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Indications

Long-term (>30 days) enteral feeding in cases of inability to maintain nutrition, e.g., post-stroke, prior to chemo-XRT for advanced Head/Neck Malignancy, ALS.

Decompression, e.g., gastroparesis, malignant bowel obstruction not amenable to surgery or stent.

Preoperative Preparation

Understand prior surgical and medical history, including any relative contraindications (massive ascites, peritoneal dialysis catheter, coagulopathy).

Decide upon the optimal point of access, pre- or post-pyloric, using appropriate tube: G-tube, GJ tube, or J-tube (Fig. 2.1); consider possible alternatives or fallback plans.

Administer prophylactic broad spectrum antibiotics prior to the procedure.

Decompress the stomach of contents prior to decompressive enteral tube placement to minimize aspiration risk.

Potential Pitfalls

Aspiration during an endoscopic procedure.

Visceral Injury with percutaneous endoscopic technique.

Bleeding along the newly established enteral access tract.

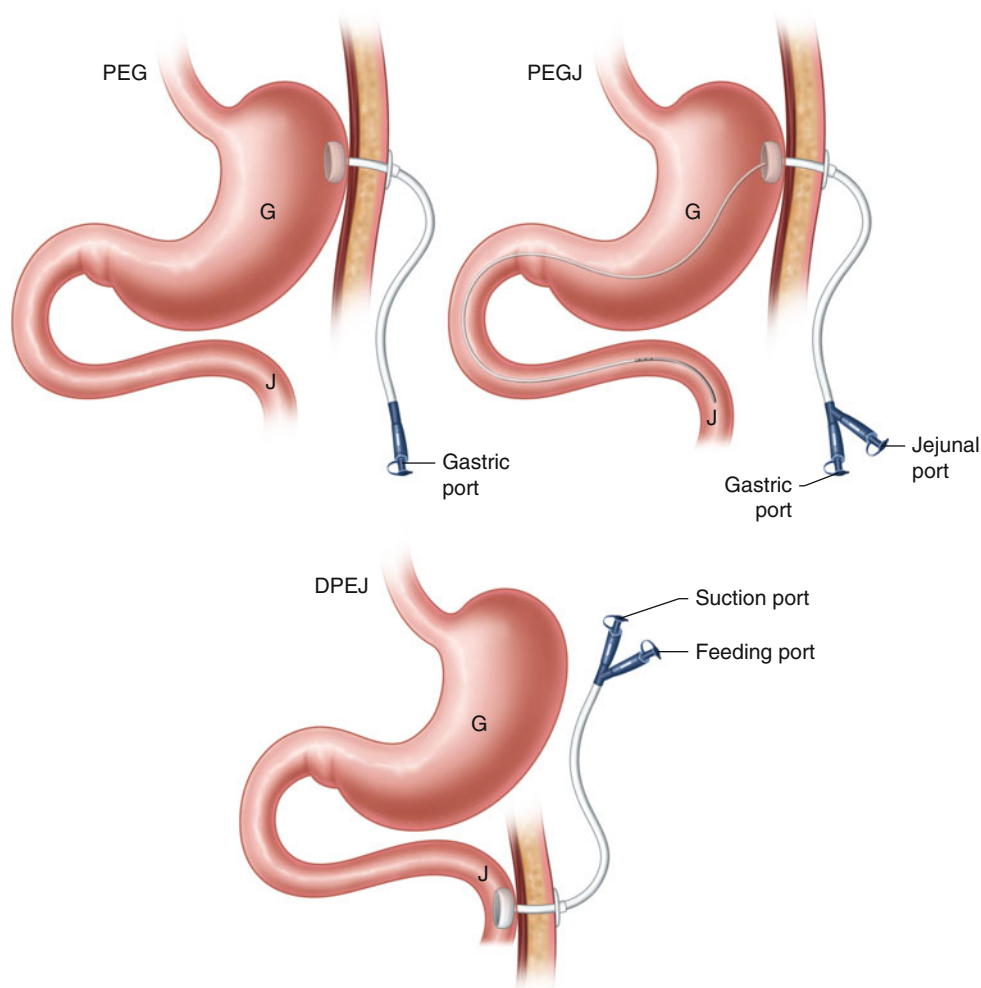
Operative Strategy

Prior to providing long-term enteral access, the surgeon must have a clear understanding of whether pre-pyloric or post-pyloric feeding is appropriate. In most instances, a percutaneous endoscopic approach with good technique can provide safe long-term enteral access to meet a patient's needs with morbidity and discomfort less than that associated with open or even laparoscopic surgery. Nevertheless, alternative surgical techniques are sometimes needed. In certain cases, it may even be appropriate to have multiple different plans available for a single operative encounter to provide a feeding tube for a given patient, e.g., PEG (Plan A), possible laparoscopic assisted PEG or a laparoscopic G-tube (Plan B), or even an open G-tube placement (Plan C). It is therefore crucial to be familiar with a number of different techniques as well as different types of feeding tubes. It is also of paramount importance that appropriate feeding tubes and equipment are available for these procedures and the facility's staff is familiar with their use and maintenance prior to performing a given procedure.

In general, the only two conditions that will preclude a percutaneous endoscopic approach to providing long-term enteral access include the inability to access the gastrointestinal tract with an endoscope (e.g., obstructing oropharyngeal mass or trauma, esophageal obstructing tumor) and the inability to establish a safe window for percutaneous tube placement. In this context, a safe window is a site where the feeding tube can be passed percutaneously through subcutaneous tissues, abdominal wall musculature, and gastric or jejunal wall with minimal chance of inadvertently damaging adjacent visceral structures. In these two situations—no endoscopic access or no safe window, a laparoscopic approach to feeding tube placement can generally be utilized as a viable alternative procedure.

