GETTING TO KNOW PEDIATRIC ENTERAL FEEDING TUBES

TYPES OF PERMANENT ENTERAL TUBES
There are two different types of feeding tubes that enter the stomach that are defined by where the actual enteral feeds are administered. These two types are gastric tubes (feeds go into the stomach directly) and trans-gastric post-pyloric feeding tubes (tube enters stomach but feeds go into the distal duodenum or proximal jejunum). To throw a wrench into that simple classification, there are also tubes placed directly into the jejunum surgically, which externally may look similar to gastric tubes. These are best referred to as surgical J-tubes.

GASTRIC TUBES
Gastric tubes or “G-tubes” go directly from the left upper quadrant abdominal skin into the stomach. Gastrostomy tubes may be used for continuous or bolus feeding. In children, these are most often placed laparoscopically. This approach works well unless the abdominal wall is very thick in an obese child, which may require conversion to standard open gastrostomy (“Stamm”). In both techniques, the stomach is anchored to the anterior abdominal wall using sutures and a tube placed directly from the skin, through the abdominal wall, and into the stomach.

In adults and some older children, the percutaneous gastrostomy (PEG) tube is used. This technique uses an endoscope placed in the stomach to guide placement of a long tube from the stomach out the abdominal wall. The disadvantage of this technique is the risk of placing the tube inadvertently through another intra-abdominal organ (colon is at highest risk). It is also painful to remove the tube for change to another kind of device once the tract has healed.

TYPES OF GASTRIC TUBES
-Standard gastrostomy (hangs out of skin)
   This tube is a long tube with a balloon at the end and is referred to only by external diameter (described as French, 3 French = 1 mm). A circular wafer around the tube is snugged down against the abdominal wall to provide the correct fit. This tube is most often used in the open technique and can be converted later to skin-level device.

   Most common brand is MIC G-tube by Halyard (formerly Kimberly-Clark). On the external side of the tube, there are three areas. The first is the balloon inflation port which typically has 5 cc or 7-10 cc written on it in black to tell you how much water to put in balloon. This is also where size (in Fr) is written. The largest opening is the feeding attachment port. The third smaller opening is for medication administration.
One problem seen with this tube is that the wafer may not be tight enough around tube, allowing end of tube to slip further into the stomach, which can lead to leaking. If it migrates too far, the balloon can block the pylorus causing significant emesis.

Another issue with this tube is the tube is hard to secure appropriately and consistently, leading to excessive motion at skin site, which can then lead to leaking and granulation tissue.

-Low-profile gastrostomy (skin level device, aka “buttons”) 
This is the most common tube placed in children and is usually performed laparoscopically. The tube has both a diameter (in French) as well as a shaft or stem length (in cm) that represents the distance from anterior wall of stomach to skin surface. The balloon port is marked with BAL and the remaining opening is for the feeding attachments. There is a one-way valve located below opening for attachments- when this becomes damaged, can cause leaking from tube itself.

MIC-KEY button: This tube is made by Halyard (formerly Kimberly-Clark) and is one of the most common button gastrostomy products. Length and width marked on top of the tube. The balloon is round in shape and is usually filled with 5 cc of water. In the smallest tubes (i.e. 12 Fr 1.0 cm), balloon is filled only with 2.5 cc. It sits at skin level and comes with right angled feeding attachment, straight bolus feeding attachment. Available in 12-18 Fr and above, shortest is 0.8 cm (but only available in 14 Fr).
**AMT Mini-One button:** This is second most common button gastrostomy tubes and is made by AMT. Exposed portion of tube is slightly lower profile than the MIC-KEY. Balloon shape is more like a pumpkin and takes 4 cc. Length and width is written on rubber strip connecting cap to tube. Volume required for balloon also written directly at balloon port. Available in 12-18 Fr and above, shortest is 0.8 cm.

-Comparison of MIC-KEY to AMT Mini-ONE:
  Shape of Mini-ONE provides more surface contact with anterior stomach wall, may help if have leaking. Some nurses think AMT causes less granulation tissue. AMT is slightly harder to place primarily in operating room. It is also slightly more difficult to attach the various feeding accessories.

