Approach to Nutrition Support: Tube Feeding

Developed by Sierra Casey and Dr. Jason Silverman for PedsCases.com.
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Introduction:

Hi everyone! My name is Sierra Casey and I am a 3rd-year medical student at the University of Alberta. This podcast was produced with the guidance of Dr. Jason Silverman, a Pediatric Gastroenterologist at the Stollery Children's Hospital and an Assistant Professor of Pediatrics at the University of Alberta. This podcast will focus on tube feeding. Tube feeding refers to nutrition that is delivered directly into the stomach or small intestine through a tube. The goal of tube feeding is to replicate the normal we will discuss both short-term and long-term tube feeding options.

Learning objectives

By the end of this podcast, listeners should be able to:

1. Discuss the indications for, advantages of, and contraindications to tube feeding.
2. Explain the routes of administration, delivery methods, and formula types used in tube feeding.
3. Write nutrition orders for a child including starting and weaning off tube feeds.
4. Describe some of the complications of tube feeding.

Let's start with a case.

You are on your inpatient pediatrics rotation and you are called to admit Lucas, a 2-year-old boy with global developmental delay who presents with a two-day history of fever and cough and has a chest x-ray consistent with pneumonia.

You take a thorough history and find out that during the past two days he has been coughing a lot and breathing more rapidly. He has also been less active than usual. You inquire about his eating, and his mother tells you that he often coughs and sputters while eating and drinking and has for most of his life. In the last two days he has also been eating and drinking much less than usual.

You discuss the case with your preceptor, and she agrees with your assessment that Lucas' presentation is in keeping with aspiration pneumonia. As you discuss your plan for Lucas' admission, your preceptor has some questions for you: "Do you think Lucas is safe to feed orally, or will he need tube feeding? If he does need tube feeding, what

type of tube and what type of formula would you choose for Lucas? Can you write some nutrition orders for him?"

We will come back to this case throughout this podcast to apply what we learn.

What are the indications for tube feeding?

There are many reasons that a patient may need tube feeding. Generally, children who cannot feed orally or who cannot get enough calories through oral nutrition alone, should be fed enterally so long as their gastrointestinal tract is functioning.

One group of patients who need tube feeding are those with an impaired oropharyngeal phase of eating. For example, premature babies who have not yet developed suck and swallow reflexes and therefore cannot be bottle or breastfed. Neurologic and motor dysfunction, such as in cerebral palsy, and upper GI abnormalities, like cleft palate, can also impair the oropharyngeal phase of eating. Critical illness and mechanical ventilation may also make short-term tube feeding necessary because they prevent oral intake. Pediatric patients with drug-related nausea and vomiting, such as from chemotherapy, may also benefit from at least temporary or partial tube feeding. Additionally, patients with acute or acute on chronic pancreatitis can benefit from tube feeding if they cannot tolerate oral nutrition.

Another group of patients who need tube feeding are those who cannot absorb adequate nutrition through oral feeding alone. Disorders of digestion, absorption, or GI motility such as short bowel syndrome, chronic diarrhea, chronic intestinal pseudo obstruction, and liver disease fall into this category. Patients with other chronic illnesses such as cystic fibrosis, renal disease, congenital heart disease, and metabolic diseases often have increased caloric or nutritional requirements beyond what can be taken orally, and therefore may also require supplemental tube feeding.

Thirdly, tube feeding can be used to administer nutritional treatments or medications. Examples include the ketogenic diet in epilepsy or exclusive enteral nutrition for the treatment of Crohn's disease. Tube feeding also allows providers to deliver fluids that cannot be taken orally. Tube feeding can even be used to deliver laxatives to treat severe chronic constipation.

Advantages of enteral nutrition

As you can see, there are many reasons that a pediatric patient may need nutrition support. There are several advantages to tube feeding when compared to parenteral nutrition. Firstly, the presence of nutrition in the gastrointestinal tract stimulates gastrointestinal motility as well as the secretion of enzymes and hormones. Nutrients passing through the gastrointestinal lumen help to preserve gut mucosa including the associated lymphoid tissue. Food in the GI tract also helps to preserve the balance of

gut flora and the intestinal immune system, preventing infections. Tube feeding allows the liver to monitor the intake of nutrients through first-pass metabolism of nutrients from the gut through the liver. Tube feeding is also less costly and easier to administer than parenteral nutrition, and is safer as it avoids more serious potential complications of parenteral nutrition, as well as the need for IV access.