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Fig. 2.1 Three different types of percutaneously placed endoscopic enteral tubes: (a) typical PEG with inner and outer flange, single port, (b) PEG with jejunal tube extension, double port for gastric aspiration, distal jejunal feeding, (c) direct percutaneously placed endoscopic jejunostomy



Operative Technique

Endoscopic Techniques

PEG

The pull technique for PEG placement can be performed using a one operator and one nurse/technician assistant approach. The patient should be positioned supine with supplemental oxygen and monitoring devices in place. A diagram of patient, operator, and assistant positioning is presented (Fig. 2.2). The abdomen should be generously prepped and draped as the safe window of PEG placement is not always strictly in the left upper quadrant—it can be epigastric and rarely even just to right of the patient's midline. The PEG kit and associated equipment should then be opened and ready. Many commercial vendors provide different versions of these kits and not every kit will have everything needed. If the kit is anticipated to provide for everything including an endoscopic snare, scissors, etc., then this must

be checked and ensured prior to starting the procedure. After the appropriate administration of conscious sedation or monitored anesthesia care, the operator introduces a flexible upper endoscope into the esophagus and a brief, standard EGD examination is performed. After ensuring no unexpected pathology, insufflation of the gastric body is provided sufficient to efface the rugal folds.

At this point, the crux of the procedure is finding the safe window for tube placement. There are three evaluations which should routinely be conducted to ensure such a safe window is found prior to PEG placement.

1. The operator can use the back of the plunger of a syringe of anesthetic (e.g., 1 % Lidocaine) to carefully palpate with this sterile instrument thereby finding a site with good 1:1 ratio of palpation that is discrete in appearance (Fig. 2.3).
2. The endoscope is then driven up to approach the greater curve, placing the tip of the scope on the anterior gastric wall. This will then achieve transillumination, casting a warm/orange glow across the abdominal wall seen at the

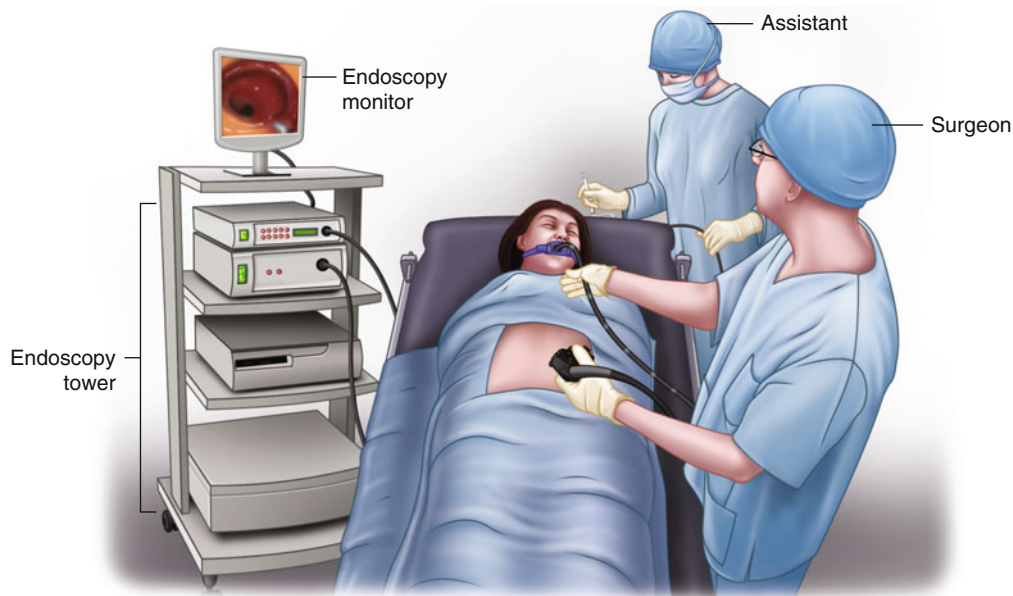


Fig. 2.2 A surgeon using this setup can perform both the endoscopic component and abdominal placement component of the procedure while an assistant (RN or GI Technician) assists by activating the transillumination feature and running the endoscopic snare

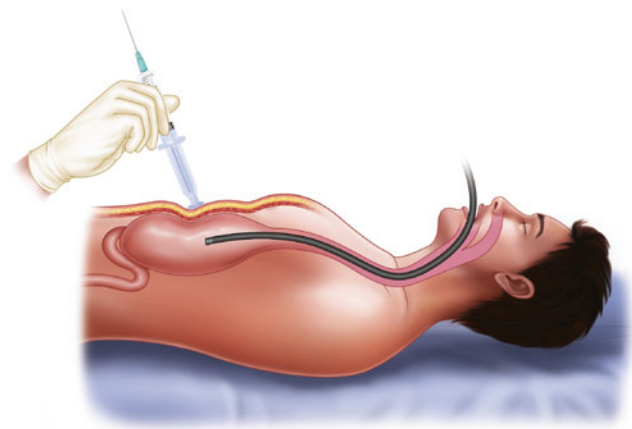


Fig. 2.3 The surgeon/endoscopist palpates the abdominal wall using the back of the plunger so as to maintain sterility of the field even as she runs the endoscope. This demonstrates discrete, 1:1 palpation at site of potential PEG placement, aiding in establishing a safe window for percutaneous placement

level of skin at the site of anticipated PEG placement. In morbidly obese patients, the assistant may need to press/deploy the transilluminate button so as to provide sufficient intensity of lighting to transilluminate a truly long abdominal wall distance. This button/feature is not generally needed in patients of normal body habitus.

3. The needle of the syringe of anesthetic is then passed into the lumen of the stomach at the site of 1:1 palpation and transillumination. While passing this needle through the subcutaneous, abdominal wall, and visceral tissues, the

syringe is aspirated to ensure no bubbles are found until the needle enters the hollow gastric lumen visualized endoscopically. If no bubbles are seen until the needle enters the stomach lumen, this is deemed a “safe track” for PEG tube placement. If bubbles or gas is aspirated prior to entry into the stomach, this track is not safe and either another track should be found or the PEG procedure potentially aborted (Fig. 2.4). In performing the safe track aspiration, it is very helpful to ensure that the operator watches the screen to ensure passage of the syringe into the gastric lumen even as the assistant watches the syringe to notify the team when bubbles are first observed within the syringe.”

Authorities have traditionally used the lack of transillumination during this procedure as a contraindication for completing the PEG procedure as planned. If however there is good 1:1 palpation and the safe track is negative for any bubbles prior to entry into the gastric lumen at the site, there are series which have demonstrated the safety of completing the procedure as planned in this setting. Thus at least two of these three criteria must be found to establish the safe window for PEG placement.