-Non-balloon buttons:
  For certain patients (i.e. neurologically impaired children who frequently pull out their tubes), a non-balloon low-profile button is chosen. It can be placed in an established gastrostomy tube tract but not at the initial surgery. The two most common are below:

  **AMT Non-Balloon Mini-One:** This may be placed in the clinic and usually comes packaged in a narrow capsule. Once placed into an established G-tube tract, a pull-away tether releases the capsule, which rapidly dissolves. Alternatively, it can be ordered in a non-capsule version which is introduced with a ratcheted insertion tool. The internal bolster is smaller than a balloon and has several holes for feeding and venting. It has normal locking feeding attachments. It comes in 14 and 18 Fr widths in a variety of shaft lengths.

  **BARD button:** This is silicone dome non-balloon button. It is placed with metal obturator, which is fairly uncomfortable for the pediatric patient. Most of these button placements require sedation or anesthesia. The feeding adaptor attachments are non-locking and patients complain that they fall out. It only comes in 18, 24, and 28 Fr widths so not best for smaller kids.

-Percutaneous endoscopic gastrostomy tubes
**Percutaneous endoscopic gastrostomy (PEG) tubes** are placed typically placed using only endoscopic guidance. A variety of methods can be used but the pull (Ponsky) method is most common. An endoscope is passed from the mouth into the stomach. An area on the anterior stomach in front of greater curvature is chosen and trans-illumination used to find a location where nothing is between the stomach and the anterior abdominal wall. A catheter-over-needle is placed through the abdominal wall into the stomach under endoscopic guidance. The catheter is removed and a looped guidewire placed through the catheter and captured by an endoscopic snare and pulled out through the mouth. The PEG tube is secured to the guidewire and pulled back into the stomach from the abdominal wall side. It will stop when the mushroom disc hits the anterior wall of the stomach. This procedure is fairly quick but has risk of putting the tube through other luminal structures (usually colon). ¹

The tube may remain long but can also be cut at skin level and attached to an adaptor. A PEG can be changed to a button at 8 weeks but first change often requires sedation or anesthesia.

**TRANS-GASTRIC JEJUNOSTOMY TUBES**

Trans-gastric jejunostomy (GJ) tubes are tubes that enter the stomach via the skin in the left upper quadrant and have a distal feeding port whose tip ideally lies in the proximal jejunum. The distal portion of the tube is often weighted with tungsten. They may either hang out of skin or fit snugly against the skin in a low-profile version. These tubes will typically allow for simultaneous gastric decompression and jejunal feeding and are indicated in patients who cannot tolerate gastric feedings. Feeds must be administered in a continuous manner as the small bowel is not designed to accommodate bolus feeding.
Trans-gastric jejunostomy tubes are most often placed via existing gastrostomy tube tracts in patients who cannot tolerate gastric feeds. These may be placed either with endoscopic assistance or in interventional radiology. Fluoroscopy is required in either case to confirm position of tip with contrast. Both of these procedures in children require either sedation or anesthesia. ²

-MIC trans-gastric jejunal feeding tube: Similar to the MIC gastrostomy tube, this tube hangs out of the skin and has a wafer for securing at appropriate length. It is measured in width (Fr) and overall length but does not have a shaft or stem. It is best for patients with limited mobility or for patients receiving a primary GJ tube (no previous gastrostomy).

-MIC-KEY low-profile transgastric jejunal feeding tube: Similar to the MIC-KEY button, this tube sits snug against the skin and is described by shaft length (in cm), width (in Fr) and overall length. For children, this is usually comes in 15, 22, 30, and 45 cm lengths.

JEJUNOSTOMY TUBES
Jejunostomy tubes (J-tubes) are placed directly from the skin into a surgically constructed jejunostomy. The longer jejunostomy tubes can be placed into a loop of proximal jejunum via an open Witzel tunnel technique or laparoscopically. Alternatively, jejunostomy tubes may be constructed with a short Roux-en-Y limb where the tube is placed into the limb directly. This
second technique can allow button gastrostomy tubes to be placed into the small bowel, which is easier for families to replace than the longer tubes. Manufactured J-tubes often feature a larger French internal diameter to help prevent clogging.

