Percutaneous gastrostomy and jejunostomy: Lessons from the first decade

JOHN S GOFF, MD

JS GOFF. Percutaneous gastrostomy and jejunostomy: Lessons from the first decade. Can J Gastroenterol 1992;6(3):149-154. Percutaneous gastrostomies and jejunostomies have increasingly been used for long term enteral feeding in patients with functioning gastrointestinal tracts but who are unable, for a variety of reasons, to use the standard oropharyngeal route. Since these devices can be placed without the use of general anesthesia, the morbidity and mortality generally are less than for placement of a surgical gastrostomy. A permanent gastrostomy tube is easy to manage in most patients who require prolonged tube feeding. There are four basic types of percutaneous gastrostomy techniques; three employ an endoscope and one uses only radiographic or ultrasonic guidance. All gastrostomy tubes may be converted to feeding jejunostomies if the clinical situation warrants. Jejunal feeding tubes are prone to many technical problems and do not always solve the problems of gastric dysfunction and reflux that make gastrostomy tubes less desirable. Percutaneous endoscopic gastrostomies are technically simple to perform and have become the main method for access to the gastrointestinal tract in many patients. If judiciously used, the percutaneous enterostomy offers many benefits over a nasogastric tube for long term enteral feeding.

Key Words: Endoscopy, Gastrostomy, Jejunostomy

Gastrostomie et jéjunostomie percutanées: bilan d'une première décennie

RÉSUMÉ: Les gastrostomies et jéjunostomies percutanées ont été de plus en plus utilisées pour l'alimentation parentérale prolongée chez des patients dont les voies digestives sont fonctionnelles, mais qui sont incapables pour diverses raisons de recourir à la voie oropharyngée normale. Puisque les dispositifs peuvent être installés sans recours à l'anesthésie générale, les taux de mortalité et de morbidité sont généralement moindres que lors d'une gastrostomie chirurgicale. Le tube de gastrostomie permanent est généralement facile à utiliser chez la

SURGICALLY CREATED GASTROSTOMIES have been used for over 100 years. They provide useful and convenient access to the gastrointestinal tract to allow feeding and medicating patients with a variety of problems that prevent use of the oral route. Surgical gastrostomies have generally been placed with the patient under general anesthesia which probably contributes to this procedure's morbidity and mortality since most of the patients are quite ill or debilitated (making them a higher risk group for complications from the general anesthesia). Minor complications from surgical gastrostomies range from 7 to 51% while major complications range from 7 to 71% (1). An endoscopic approach to placement of a gastrostomy tube under local anesthesia was first reported approximately 10 years ago (2). We have learned many things since the first placement of a percutaneous endoscopic gastrostomy (PEG). This technique and its many variations have become standard practice for gastroenterologists, surgeons and radiologists all over the world.

TECHNIQUES

Although there are numerous PEG kits on the market, there are only four basic methods for placement of a PEG:

University of Colorado Health Sciences Center and Denver Veterans Administration Medical Center, Denver, Colorado, USA

Correspondence and reprints: Dr JS Goff, 209 North Overland Trail, Fort Collins, CO 80521, USA. Telephone (303) 484-9773

plupart des patients qui requièrent une alimentation parentérale prolongée. Il existe quatre types principaux de techniques de gastrostomie percutanée. Trois d'entre elles supposent l'emploi d'un endoscope et la dernière recourt au guidage radiologique ou échographique. Tous les tubes de gastrostomies peuvent être adaptés pour l'alimentation par jéjunostomie, selon la situation clinique. Les tubes d'alimentation jéjunale sont associés à diverses difficultés techniques et ne règlent pas toujours les problèmes de dysfonction gastrique et de reflux qui rendent moins favorables les tubes de gastrostomie. Les gastrostomies endoscopiques percutanées sont simples à exécuter au plan technique et sont devenues les principales voies d'accès au système digestif chez de nombreux patients. Utilisée judicieusement, l'entérostomie percutanée offre plusieurs avantages sur la sonde nasogastrique pour l'alimentation parentérale prolongée.

the Ponsky-Gauderer or pull technique; the Sachs-Vine or push-pull technique; the Russell technique; and the totally nonendoscopic radiographic technique (3-6) (Figure 1). Each of these has pros and cons, and each has a place in the proper and safe placement of a PEG depending on the clinical situation.

