American Journal of Gastroenterology and Hepatology

ISSN 2692-7942

Review Article

Management of Oral Functioning in Tube-Fed Infants: New Considerations Regarding Tube Feeding at Birth and the Prevention of Food Refusal

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Abstract

In pediatrics, since 1970, tube feeding has been a huge step forward by improving the survival of neonates exhibiting malformations or medical problems. After medical or surgical repair, resumption of oral feeding is difficult if not impossible for some. They become dependent on the tube even when it is no longer useful. Furthermore, upon returning home, continued tube feeding leads to great stress and difficulties for the parents.

We will see how to effectively manage tube feeding while getting the mouth used to stimulation by taste and by instituting a periodicity that increasingly approximates the circadian rhythms. The intolerance to rapid flowrates and to bolus is explained by the physiology of digestion and particularly by the importance of the physiological sequence that goes from the mouth to the intestine.

Cases of food refusal are also analyzed, based on notions of hypersensitive olfaction and taste and treated by desensitization massages.

Lastly, the specific case of hydration with pure water is considered.

Keywords: Tube feeding; Infants; Gagging; Vomiting; Circadian rhythm; Food aversion; Dumping syndrome

Introduction

Although it has been available for centuries, nasogastric feeding has only been used in neonatology and in pediatrics since the early 1970s.

Its efficacy is well and truly established, as tube feeding allows many children to get through critical situations such as when medical or surgical problems need to be addressed that require bypassing the mouth.

Unfortunately, we do not have any figures in this regard, but with current practices, we know that a significant number are unable to transition from a tube to the mouth. This used to result in prolonged stays in the nursery, with all of the ensuing issues that can stem from long interruption of the neonate/parent relationship. Getting the child back with its parents as soon as possible hence represents a step in the right direction, although it does often lead to other difficulties.

Once at home, if the parents have been advised to feed their child at night, they are generally ill-prepared to tackle all of the night-time nursing care issues that are likely to arise with their child, such as: a nutripump that is beeping, a child that is gagging and crying, detached tubes, and milk that flows into the bed, which can result in them being woken up as many as ten times during the night. Thus, in addition to the stress, the parents and the child suffer from a lack of sleep and their circadian rhythms are completely disrupted.

The aim of this contribution is to present what a speech therapist in feeding can contribute in regard to care at home [1].

We will successively consider:

At what point should one submit the child to force-feeding?

When to switch to Tube Feeding (TF)? During the day? At night?

Intolerance to rapid flowrates and to bolus. What flowrate?

3.4. How to respond to refusal of oral feeding?

At what point should one submit the child to force-feeding?

Once at home, the parents will want their child to eat with their mouth, which is a perfectly valid expectation.

They hence persist, spoonful after spoonful, until their child rejects the food and refuses all oral intakes. Unfortunately, the hospital has not cautioned them regarding the very harmful nature of force-feeding Tube feeding is a way to avoid forcing children and hence represents immense progress! Indeed, the tube can be seen as a great convenience provided that preparations are made for future oral intake as of its implementation.

To answer the question at hand, a brief recap of mealtimes in normal development is required:

The duration of a breastfeeding, on average, lasts 14 minutes, although 90% of the milk is ingested within the first four minutes [2].

With functional suction, 250 ml of milk are ingested in 3 to 4

Citation: Senez C. Management of Oral Functioning in Tube-Fed Infants: New Considerations Regarding Tube Feeding at Birth and the Prevention of Food Refusal. Am J Gastroenterol Hepatol. 2020;1(2):1007.

Publisher Name: Medtext Publications LLC

Manuscript compiled: Nov 27th, 2020

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minutes by children aged 9 to 10 months!

Sucking is an "exhausting" motor activity for the infant (let alone for a neonate), and fast breastfeeding and rapid spoon-feeding amounts to an "energy saving mode" as they ingest a maximum amount of nutrients in a minimum amount of time and effort. They need to increase their weight and size as much as possible in just a few months in order to get through this vulnerable period as fast as possible

Some examples:

A spoon-fed meal of 190 g is consumed in 4'32 by a child of 13 months.

It is easier to draw on a bottle than on the breast, and hence with a bottle, beyond 5 minutes, it becomes forced.

With spoon-feeding, one or two spoonfuls are enough to bring on oro-pharyngo-oesophageal peristalsis, as we will see further on.

The energy used to ingest food should be minimal relative to the caloric intake of the meal.

Parents! Professionals! Start your timer!

When to switch to Tube Feeding (TF)? during the day? at night?