An endoscopic snare is then passed through the endoscope and is left waiting in the gastric lumen. With this done, a 1 cm incision is made through skin at the selected site. A catheter is passed through the incision along the same trajectory as the 1:1 palpation and aspiration anesthetic needle into the stomach lumen. The snare is used to encircle the catheter thus securing it. The operator passes the looped wire through the catheter into the gastric lumen, taking care to

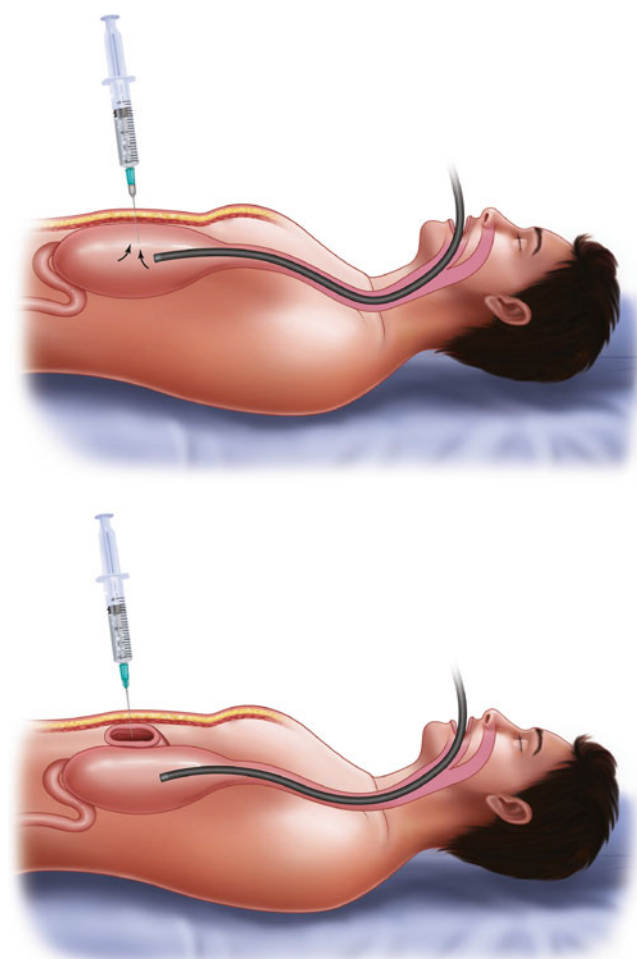


Fig. 2.4 (a) This demonstrates a negative safe track aspiration with the anesthetic/sounding needle, helping to assure a safe window for percutaneous placement of a PEG even as (b) demonstrates a positive safe track aspiration suggesting viscera between the stomach and abdominal wall, potentially despite apparent 1:1 palpation

orient it properly. The snare is then moved from where it is secured on the catheter to the wire. Once the snare is securely around the wire, the entire endoscope along with snare and wire are removed from the patient's mouth. The wire is then freed from the endoscope channel and secured to the tip of the PEG tube. The wire is then pulled (thus PULL technique) at the level of the abdominal wall, bringing the wire and the now secured tip of the PEG tube completely out of the patient until gentle traction or resistance is felt as the inner flange abuts the gastric wall (Fig. 2.5). Once positioned, an outer flange is placed down the tube (typically resting at 2–4 cm on the skin of a normal body habitus patient), the wire and some of the excess length of tubing is cut free and the cap is applied. At this point, a repeat endoscopic evaluation may be performed to ensure the inner flange is sitting without undue tension and no bleeding is visualized.

When completed, the outer flange of the PEG should rest snugly upon skin but not so snugly as to excessively dimple the skin.

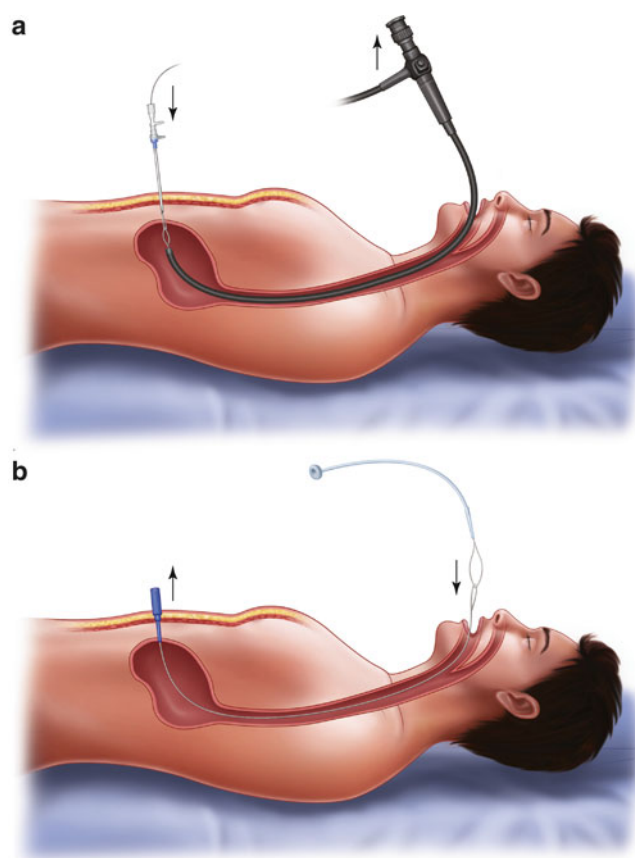


Fig. 2.5 (a) This sagittally depicts the endoscopic snaring of the trans-abdominal, trans-gastric wire which has been passed through a catheter. This wire, snare, and endoscope are then pulled back out of the oropharynx. (b) This depicts the pulling of the wire, now secured to the PEG tube, back out and across the abdominal wall until the inner flange is felt to abut the gastric and abdominal wall

Tension between the skin and outer flange is mirrored in the form of tension between the gastric mucosa/wall and the inner flange—excessive tension can lead to eventual necrosis of skin, abdominal wall, and even gastric tissue. This in turn can lead to gastric erosion, leakage/infection, or a buried bumper syndrome.