Contraindications to tube feeding

Although there are a large range of patients who can benefit from tube feeding, there are a few cases in which patients should not be fed enterally. These contraindications include:

1. Gastrointestinal ischemia, such as in necrotizing enterocolitis or toxic megacolon.
2. Severe and intractable vomiting and diarrhea.
3. Diffuse peritonitis, for example from a ruptured appendicitis.
4. Mechanical bowel obstruction.

Routes of administration

Once you decide that a patient needs tube feeds, there are four main routes of administration to consider. Shorter term options include nasogastric or “NG” and nasojejunal or “NJ” tubes. Longer term feeding options include gastrostomy, jejunostomy and gastrojejunostomy tubes.

Let’s talk about the short-term options first:

Nasogastric tube feeds are the go-to option for most patients who need short term nutrition support. Nasogastric or NG tubes are passed through the nose into the stomach. This allows for physiologic digestion that is more similar to feeding orally, and also enables larger volumes to be delivered at once. NG tubes are relatively comfortable and easily inserted by allied healthcare, caregivers, or by older children and teens themselves. However, they are easily blocked due to their small caliber and therefore need to be flushed with a small amount of water after each feed and infusion of medication. NG feeding can also irritate the nasal area, and may impact oral intake, or even contribute to oral aversion.

Nasojejunal or NJ tubes are passed through the nose and deliver nutrition to the jejunum, the second part of the small intestine. Jejunal feeds are required if the patient is at risk for severe gastroesophageal reflux, or if they have gastroparesis that prevents the stomach from emptying properly. Additionally, jejunal feeds are preferred in critically ill patients due to a lower risk of aspiration during mechanical ventilation. Placement of nasojejunal tubes is more difficult than placing a nasogastric tube because the tube must pass through the pylorus of the stomach. There are a variety of techniques that can be used to place NJ tubes either blindly, under fluoroscopic guidance, or endoscopically. If the tube becomes dislodged and requires replacement this will require a trip to the doctor or hospital because the tube cannot be replaced by a caregiver.

One disadvantage of nasojejunal feeding is that feeds must be delivered slowly, typically continuously or intermittently over many hours each day. If jejunal feeds are administered too rapidly, this can cause dumping syndrome, a syndrome of abdominal bloating, pain, and diarrhea immediately following feeds. Dumping syndrome is caused by rapid infusion of hyperosmolar formula into the small intestine. This means that a child receiving NJ feeds will have to spend more time attached to a pump while formula is delivered.

Types of formulas used in tube feeds

Many different formulas are used in tube feeding. For infants, breast milk is the preferred nutrition source if possible. Infants who are tube fed can receive expressed breast milk through their feeding tube. In the NICU, where many infants need tube feeds due to prematurity or mechanical ventilation, you may encounter the abbreviations EBM (expressed breast milk), MOM (mom's own milk), or DHM (donor human milk).

Calorie content: Both breast milk and standard infant formulas typically contain about 0.67 kilocalories/mL. Infant formulas and breast milk may be fortified to increase their caloric density to 0.8 kilocalorie/mL or higher. Standard enteral formula used for tube feeding children older than 1 year contains 1 kilocalorie/mL. There are also more concentrated formulas that contain up to 2.5 kilocalories/mL. These concentrated formulas can be helpful in children with poor growth or who need to have their fluid intake restricted.

Nutrient content: There are several types of formulas that can meet the daily needs for micro- and macronutrients. The main differences between formulas are the extent to which the main macronutrients, protein, carbohydrates, and fats, are broken down.

Polymeric formulas or standard formulas are most commonly used and are usually well-tolerated. They contain intact proteins or polypeptides from either cow's milk or soy. In terms of carbohydrate content, they include both disaccharide sugars and starches. Polymeric formulas also contain polyunsaturated fatty acids from sunflower, safflower, or soy oils.

Oligomeric formulas, also known as partially or extensively hydrolyzed formulas may be required if there is underlying gastrointestinal disease. They are also used for jejunal feeding. The proteins in oligomeric formulas are hydrolyzed, meaning they are broken down into shorter peptides. In terms of carbohydrate content, they are usually lactose free.