Night-Time Tube Feeding (NTF) allows some children to have a social life and attend school. When it is well tolerated, it allows for a good level of weight gain in case of rare medical problems. Yet NTF is rarely prescribed due to a medical necessity.

Night-time food intake results in an increase in body temperature, heart rate, the production of urine and stool, and consequently highly restless sleep, with frequent waking up. At night, the digestive system is at rest and most of the biological functions are slowed down (interruption of the movements of the intestine at 22:30 [3].

Furthermore, nutrients infused over long periods during the day and/or at night considerably perturb the physiological rhythms, referred to as circadian, which have approximately 24 hour regularity. Meals are synchronizers of the biological rhythms [4].

Energy metabolism, which is controlled by the circadian clock, is perturbed when the circadian clock is deregulated, for example by night work. In the long run, this dysfunction leads to the development of pathologies such as obesity and diabetes. Studies with mice have shown that this is mainly due to mealtimes being altered.

The work of chronobiologist has pin-pointed the Achilles heel of metabolic equilibrium: if, for example, one eats at night, all metabolism is disrupted (P. Sassone-Corsi 2008). Is this why the risk of obesity is greater in former premature babies, as they would have been fed both at night and during the day?

Intolerance to rapid flowrates and to bolus

Administration by bolus has advantages in the long run, as it better approximates the physiological rhythm of feeding. Most children, however, cannot tolerate a milk flowrate that is too fast. They react with sweating, gagging, vomiting, abdominal distension, and/or diarrhoea. In light of this, they are exposed to very low flowrates. For example, feeding at 250 ml at 100 ml/h takes 2 h 30, while a child of less than 10 months consumes a bottle of 250 ml in 3.5 minutes, which, upon extrapolation, corresponds to a flowrate of 4,285 ml/h!

How can this phenomenon be explained?

The mouth is not an isolated organ that merely needs to be "titillated" a bit to re-establish its function. It is part of a larger entity, and in terms of swallowing, it is part of the digestive system. André Jean (1983) [5] developed the notion of a "central keypad" that records swallowing. Motor sequences controlled by the central nervous system follow in an immutable order, such as with a row of dominos whereby knocking over the first domino cause the second one and then the next one and so on to fall over.

In its resting (empty) phase, the stomach is collapsed and the pylorus is open. Saliva, which is at body temperature, is never stored in the stomach as the pylorus, which is open, allows it to pass into the duodenum.

Once swallowing starts, the oropharyngeal and oesophageal peristalsis trigger gastric activity, the stomach relaxes (ready to distend), and the pylorus closes the access to the duodenum. The stomach fills progressively with nutrients and mashing of the ingested substances starts, permeating them with gastric juices, which dissolves and dilutes them, thereby transforming them into a type of liquid called chyme. The pylorus remains tightly closed for 20 minutes. It then opens, but it only allows 3 ml to pass through at a time, the rest of the chyme is again mixed and mashed [6]. It, therefore, takes the stomach 3 to 4 hours to empty itself. It takes less time in infants who drink milk: a study has shown that the time required for half of the absorbed milk to leave the stomach was 47 min on average in children who had received maternal milk, and 65 min on average in children who had received industrial milk. The authors concluded that the gastric emptying was significantly less fast in the children who had been given industrial milk, which is in keeping with the results of other studies on this subject (T. Tomomasa et al. 1987).

However, when the mouth and the oesophagus have been short-circuited, such as with TF, the nutrients arrive directly in the stomach while it is at rest, and the pylorus is open: the nutrients pass too quickly and in too great of an amount into the duodenum and the intestines without first having been exposed to the gastric juices and at a temperature that differs considerably from normal body temperature. This then is the cause of the adverse reactions described above: pain, vomiting, gagging, etc.

These symptoms are identical to those described in adults who, after a bypass, exhibit Dumping Syndrome (DS). DS is a collection of symptoms that occur after a meal when the stomach has been short-circuited by a bypass or a jejunostomy, consecutive to a too fast interruption of hyperosmotic food items, undigested by the stomach, in the small intestine that leads to water being drawn toward the intestine and a hyperglycemic peak [7].

The symptoms comprise vasomotor disorders, hypotension, palpitations, sweating, and tachycardia. There can also be digestive signs: gagging, vomiting, eructation, bloating, abdominal pain, and diarrhoea. In severe cases, these are accompanied by malnutrition and substantial weight loss.