PEG-J

The PEG-J is placed as a PEG tube with a J-tube extension nested within its lumen. Therefore, the first part of the procedure is conducted just at the PEG tube is with the following caveats. The size of a nested J-tube is dictated by the diameter of the PEG tube that is selected. Therefore in order to have a larger diameter J-tube, a larger diameter PEG tube must be used. With commercially available BARD kits, a 9 Fr J tube can be nested within a 20 Fr PEG even as a 12 Fr J tube can be nested within a 28 Fr PEG. J-tubes themselves can be selected with different elements: (1) different diameters: 9, 12 Fr, (2) single port for jejunal feeding only versus dual port allowing for both gastric decompression as well as

jejunal feeding, and (3) a prefabricated loop on the end for pull placement versus no such loop for guidewire push placement (Fig. 2.6). In order to minimize clogging issues with medications as well as certain enteral formulations, use of a 28 Fr PEG with a 12 Fr J-tube ideally with two ports should be used. Additionally, the use of a pediatric colonoscopy, with its longer length, has the advantage of more readily allowing for proximal jejunal intubation and should generally be used for the PEG-J procedure.

Following the establishment of the PEG using the previous technique description, the pediatric colonoscopy is used to re-intubate the stomach and an endoscopic clip is passed into the gastric lumen. A 12 Fr J-tube is passed through the

PEG tube into the gastric lumen where its distal tip loop is then grasped with an endoscopic clip (Fig. 2.7). The endoscopic clip with loop in tow is then pulled into the instrument channel of the colonoscopy so that it is no longer visible endoscopically. The scope is then driven out into the duodenum and as far as possible, ideally into the proximal jejunum—the endoscopic clip holding the loop at the tip of the j-tube ensures that the tube is in tow. C-arm fluoroscopy can be used adjunctively to ensure that reasonable depth of intubation is achieved. Once the proper depth of intubation is achieved, the endoscopic clip is used to secure the loop onto the small bowel mucosa (Fig. 2.8). The scope is then withdrawn. The endoscopic clip ensures that j-tube extension migration is minimized both with scope withdrawal as well as in the postoperative period.

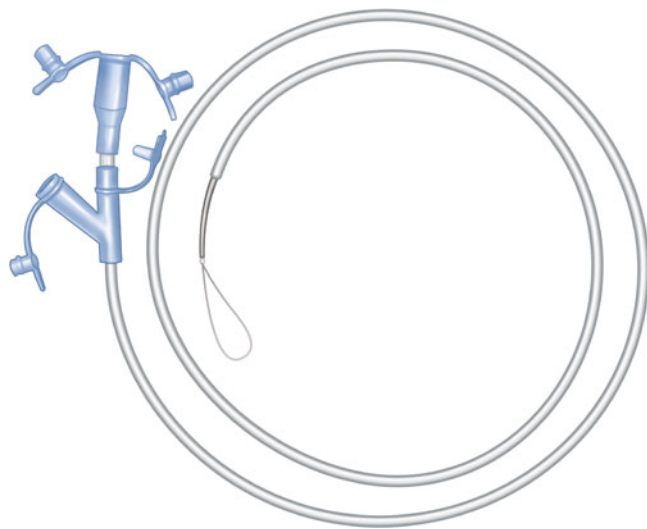


Fig. 2.6 This is a 12 Fr J-tube which can be placed in a nested fashion within the lumen of a 28 Fr PEG tube. Notice there are two ports—a proximal gastric decompression and distal jejunal feeding port. Also there is a distal tip suture/loop provided for endoscopic placement distally

DPEJ

The use of a direct percutaneous endoscopically placed jejunostomy tube using a modification of the Pull PEG technique can be technically difficult in an anatomically intact upper gastrointestinal tract. So much so, that some authorities have advocated using double balloon enteroscopy technique to facilitate reaching an appropriate loop of jejunum and stabilizing it against the abdominal wall. Without resorting to these more complex endoscopic approaches, the DPEJ approach is therefore most likely to be successful in patients who have already undergone previous esophageal or gastric resection (e.g., a Billroth II).

Bearing this in mind, the procedure requires a setup and sedation or MAC as in the previous percutaneous endoscopic procedures. A pediatric colonoscopy is advanced into the jejunum—C-arm fluoroscopy may prove helpful adjunctively in some cases. As in the PEG technique, a safe window must be obtained for purposes of DPEJ placement. This therefore requires: (1) careful palpation with 1:1 movement

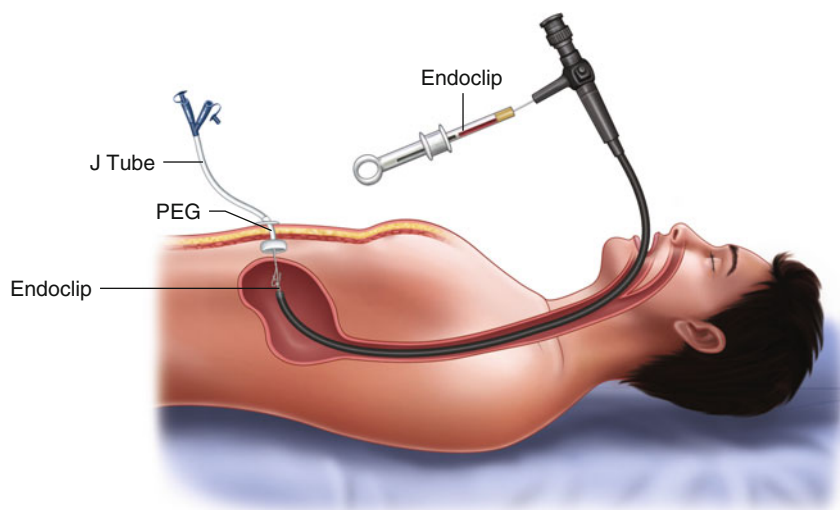


Fig. 2.7 This sagittal figure demonstrates the jejunostomy tube being threaded through the lumen of the previously placed PEG tube. A pediatric colonoscope grabs the loop on the distal tip of the jejunostomy tube with an endoscopic clip