FEEDING ACCESSORIES
There is a wide variety of feeding extension sets available for each kind of tube. Most commonly seen are the extensions for G-tube buttons. They come in either a straight or right-angle version. Bolus feeds are given either via gravity or syringe fairly quickly through a wide, straight bolus feed adaptor or via pump through standard angled adaptors. Most bolus feeds are given over 20-40 minutes. Feeds given via pump are usually given through right-angle adaptors as they are able to be better secured to the skin.

ENTERAL TUBE CARE
Cleaning
- For 1st week, clean site with warm water or saline once daily to remove crusts and exudates. A Q-tip may be required while external sutures remain in place. Any external G-tube sutures should be removed on POD #7.
- After 1 week, wash site daily with soap and water. Be sure to dry skin completely when done.
- No daily dressing required if site is clean and dry. Drain sponge is used if site draining. Some families prefer commercially available “Toobie Whoobies” or “Button Buddies”.

Tube maintenance
- For low-profile gastrostomy devices, rotate the tube 90 to 180 degrees daily to prevent balloon from adhering to wall of stomach. Do NOT rotate tubes with jejunal feeding ports.
- All balloon devices should have balloon filled with sterile or distilled water. Tap water can also be used but may have impurities that will shorten life of the balloon. Saline should not be used as will crystallize. Volume of balloon should be checked as needed only if leaking noted or fit seems off.

Flushing
- Tubes should be flushed frequently. Flushing should be performed with 30-60 cc catheter tip syringe attached to the feeding extension tubing. The volume for flushing tubes in children is from 3-10 cc, larger volumes for teenagers (10-25 cc).
- Tubes should be flushed:
Every and after continuous feeds
Every 6 hours during continuous feeds via jejunostomy port of GJ
Before and after bolus feeds
Before and after medications
- Tube flushes many be combined with the calculated free water boluses recommended by dietician

**Gastrostomy tube change**
- The first post-operative tube change is usually performed in the clinic at 6-8 weeks after a laparoscopic gastrostomy tube but can be performed sooner (4-6 weeks) after an open Stamm gastrostomy. Before starting, the tube should be checked for correct size in both the sitting and lying down position.
- The patient is laid flat on the table. The balloon is emptied of all water and the tube removed. The new tube balloon should be checked with water to ensure it is intact with no obvious leaking. The water is then removed from the balloon, water-based lubricant applied, and the new tube placed in the tract. The balloon is then inflated. To check proper placement, the bolus feeding extension is attached and gastric contents aspirated to confirm intragastric position. Water may also be allowed to flow in via gravity. Routine changes usually occur every 3-6 months.

- If initial tube appears tight on inspection, the next shaft length up should be obtained and used. Alternatively, a stoma measuring device may be used to measure the tract. This device is thin with small balloon and a wafer. It is placed 3 cm deep into tract and balloon inflated, then pulled snug against the abdominal wall and the wafer pushed down to the skin. Markings on the device will allow tract to be measured.

**TROUBLE-SHOOTING**

**Granulation tissue**
Granulation tissue is beefy red, friable inflamed epithelial tissue surrounding an enteral tube skin entry site. This is common and occurs in up to 68% of patients. Unless the surrounding skin is red and inflamed, this does NOT represent an infection and therefore (1) should not be cultured and (2) should not be treated with antibiotics.

The most common causes are too much movement of the tube in the stoma when attached to feeding extensions and improper fit of tube (too short/tight). If left alone, granulation tissue
can contribute to G-tube site leaking. Granulation tissue can be treated topically with one of two methods:

- Silver nitrate sticks can be used to chemically cauterize the tissue in clinic and can be used at home by competent caregivers. However, the surrounding skin must be protected from discoloration and burning, usually with zinc-based barrier cream. Lidocaine jelly (2%) should be applied prior to application to decrease pain. A dressing is placed after cauterization but may be removed within 24 hours.
- Triamcinolone cream (0.1% in infants and toddlers, up to 0.2% in older children) can be applied topically 3x/day for one week. Site should be covered with drain sponge while being treated with triamcinolone.

**Leaking tube**
A leaking gastrostomy tube is a very common problem. If left unchecked, it can lead to excoriation and infection of the gastrostomy tube site. Leaking may be due to low balloon volume, enlarged gastrostomy tube tract due to too much movement, malfunctioning valve, or poor gastric emptying (i.e. in setting of GI illness or chronic dysmotility). While leaking, the G-tube site should be cleaned several times a day with a drain sponge dressing applied. In addition, a barrier cream like Critic-Aid should be applied to protect surrounding skin.