Elemental formulas are fully digested formulas that are typically only used when there is severe intolerance to other types of formulas. The protein in elemental formulas is broken up into individual amino acids and the carbohydrates are mostly monosaccharides. The fats in elemental formulas are mostly medium chain triglycerides, which aids in fat absorption.

In addition to polymeric, oligomeric, and elemental formulas, there are also specialized formulas that restrict or enhance the content of specific types of fat, carbohydrate or, in the case of metabolic disorders, individual amino acids.

Methods of delivery

There are three main schedules that tube feeds can follow:
The simplest feeding schedule is called **bolus** feeding. Bolus feeds mimic a typical daily meal pattern for age. This could mean feeding every 2-3 hours in an infant less than 6 months old, or 3 meals a day in adolescents. Feeds can be delivered by gravity infusion without a specialized pump over 10-12 minutes. It should be noted that bolus feeds cannot be used in jejunal feeding due to the risk of dumping syndrome.

Intermittent or cyclic feeds are delivered at a specific rate over 1 or more hours, with at least 4-8 hours per day disconnected from pump to allow for gut rest and freedom from the pump. Patients who do not tolerate gastric bolus feeds can often tolerate intermittent or continuous feeds.

Continuous feeding delivers constant infusion of formula throughout the day and night through an infusion pump. Pumps can be carried by children in backpacks allowing them freedom to move around and enjoy daily life while on intermittent or continuous feeds.

Writing nutrition orders

Now how would you approach writing nutrition orders for an infant or child?

To start tube feeds, you first need to calculate the child's daily energy needs, also called the total energy expenditure.

To calculate total energy expenditure, you first must calculate the resting energy expenditure, which is the number of calories that a sedentary, healthy child would need for a day. The resting energy expenditure is a function of the child's weight, height, and age. There are several equations that can be used to calculate resting energy expenditure such as the Schofield, WHO, and Harris-Benedict equations. Daily reference intake tables from the government of Canada are also available to calculate resting energy expenditure [4]. To get total energy expenditure, resting energy expenditure is multiplied by an adjustment factor, which accounts for the activity level and illness state of the child. In general, you would multiply the resting energy expenditure by 1.2 for well-nourished low-activity children, 1.5 for ambulatory children with mild to moderate stress, and 1.7 for active children with catch up growth or severe stress. Children who require tube feeds for longer than a few weeks should be monitored for growth parameters by plotting height and weight on a growth chart. Infants will require more frequent monitoring. If insufficient growth is achieved daily calorie intake may need to be increased.

Finally, at some point the patient will either need to be weaned off tube feeds or will need a permanent tube. Weaning off feeds will depend on the route of administration of feeds and the indication for tube feeding. Children who were on tube feeds short term may be able to go back to their regular oral feeding schedule as tolerated. Those who have been on continuous feeds will need to have their feedings advanced more slowly. Advancing feeds means increasing the rate of delivery of continuous or intermittent feeds to allow for more pump-free time, with the goal of eventually progressing to bolus feeds. In general, you can advance the rate every 4 hours, by 1-5 mL/hour for infants less than 1 year old and 5-20 mL/hour for patients older than 1 year old. When advancing feeds, make sure to watch out for signs of intolerance such as diarrhea, vomiting, and abdominal pain.

Case:

Now let's go back to the case. To refresh your memory, Lucas is a 2-year-old boy with a history of Global Developmental Delay who is being admitted to hospital with aspiration pneumonia.

You decide that Lucas needs tube feeding with an NG tube while in hospital. A standard polymeric formula is appropriate because Lucas is otherwise healthy and has no indication for an oligomeric or elemental formula.

You calculate his resting energy expenditure using his body weight, which is 12 kg, and multiply by an adjustment factor of 1.2 to get a total energy expenditure of 922 kilocalories per day. Next, you write orders for his feeding schedule. 922 kilocalories per day works out to 922 mL of formula per day if using 1 kilocalorie/mL standard formula. A bolus feeding schedule would be reasonable to start off with, so you decide to order 4 bolus feeds per day with 231 mL of formula given at each feed.

You write admission orders for Lucas and review them with your preceptor. As you are discussing this plan with Lucas' mother, she asks you: "What are some of the possible complications related to tube feeding?"

Complications of tube feeding

While there are several complications that can occur with tube feeding, life-threatening complications are rare.