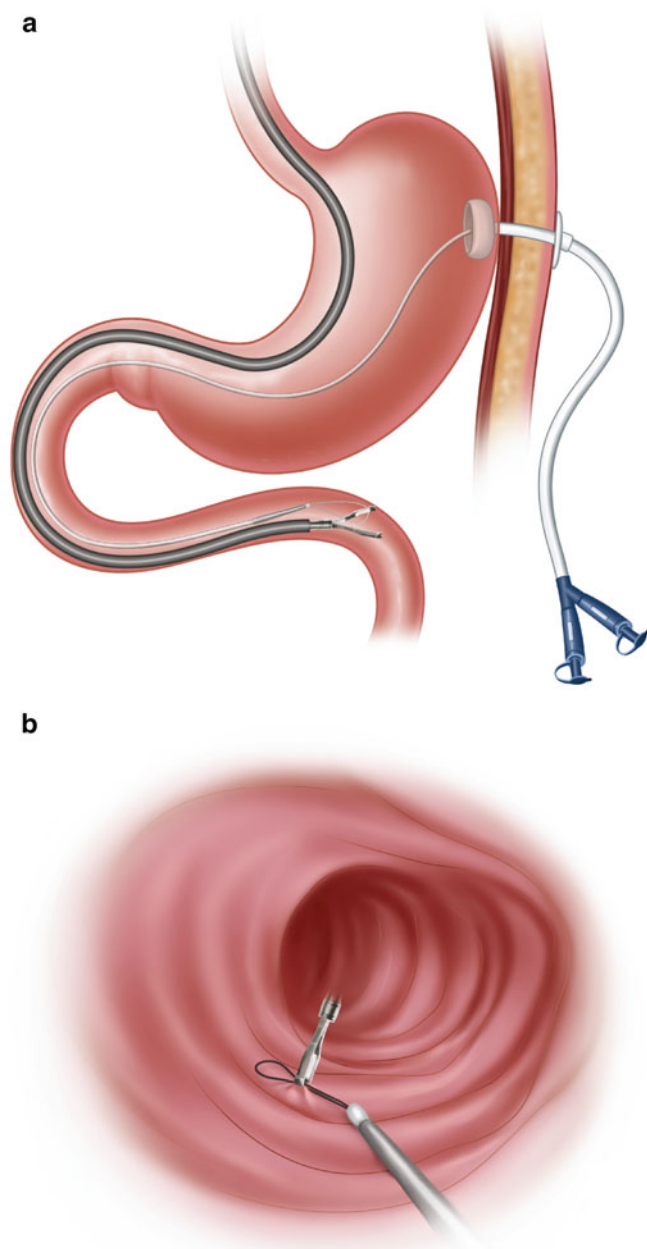


Fig. 2.8 (a) A pediatric colonoscope is used to drag the jejunostomy extending tube distally to the proximal jejunum with the use of an endoscopic clip. (b) This same clip is then used to secure the loop to the mucosa of the small bowel at this point, reducing likelihood of proximal migration

transabdominally and a discrete endoscopic “indentation,” (2) transillumination—this can conceivably be almost anywhere in the abdomen unlike the PEG location and thus the abdomen must be widely prepped, and (3) a Safe Track aspiration which is free of bubbles/gas until entering the lumen endoscopically. At this point in contrast with the PEG technique, it is advisable to LEAVE the anesthetic or sounding needle in place and secure it with the endoscopic snare so as to avoid

movement or shifting of the loop of jejunum and loss of apposition of the small bowel loop to the abdominal wall. With this needle secured in place for bowel fixation, a catheter is placed into the lumen of the bowel alongside the snared needle. The snare is then removed from the sounding needle and used to snare the catheter. A looped wire is then passed through the catheter and ensnared in the jejunal lumen. Again, the entire endoscope, snare, and ensnared wire are then removed as a unit orally. The wire is then freed from the endoscope channel and secured to the tip of a typically 16–18 Fr PEG type tube. The wire is then pulled (thus PULL technique) at the level of the abdominal wall, bringing the wire and the now secured tip of the DPEJ tube completely out of the patient until gentle traction or resistance is felt as the inner flange abuts the jejunal wall (Fig. 2.9). Once positioned, an outer flange is placed down the tube, typically resting at 2–3 cm on the skin of a normal body habitus patient, the wire and some of the excess length of tubing is cut free and the cap is applied. At this point, a repeat endoscopic evaluation may be performed to ensure the inner flange is sitting without undue tension and no bleeding is visualized.

Laparoscopic Approaches

Laparoscopic-Assisted PEG

Either due to a patient’s morbid obesity or some other factor a safe window for conventional PEG placement occasionally cannot be demonstrated and the procedure is aborted. This is an opportunity for using a laparoscopic-assisted PEG approach. As well as requiring general anesthetic, this requires someone operating the endoscope as well as someone using the laparoscope and cannulating the stomach—a potential setup is diagrammed (Fig. 2.10). The patient’s abdomen is sterilely prepped and draped in usual fashion and a trocar is placed peri-umbilically for direct laparoscopic visualization of the abdominal contents. After insufflation with CO₂, the abdomen is surveyed to ensure no unexpected pathology or abnormalities. An endoscope is then passed orally and the stomach insufflated. With direct laparoscopic visualization, an appropriate location is selected along the abdominal wall and a catheter passed directly into the stomach under combined laparoscopic/endoscopic visualization. If needed, an additional trocar can be placed so a grasper can bring the gastric wall—typically along the anterior aspect of the greater curve—closer to the catheter to allow gastric cannulation (Fig. 2.11). Once the intragastric wire is ensnared by the endoscope, the remainder of the procedure is performed in a manner similar to conventional PEG placement. The laparoscope can be used to demonstrate the inner flange sitting against the gastric wall with no undue trauma or bleeding. The tube once brought out through the abdominal