The first step in evaluating a leaking tube is to remove all water from the balloon and re-inflate with the full volume for the tube. However, this should NOT be tried in a brand new G-tube without pediatric surgery involvement due to risk of early tube dislodgment. Infant tubes often take only 2.5 cc, AMT buttons have the balloon volume printed on balloon port, and MIC-KEY standard buttons take 5 cc. Second step is to ensure the tube is secured well to the skin to minimize movement within the stoma site.

If the gastrostomy tract has enlarged, the tube may be replaced by a smaller size Foley catheter (usually two French sizes smaller) for up to 24-48 hours. Alternatively, the tube may be removed completely for a few hours under medical supervision to allow stoma to shrink down. Leaking can also be decreased by switching from bolus to continuous feeds for several days. Some patient with severe leaking require placement of post-pyloric feeding tube in combination with drainage of the stomach to allow tract to heal.

**Accidental dislodgement**
This is common and can occur in the acute setting (before 8 weeks post-op) or in an established gastrostomy tract.³,⁴
- **Acute post-op period**: Families should try to place the small emergency Foley catheter several cm into the tract as soon as dislodged tube is noted and inflate balloon with several ml of water. If this does not pass very easily, attempts should be aborted. No food or drink should be administered by mouth or tube after Foley placement. The child should then be brought to the ER where tube replacement can be attempted with **mandatory post-placement contrast study via the tube to ensure intra-gastric position**. The optimal imaging study post-placement is a fluoroscopy exam performed by the radiologist; this is ordered as FL Gastric Tube change. If it is unable to be replaced safely or without too much pressure, safest option is then replacement under endoscopic or fluoroscopic visualization in the OR. Keep NPO until new tube confirmed to be in position.

- **Mature tract**: the tube can often be immediately replaced by many families at home with the back-up G-tube. Confirmation of position can be obtained via aspiration of gastric contents. However, if the tube was out for several hours prior to discovery of dislodgement, the stoma may have started to close. In that case, the patient should be made NPO and an emergency Foley should be placed as above and the patient brought either to ER or to clinic the following am. If no tube is able to be replaced, patient should proceed immediately to ER to prevent further narrowing of stoma. There is no indication for routine imaging in uncomplicated tube replacement in a mature tract.5

Tube replacement should be undertaken with caution as serious complications can occur. Overall complication rate is ~ 1.3%.6 Complications may include disruption of the gastro-cutaneous fistulous tract, gastric outlet obstruction from balloon placed near pylorus, and duodenal perforation or obstruction from balloon inflated or overinflated in the duodenum.6,7

Replacement of gastrostomy tubes in children should take into consideration the following:
- width of tube
- length of tube inserted into the stomach (especially if using a Foley or Mic-G tube)
- volume of balloon

*Clogged tube*

Enteral feeding tubes can become clogged. This is most common with the longer trans-gastric GJ tubes or the long primary jejunostomy tubes. Short low-profile gastrostomy buttons are the least likely to become clogged. Clogging is best prevented by following recommended flushing protocols before and after feeds and meds and during long duration continuous feeds. Also, medications should not be crushed and put directly down tube or mixed with feeds, especially extended release medications. Medications should be in liquid form or dissolved in water before administration.
To unclog, attach extension to clogged port. Fill catheter tip syringe with warm water. Pull back gently, and then try to flush. Repeat, leaving the warm water in the extension tubing for 10-15 minutes before second and third attempts. If unsuccessful, you may try diet non-cola sodas or seltzer water. If this fails, some practitioners and families have success with ClogZapper, a combination of papain along with digestive enzymes. Recent reports suggest an alkalinized Creon pancreatic enzyme delayed release mixture can also be used. If nothing is successful, the tube will need to be replaced. Studies do not support the use of cranberry juice or colas, as the acidity may denature caseinate proteins and lead to recurrent clogging.

KEY POINTS FOR SUCCESS
1. Secure feeding extension sets appropriately with 90 degree angle to minimize tube movement
2. Flush all tubes per protocol before and after feeds, before and after meds
3. Keep tube site clean and DRY at all times

REFERENCES


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