DS is an example of the effect of feeding that has not followed the proper physiological sequence. The symptoms exhibited by children undergoing TF are analogous to those of DS, although they have not been clearly identified as being of the same nature, which can mislead the diagnosis, with a consequent risk of radical treatments (Nissen or Jejunostomy) that fail to address the actual cause. In reality, the

stomach and the cardia are wrongly implicated with gagging and vomiting in a child during or after tube feeding, while it is, in fact, the intestines that expel these nutrients that are non-treated and at the wrong temperature.

Once the physiology is understood, the solution is straightforward. It suffices to trigger swallowing and the consequent oro-pharyngo-oesophageal peristalsis will close the pylorus at the start of the TF. If this TF lasts for one hour, swallowing needs to be triggered again every 1/4 hour as the pylorus opens after 20 minutes.

These stimulations of swallowing are achieved with a pacifier or by using a finger of a parent or of the professional dipped in milk or a glucose solution or a small spoon full of desert cream or another flavour acceptable to the child. By doing so, the chain reaction is restored, the child will better tolerate a faster flow, and the gagging and vomiting will stop. There is no need for a control group, as a child being tube-fed will stop exhibiting these adverse reactions immediately when it is made to swallow in order to close the pylorus.

An example of oral food intake:

For a child of 20 months fed by isocaloric NUTRINI® (900 ml/24 h) exclusively at night (poorly tolerated, wakes up at night, gagging and vomiting in the morning:

The first week, we remove 100 ml at night, which is distributed into four diurnal feedings of 25 ml.

Each of these diurnal snacks is delivered with a syringe and preceded by oral swallowing of just a spoonful or two.

The next 7 days, 100 ml are still removed at night and the four diurnal feedings are 50 ml each, with alteration of swallowing and injections of 15 ml in the tube.

As of the 2nd week, cessation of the waking up at night and calmer waking up in the morning can be noted as the night feeding will have been reduced by 200 ml and the flowrate by as much.

Next, one needs to go through stages of 7 days until reaching the point whereby use of the pump can be replaced with bolus administration with a syringe.

At the start of the protocol, the child is happy to taste the spoonfuls of food that are offered to them. As we progress, the more they will become used to this and swallow increasing quantities during these diurnal feedings. Then, encouraged by the favorable reaction of their child, the mother will present them with larger amounts that are also more varied. These will have to be deducted from what is provided by the tube. This is an important consideration. The infant should not be overfed as this would expose them to two risks. On the one hand, the risk of vomiting, which would be a step backward, and, on the other hand, what is referred to as quick catch-up growth, that is to say, a rapid return to gaining weight or metabolic syndrome, which entails a risk of obesity as a future adult? The children at risk as premature babies, children born with an IUGR, or any child who regained weight too fast after a period of denutrition.

Refusal of oral feeding

In normal development, neonates and infants are breast or bottle-fed every three hours, even at night, in the first months of life. As the months go by, a neonate who was hypersensitive will have numerous sensory experiences that will desensitize and habituate it to the stimulus of the nipple and of the milk. According to Kandel, this habituation is a simple form of learning: the amplitude and the number of synaptic potentials decrease progressively as a result of the stimuli. As these stimuli are presented several times a day, they result in long-term habituation.

For a child fed by a tube since birth, this absence of rhythmic and repetitive stimulations keeps them in a state of long-term sensitization that increases the number of and the size of the synaptic connections. This translates into gagging at the slightest contact of a spoon or food with the mouth or even the lips, and thus refusal of feeding. They will only tolerate drinking odorless and flavourless water. If the parents try to add a bit of flavouring to the water, the child categorically refuses it.

These children will require desensitization massages along with implementation of a protocol involving a progressive increase of the flowrate to reach bolus. This desensitization is undertaken by the parents as relayed by a speech therapist. This will consist of very fast and firm intraoral massages in keeping with the rhythms of the child and without ever exceeding their threshold for tolerance. These massages are carried out on a daily basis, 6 to 7 times a day, for 5 months to 6 months. The physiology underlies their efficacy: for all of the sensory organs, the phenomena of habituation to continuous or iterative stimuli are known. With habituation, the child will be less reactive to stimuli such as touch and the flavours and odours of food.

In France, speech therapists perform this work by the technique of parental guidance. They are increasingly being trained in regard to this type of engagement.