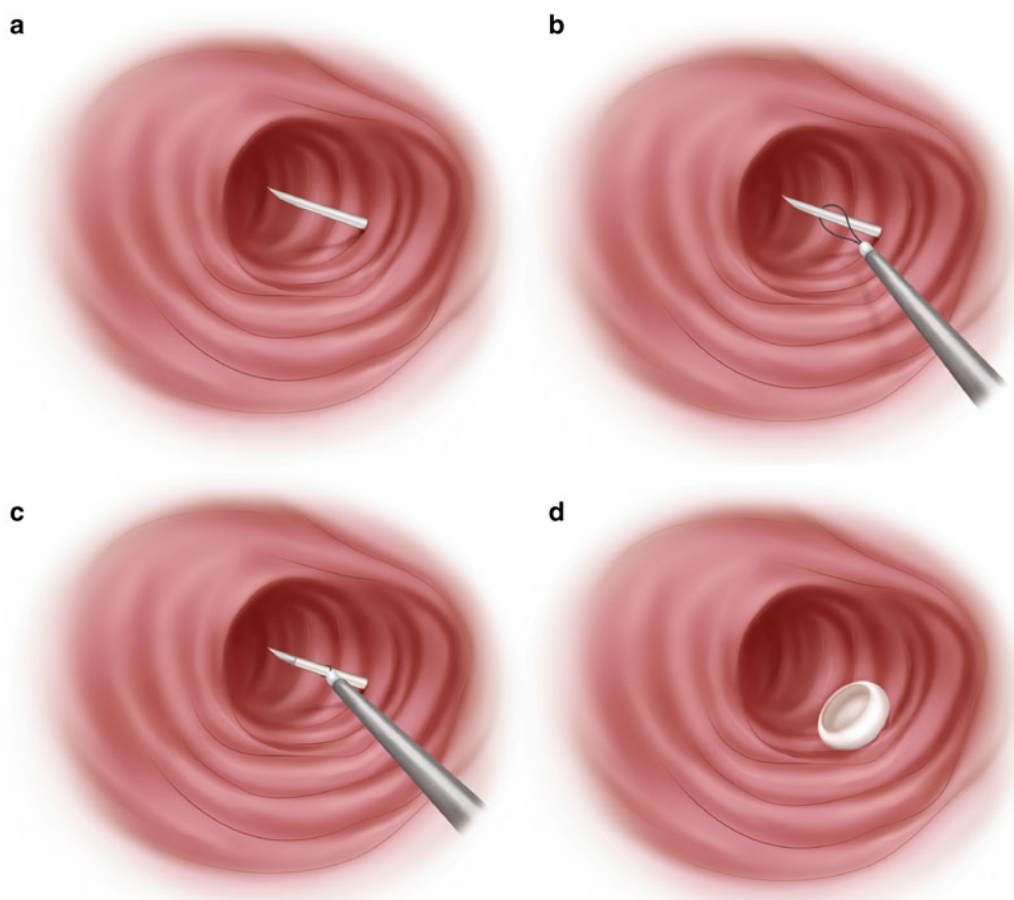
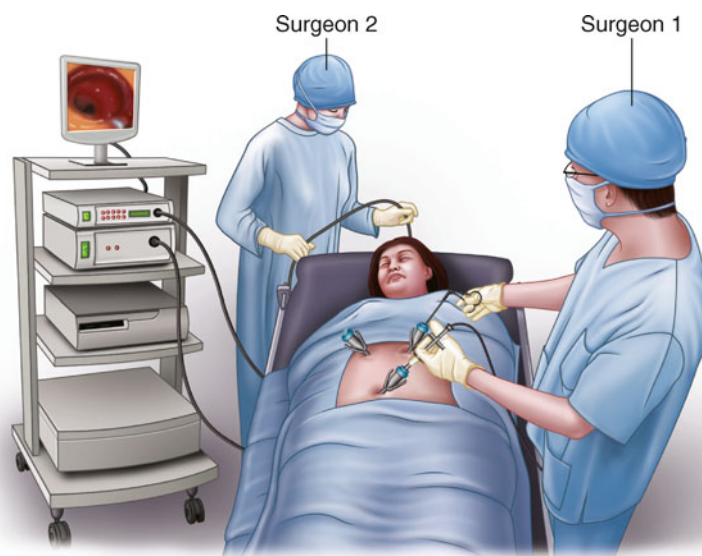


Fig. 2.9 (a) An anesthetic needle is introduced into the jejunal lumen. (b) This needle is ensnared to prevent jejunal loop migration or movement and loss of apposition to the abdominal wall. (c) The snare is transferred to the angiocatheter once this is introduced alongside the

anesthetic needle. (d) A 16 or 18 Fr PEG type tube is secured in a manner similar to gastric PEG placement with inner flange securing the tube to the abdominal wall

Fig. 2.10 The typical setup for a surgeon on the patient's left performing laparoscopy even the endoscopist assists while standing at the patient's head



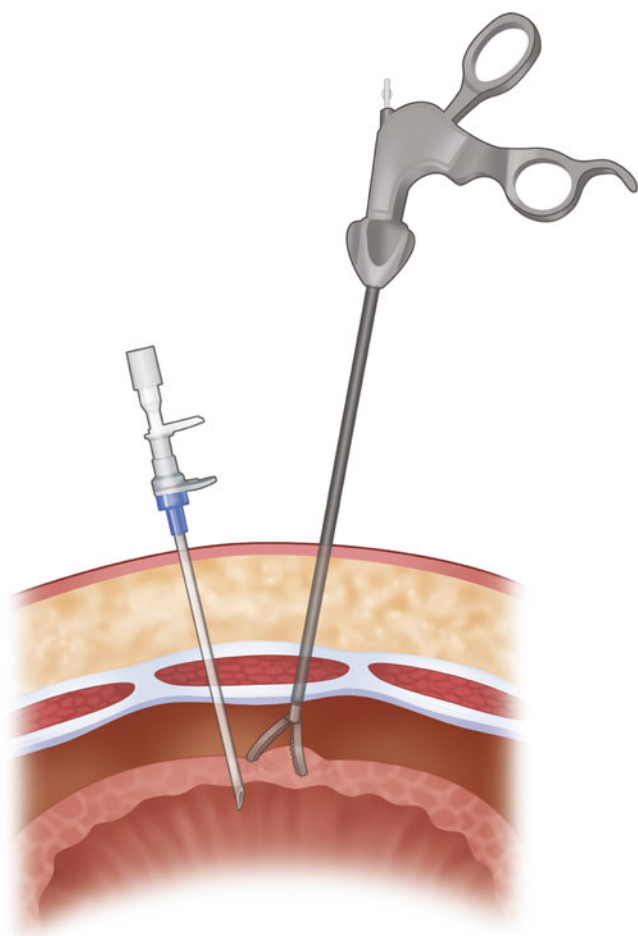


Fig. 2.11 Sagittal depiction of a laparoscopic grasper used to facilitate placement of the angiocatheter into the gastric lumen during pneumoperitoneum

wall can be covered with a sterile towel to minimize any contamination of the field. The laparoscopic procedure is terminated and the trocars sites closed and dressed prior to placing the outer flange and cap on the PEG tube.