The Ponsky-Gauderer and the Sachs-Vine techniques are similar. Both start with establishing the site of puncture on the abdominal wall by a combination of transillumination of the abdominal wall and observing the indentation of the gastric lumen created by a finger probing the abdominal wall (Figure 2). The indentation of the gastric lumen has become more important than transillumination because many of the new video endoscopes do not produce enough light to transilluminate. Once

the site is selected, it is sterilized and anesthetized with a lidocaine injection. A skin incision is made with a scalpel followed by insertion of a needle with a trocar (Seldinger needle). The needle is grasped by a snare passed through the endoscope. One passes a string (Ponsky-Gauderer) or a guidewire (Sachs-Vine) through the needle which is then grasped by the snare and pulled out the mouth with the endoscope (Figure 3). In the Ponsky-Gauderer technique, the string (or soft wire loop) is secured to similar material on the tapered tip of the gastrostomy tube (G-tube). The tube is pulled retrograde through the mouth, gastric wall and abdominal wall (Figure 4). The other end of the G-tube has a bumper which rests against the gastric mucosa and pulls the stomach into close proximity with the abdominal

wall. Another bumper is slipped over the external portion of the G-tube to secure the position of the tube with the abdominal wall. The stiff tapered tip is trimmed off the G-tube and an adaptor is placed on the tube so it can be occluded or attached to feeding tubes (Figure 5). The Sachs-Vine technique is very similar except that the guidewire is passed through the G-tube. The G-tube is then passed over the guidewire through the mouth and pushed forward until the tip protrudes from the abdominal wall. The tip is grasped by the endoscopist and pulled out the rest of the way. The endoscopist passes the endoscope back into the stomach to be sure the internal bumper is properly positioned for both techniques.

The Russell technique is somewhat different. The endoscopist locates the site of placement by the same method. After the Seldinger needle is passed into the stomach, a short guidewire is passed into the gastric lumen and the needle is removed. Tapered dilators are then passed in sequence over the guidewire until the tract is large enough to accept the largest one which has an outer breakaway sheath. The final dilator is removed and a balloon tip catheter (G-tube) is passed through the sheath. The balloon is inflated with water and pulled up against the gastric mucosa. The break-away sheath is removed and a bumper is secured to the external portion of the G-tube to keep it in place and to oppose the gastric and abdominal walls. Finally, the endoscope is removed. Advantages of this technique are that the endoscope has to be passed only once and it can be any size, and that the G-tube does not have to pass through the mouth; this particularly is useful for patients with partial obstruction of the oropharynx or esophagus. It also prevents contamination of the G-tube with oral flora.

The nonendoscopic method for placement of a G-tube also employs the use of a Seldinger needle to penetrate the stomach from the skin, but the stomach is localized by either standard radiography or ultrasound. The stomach often is inflated with air from a nasogastric tube or ingestion of sodium bicarbonate. Once the stomach is

Figure 1) A large variety of commercial percutaneous endoscopic gastrostomy kits are available, some of which are shown

Figure 2) The first step in placing a G-tube is to select a proper site on the abdominal wall; this is done by observing indentation of the gastric wall by the examining finger. The site should be away from the rib margin and over the body of the stomach

Figure 3) After selecting the site, preparing the skin with an iodine solution, anesthetizing the skin and making an adequate skin incision, the needle is inserted into the stomach under direct vision. The string or wire passed through the needle is grasped with a snare and pulled out the mouth

Figure 4) The gastrostomy tube is passed over the guidewire. The tapered end leads and the internal bumper follows. Once the tapered tip protrudes through the abdominal wall, it is grasped and the tube is pulled out until the internal bumper engages the gastric wall