Feeding tubes can become dislodged, occluded, or accidentally removed. Granulation tissue can occur at the site of gastrostomy or jejunostomy tubes. Rarely, there can be perforation of abdominal organs. Accidental pulmonary intubation on insertion of a nasogastric tube is also a complication to watch out for, making it important to confirm the placement of the tube after insertion.

Intolerance of feeds is a common complication of tube feeding. Symptoms of gastrointestinal intolerance of tube feeds include nausea, vomiting, diarrhea, and abdominal distention. If these symptoms occur, you may consider changing the feeding schedule, the rate of infusion, or the formula used. A rare but serious complication of tube feeding is aspiration of gastric contents into the lungs. Risk factors for aspiration include severe GERD, sedation, mechanical ventilation and neuromuscular disease.

Refeeding syndrome is an important complication to look out for in patients who had a long period of fasting, malnutrition, or weight loss >10% [2]. Refeeding syndrome is a combination of clinical complications that occur because of fluid and electrolyte shifts. To quickly identify and treat refeeding syndrome, patients with malnutrition being started on enteral feeds should be monitored with daily assessment of fluid status and serum electrolytes.

Case:

Let's go back to the case. Lucas tolerated his nasogastric feeds well while in hospital, without any vomiting or abdominal distention. During his admission, he undergoes a swallowing study which reveals oropharyngeal dysphagia with both liquids and solids, putting him at risk for another aspiration pneumonia if he continues to feed orally. He recovers from his acute illness but is discharged with an NG tube in place along with recommendations to avoid oral feeding to prevent future aspiration pneumonia.

You see Lucas again in follow-up 6 weeks later in General Pediatrics clinic. Lucas' mother is happy to see you again and happy to report that Lucas has been well since you last saw him. He still has his NG tube in place and is getting 4 feeds per day. You check his weight and height and find that his growth is tracking well along the 10th percentile for both weight and height.

Lucas' mother asks you: "Are there any longer-term options for tube feeding that don't need to be changed out so often?"

Long term routes of administration

Gastrostomy tubes: Patients who require tube feeding for longer periods, usually longer than 3 months, may require a permanent gastrostomy tube. Gastrostomy tubes, also called G-tubes, are placed directly through the abdominal wall into the stomach. Placement of a G-tube requires the creation of a stoma, or artificial connection, between the skin and the stomach lumen. This can be done through an endoscopic, surgical, or radiologic approach by a pediatric gastroenterologist, general surgeon, or interventional radiologist. Feeding tubes placed surgically through the abdominal wall into the stomach are simply called gastrostomy tubes. Feeding tubes that are placed into the stomach

using endoscopy are called “Percutaneous Endoscopic Gastrostomy” or “PEG” tubes. Insertion of a PEG tube is relatively simple and fast and can be performed under conscious sedation or general anesthetic by a trained Pediatric Gastroenterologist. Gastrostomy tubes are anchored in place using either bumpers or inflatable balloons on the gastric lumen and skin side of the abdominal wall.

G-tubes or PEG tubes are better maintained in position than NG tubes. A single tube can last for 6 months before needing to be changed. Gastrostomy tubes also tend to be larger than NG tubes and are thus less easily blocked. Placement of a gastrostomy tube reduces oral aversion and nasal irritation associated with repeatedly inserting NG tubes. While they do not require frequent tube changes, all permanent tube options will require regular cleaning to avoid skin irritation

Jejunostomy tubes: Permanent tube options also exist for patients requiring long-term jejunal feeding. Tubes placed through a stoma from the skin into the jejunum are called J-tubes, while tubes inserted into the stomach and then threaded through the pylorus into the jejunum are called gastrojejunostomy or GJ-tubes

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Case:
You discuss the risks and benefits of a G-tube with Lucas’ mother. She has some concerns about the insertion procedure but also realizes that it will be more comfortable for Lucas and easier for her to not have to replace the tube so often. You decide together to refer him to a pediatric gastroenterologist for consideration of G-tube placement.

Summary
That was a lot of information to take in! In summary:

Tube feeding is used to deliver nutrition beyond the esophagus. Tube feeding is indicated in patients with an impaired oropharyngeal phase of eating and in those who cannot take sufficient nutrition orally. Tube feeding is relatively inexpensive with fewer complications than parenteral nutrition. When choosing a formula for tube feeding, remember that most pediatric patients will tolerate standard polymeric formula. Many options exist for both short-term and long-term tube feeding.

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