Laparoscopic Gastrostomy Tube Placement

When either obstructing mass or prior surgery (e.g., Roux en Y Gastric Bypass) prevents pre-pyloric enteral access endoscopically, a fully laparoscopic gastrostomy approach can be employed. After establishment of pneumoperitoneum and survey of the abdomen, a place for tube placement is sited along the anterior aspect of the stomach, close to the greater curvature and two concentric purse string sutures are placed around this using a laparoscopic needle driver and 2-0 silk sutures. As an alternative to a laparoscopic needle driver and suture, the Endostich (Ethicon) device can be used for purse string placement. A skin incision is then made at an appropriate site in the left upper quadrant and an 18 Fr Latex Foley catheter is placed through this into the abdominal cavity.

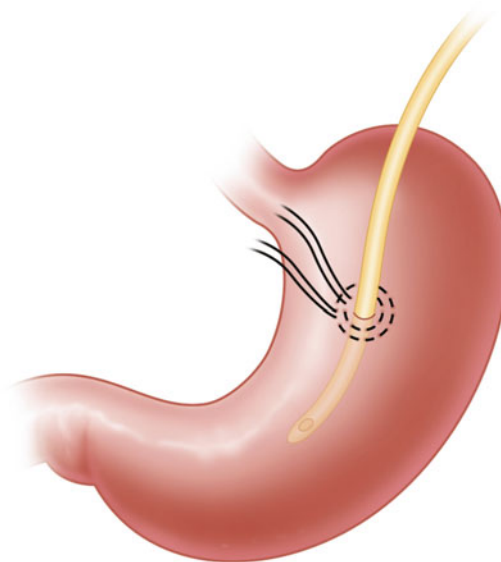


Fig. 2.12 Two concentric purse string sutures are placed around an 18 Fr Foley catheter for gastrostomy tube placement

Next a gastrotomy is made within the purse string sutures and the catheter is placed into the gastric lumen (Fig. 2.12). The balloon of the catheter is inflated and irrigation and aspiration is performed to ensure proper intragastric positioning. The purse string sutures are tied sequentially with the second/outer one ensuring the first/inner one is covered by serosa. Four sutures are then sequentially placed in the seromuscular layer of the gastric wall around the tube exit site and secured to the abdominal wall using a trans-fascial suture-passing technique (Fig. 2.13). This creates a laparoscopic modification of the Stamm gastrostomy tube and the procedure is complete after it is secured to the skin with non-absorbable suture.

Laparoscopic GJ Tube

A laparoscopic GJ tube (Fig. 2.14) can be placed in much the same way as described for the laparoscopic G-tube. Once its intragastric balloon and proximal aspect are firmly secured as previously described, endoscopy can be utilized to pass the jejunal tube distally and secure it within the jejunum in much the same way as was described in the PEG-J technique. The pediatric colonoscope is used to intubate the stomach and an endoscopic clip is passed through the instrument channel and grasps a loop on the end of the jejunal tube (loop is either premanufactured or a suture placed previously). The endoscopic clip holding this loop is then driven out into the duodenum and as far as possible, ideally into the proximal jejunum—the endoscopic clip holding the loop at the tip of the j-tube ensures that it is in tow. C-arm fluoroscopy can be used adjunctively to ensure that reasonable depth of intubation is achieved. Once the proper depth of intubation is

