, the extension tubing was additionally connected to a nasogastric/orogastric feeding tube which then ran to the collection jar. See upper-right photo for example.

Tube feeding scenarios tested with feeding pumps were (1) 30 minute with syringe tip horizontal; (2) 30 minute with syringe tip up; (3) 4 hour with syringe tip horizontal; (4) 4 hour with syringe tip up; (5) 30 minute control; (6) 4 hour control. All milk samples were analyzed for fat, lactose, nutritive protein, and calorie content. Nutrient content was compared between the paired "pre" and "post" samples.



Results

Both syringe position and infusion time were found to affect fat loss from human milk. Fat accumulation on the plastic surfaces began quickly following start of milk infusion – see lower left photo for example. More fat was lost with the syringe tip horizontal than with the syringe tip pointed up. Higher fat loss was also seen with a longer infusion time. The greatest fat loss occurred with the 240-minute infusions with syringe tip horizontal (12.4% fat loss). However even with a shorter 30-minute infusion time with syringe tip up, the fat content of the milk still decreased (3.3% loss).

Fat losses were similar with or without the addition of a nasogastric/orogastric feeding tube. Calorie loss was consistent with the observed fat loss. No losses were seen in the lactose (carbohydrate) or protein content of the milk.

Discussion/Conclusions

Results of this pilot study are consistent with previous published studies which found that the nutrient in human milk that is most affected by tube feeding method is the fat content. These preliminary findings suggest that, for best delivery of fat, tube feedings of human milk should be run with the syringe tip pointed directly up and with the shortest infusion time that the infant will tolerate.

A limitation of this study is that only one type of infusion pump, tubing, and syringe were tested. The milk samples tested were unfortified milk which had been frozen then thawed, so these findings may not apply to milk that has undergone different processing such as pasteurization or nutrient fortification. Further testing is needed to: (1) increase sample size for statistical significance; (2) compare gravity delivery to pump infusion; and (3) test the effect of tube feeding method on other types of human milk, such as pasteurized donor milk, fresh milk or fortified milk. We thank Providence St. Vincent NICU and NWMMB for their support of this research study.

Below: Simulated tube feeding infusions with syringe tip pointed up.

References

1. Brooks, C., Vickers, A.M., & Aryal, S. (2013). Comparison of lipid and calorie loss from donor human milk among 3 methods of simulated gavage feeding. *Advance in Neonatal Care*, 13(2), 131-138.
2. Chien, H., Chen, C., Wang, T., Hsu, Y., & Lin, M. (2018). Neurodevelopmental outcomes of infants with very low birth weights are associated with the severity of their extra-uterine growth retardation. *Pediatrics and Neonatology, 59*, 168-175. http://dx.doi.org/10.1016/j.pedneo.2017.08.003
3. Jones, F. (2011). *Best practices for expressing, storing and handling human milk in hospitals, homes and child care settings* (3rd ed., p. 41). Fortworth, TX: Human Milk Banking Association of North America.
4. Ong, K.K., Kennedy, K., Castaneda-Gutierrez, E., Forsyth, S., Godfrey, K.M., Koletzko, B., Latulippe, M.E., Ozanne, S.E., Rueda, R., Schoemaker, M.H., van der Beek, E.M., van Buuren, S., & Fewtrell, M. (2015). Postnatal growth in preterm infants and later health outcomes: a systematic review. *Acta Pediatrica, 104*, 974-986. DOI:10.1111/apa.13128
5. Rogers, S.P., Hicks, P.D., Hamzo, M., Veit, L.E., & Abrams, S.A. (2010). Continuous feedings of fortified human milk lead to nutrient losses of fat, calcium and phosphorus. *Nutrients*, 2, 230-240.
6. Vieira, A.A., Soares, F.V.M., Pimenta, H.P., Abranches, A.D., & Moreira, M.E.L. (2011). Analysis of the influence of pasteurization, freezing/thawing, and offer processes on human milk's macronutrient concentrations. *Early Human Development*, 87, 577-580.

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