Similarly, to desensitize children who only tolerate water, based on the work of physiologists of digestion [8,9], who described taste receptors in the intestine, I recommend adding flavouring to the water for rinsing the tube after each feeding based on the same principle. The protocol is straightforward: place 12 drops of natural flavouring in a syringe of 10 cl for a week, and then get the child to orally taste the water and change the flavour each week. Once they have become accustomed to a new flavour in their mouth, the flavouring should be added to cream cheese so that they then learn to accept a more consistent texture. In a few weeks, they will thereby be desensitized and accept 8 to 10 different flavours that they can sample every day, with a spoonful given to close the pylorus [10-18].

Conclusion

In conclusion one need to be aware that, with infants, there is a continued intense and global process of development that starts in intrauterine life, and that the olfactory, taste, feeding, and digestive sensorimotor experiences are part of this process that will condition what happens with these children. A child does not fill up like a simple reservoir: so many ml/kg/24 h. Aside from this number, the techniques of feeding need to be tailored to the developmental complexity of the functions of swallowing and of digestion. The succession of mouth, oesophagus, and stomach, which is the physiological norm, needs to be re-established. It also needs to be kept in mind that meals are synchronizers of the circadian rhythms and that the child needs to be exposed as early as possible to an alteration of hunger and satiation. This can only be achieved by means of a permanent dialog with the parents. The latter play an essential role, but they cannot succeed without input and support from well-trained professionals.

Compared to the sometimes-life-threatening problems faced by these children, orality is, however, of secondary importance. It has long been thought that oral functions occur naturally, without further input. But there you have it, input is essential…!

References

1. Piche T, Dapoigny M, Bouteloup C, Chassagne P, Coffin B, Desfourneaux V, et al. Recommandations pour la pratique clinique dans la prise en charge et le traitement de la constipation chronique de l'adulte: Recommendations for the clinical management and treatment of chronic constipation in adults. Gastroenterol Clin Biol. 2007;31(2):125-35.
2. Howie PW, Houston MJ, Cook A, Smart L, McArdle T, McNeilly AS. How long should a breast feed last? Early Hum Dev. 1981;5(1):71-7.
3. Sahar S, Sassone-Corsi P. The epigenetic language of circadian clocks. Handb Exp Pharmacol. 2013;(217):29-44.
4. Challet E. The circadian regulation of food intake. Nat Rev Endocrinol. 2019;15(7):394-405.
5. Jean A. Contrôle nerveux de la déglutition et de la motricité œsophagienne. Thèse Médecine Marseille. 1983.
6. Pocock G, Richards C. La physiologie humaine. Masson. 2004.
7. Bufler P, Ehringhaus C, Koletzko S. Dumping Syndrome a common problem following Nissen fundoplication in young children. Pediatr Surg Jan. 2001;17(5-6):351-5.
8. Rozengurt E. Taste receptors in the gastrointestinal tract. I. Bitter taste receptors and alpha-gustducin in the mammalian gut. Am J Physiol Gastrointest Liver Physiol. 2006;291(2):171-7.
9. Bezencon CJ, Johannes le C, Damak S. Taste-signaling proteins are coexpressed in solitary intestinal epithelial cells. Chem Senses. 2007;32(1):41-9.
10. Mathew OM. Science of bottle feeding. J Pediatr. 1991;119(4):511-9.
11. Lang S, Lawrence CJ, Orme RL. Cup feeding: an alternative method of infant feeding. Arch Dis Child.1994;71(4):365-69.
12. Marlier L, Gaugler C, Astruc D, Messer J. The olfactory sensitivity of the premature newborn. Arch pediatr. 2007;14(1):45-53.
13. Dulloo AG, Jacquet J, Seydoux J, Montani JP. The thrifty "catch-up fat" phenotype: its impact on insulin sensitivity during growth trajectories to obesity and metabolic syndrome. Int J Obes (Lond). 2006;30 suppl 4:S23-35.
14. Rothschild J, Lagakos W. Implication of enteral feeding times: considering a circadian picture. JPEN J Parenter Enteral Nutr. 2015;39(3):266-70.
15. Jehl C, Royet JP, Holley A. Odor discrimination and recognition memory as a function of familiarization. Percept Psychophys. 1995;57(7):1002-11.
16. Nakahata Y, Sahar S, Astarita G, Kaluzova M, Sassone-Corsi P. Circadian control of the NAD+ salvage pathway by CLOCK-SIRT1. Science. 2009;324(927):654-7.
17. Senez C. Going from the tube feeding to the oral feeding in infants. Rev Laryngol Oto Rhino (Bord). 2008;129(2):115-9.
18. Senez C, Guys JM, Mancini J, Paredes AP, Lena G, Choux M. Weaning children from tube to oral feeding. Childs Nerv Syst. 1996;12(10):590-4.