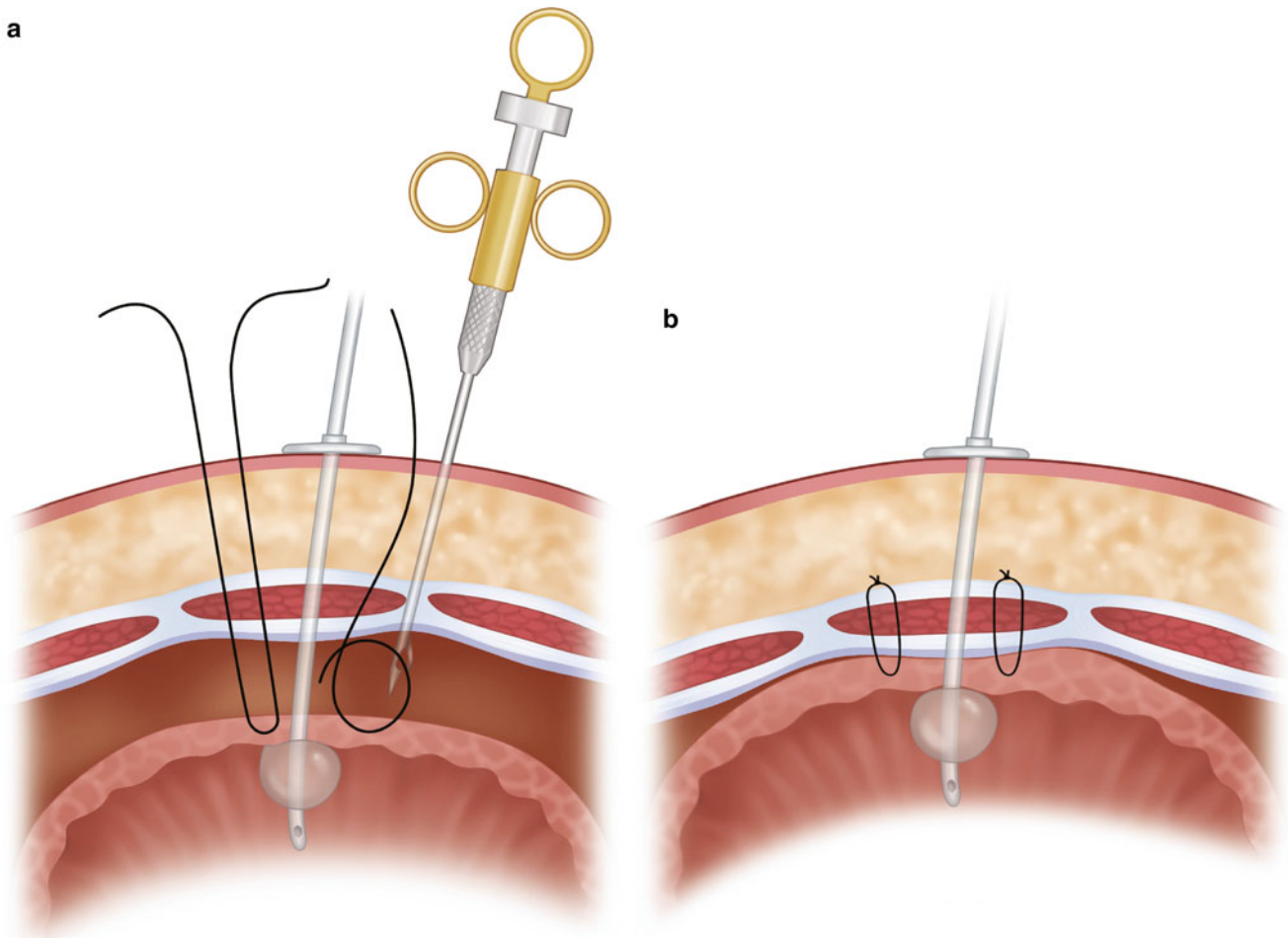


Fig. 2.13 (a) After the purse string sutures are tied and the gastrostomy tube is secured, four 2-0 silk suture are laparoscopically placed in the seromuscular layer before being secured via suture passer to the fascia. (b) Each is placed sequentially before tying all four in place

achieved, the endoscopic clip is used to secure the tube to the small bowel mucosa. The scope is then withdrawn; the endoscopic clip ensures that j-tube migration is minimized both with scope withdrawal as well as in the postoperative period.

J-Tube

A large number of laparoscopic jejunostomy techniques have been described. Once trocars are placed and the abdomen is surveyed, a segment of jejunum distal to the ligament of Treitz is carefully identified and evaluated to ensure it can reach the abdominal wall. Once this is established, a purse-string of 2-0 silk is placed on the anti-mesenteric aspect of the small intestine using a laparoscopic needle driver or an Endostitch (Ethicon). A 1 cm incision is made at an appropriate position in the abdominal wall and a 16 Fr red rubber catheter is introduced through this incision into the peritoneal cavity. An enterotomy is made within the previously placed pursestring and the j-tube is threaded through the enterotomy distally into the small bowel lumen. The purse-

string is tied and subsequently a number of imbricating seromuscular sutures are placed creating a Witzel tunnel approximately 2 cm in length (Fig. 2.15). Two sutures are then sequentially placed in the seromuscular layer of the bowel wall proximal and distal to the Witzel tunnel and secured to the abdominal wall using the previously described trans-fascial suture-passing technique (see Fig. 2.14). The tube is flushed and aspirated to ensure patency prior to securing the catheter to skin.

Postoperative Care

Perioperative antibiotics as appropriate.

Early feeding.

Flushing routinely to maintain patency.

Avoidance of crushed meds, etc. depending on Tube diameter.

Avoidance of inadvertent traction/dislodging of tube.



Fig. 2.14 Picture of a gastrojejunostomy (GJ) tube with dual ports for gastric decompression/aspiration and a distal port for jejunal feeding

Common Complications

Tube clogging.

Tube dislodgement or accidental removal.

Tube exit site Infection, leakage, or irritation.

Buried bumper syndrome—clinical picture resulting from partial or complete growth of gastric mucosa over the internal bolster of a PEG.

Suggested Reading

DiSario JA. Endoscopic approaches to enteral nutritional support. *Best Pract Res Clin Gastroenterol.* 2006;20(3):605–30.

Fan AC, Baron TH, Rumalla A, Harewood GC. Comparison of direct percutaneous endoscopic jejunostomy and PEG with jejunal extension. *Gastrointest Endosc.* 2002;56(6):890–4.

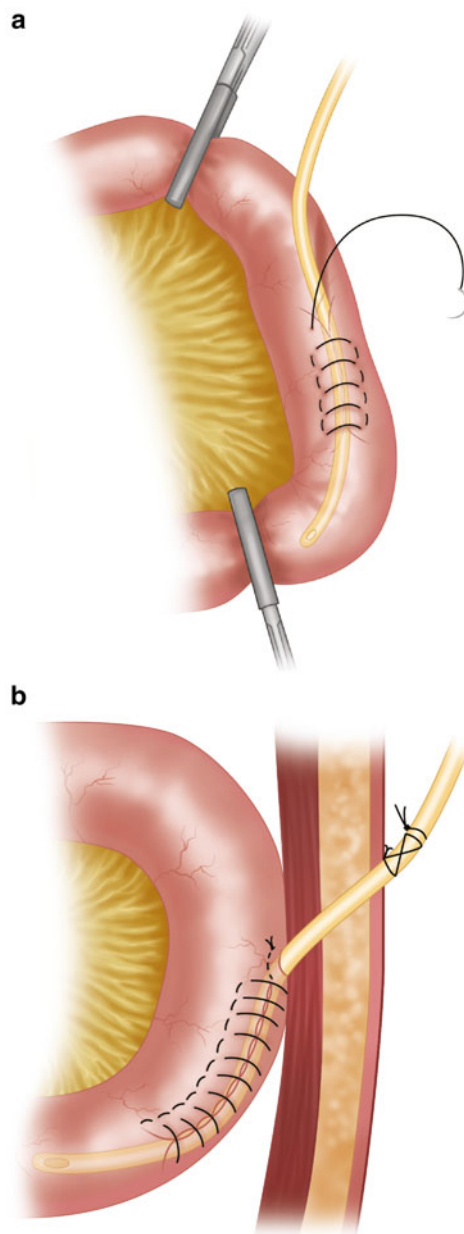


Fig. 2.15 Diagram of the Witzel tunnel created laparoscopically at time of jejunostomy tube creation

Hirdes MM, Monkelbaan JF, Haringman JJ, van Oijen MG, Siersema PD, Pullens HJ, et al. Endoscopic clip-assisted feeding tube placement reduces repeat endoscopy rate: results from a randomized controlled trial. *Am J Gastroenterol.* 2013;107(3):1220–7.

Nagle AP, Murayama KM. Laparoscopic gastrostomy and jejunostomy. *J Long Term Eff Med Implants.* 2004;14(1):1–11.

Paski SC, Dominitz JA. Endoscopic solutions to challenging enteral feeding problems. *Curr Opin Gastroenterol.* 2012;28(5):427–31.

Stewart JA, Hagan P. Failure to transilluminate the stomach is not an absolute contraindication to PEG insertion. *Endoscopy.* 1998;30(7):621–2.

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