Figure 5) The gastrostomy tube is pulled up against the abdominal wall and secured there by placing an external bumper on the tube at the skin surface. This should be done with just enough tension to loosely appose the gastric wall and the abdominal wall

entered, a guidewire is passed followed by a catheter that will serve as the feeding tube. The tube often is passed into the duodenum before terminating the procedure. Until recently no attempt was made to secure the stomach to the abdominal wall and yet there have been no reports to indicate increased complications. A few reports have described a way to secure the stomach to the abdominal wall with T-fasteners (7,8). These fasteners not only prevent the stomach from pulling away from the abdominal wall later with the potential for leakage, but also help keep the stomach from pushing away from the dilating catheters when one is

trying to place a larger G-tube. These fasteners, which partially counter the drawback of the G-tubes placed by this method, are too small to allow bigger dilations to be accomplished easily.

The Ponsky-Gauderer and Sachs-Vine methods result in a G-tube that must be removed endoscopically since the internal bumper cannot be pulled through the tract and it is too big to assume it will safely pass through the entire gut without causing obstruction if it is only cut off at the skin. Therefore, if the G-tube needs to be changed or removed, the patient must endure the added cost and discomfort of a second endoscopy. The Russell method

avoids this problem since it can be exchanged after the tract matures by simply deflating the balloon and removing the original tube. The disadvantage to the Russell method is that the balloon can deflate, rupture or leak prior to when the tract has matured. The stomach may then drop away from the abdominal wall with spillage of gastric contents or enteral feedings into the peritoneum. The Bard company (Massachusetts) has developed a device that solves both of these problems. The internal bumper on the Bard G-tube is a soft mushroom cap that is firm enough to hold the stomach against the abdominal wall but flexible

enough to be drawn through a tight oropharyngeal or esophageal stricture, or be extracted through a mature gastrostomy tract if the G-tube needs to be replaced or discontinued.

Most patients will not require a tube exchange because the tubes are made of materials that do not break down readily and the patients are often very ill with short life expectancies. However, for those who are active and expected to survive a long time, the long G-tube protruding from their abdominal wall often is unacceptable. For these patients, a button device can be inserted once the tract has matured and after the standard G-tube is removed (9). The buttons are flush with the skin surface and, thus, are well-liked by patients. The buttons can easily be exchanged if they malfunction by simply inserting a stylet to stretch the mushroom portion that holds it in the stomach and removing it. The new one is replaced by the same technique.

A new one-step button placement technique currently is being evaluated; this technique uses the Sachs-Vine push-pull technique, but the stylet portion of the G-tube placement catheter contains a button folded into a break-away cocoon. Once the G-tube is pulled out to where the internal bumper has engaged the gastric wall, the cocoon is opened and the external flaps of the button are deployed onto the abdominal wall.

JEJUNOSTOMY TUBES

Some patients will need to be fed into the small bowel because their stomachs will not tolerate enteral feedings (gastroparesis, outlet obstruction, etc) or because the patient is experiencing excessive gastroesophageal reflux and therefore is at high risk of developing aspiration pneumonia. In these situations one can use a small feeding tube passed through a G-tube which is already in place (percutaneous endoscopic jejunostomy [PEJ]) (10). A well-placed jejunostomy tube (J-tube) can eliminate the reflux risk and thus reduce the aspiration risk, but these tubes cannot totally prevent aspiration because patients will reflux feeding all the way back into the stomach and

esophagus, they will reflux and aspirate normal gastric contents (acid) or will aspirate oral secretions. There are tubes available that will allow one to aspirate the gastric contents while feeding the patient through a coaxial tube that passes into the small bowel. Jejunal feeding tubes have not proven to be a panacea for feeding patients with aspiration problems. Several investigators (10,11) have shown that the presence of a J-tube does not prevent aspiration of enteral feedings. Also, the J-tubes are more prone to mechanical failure, especially from clogging due to their smaller diameter (11,12). These tubes will need to have further modifications to eliminate some of the mechanical problems created by their small size and poor connections with the gastric portion of the device.

TIPS FOR SUCCESSFUL PLACEMENT

One of the major problems with G-tube placement is the development of wound infections. Infections can be minimized by thoroughly cleaning the oropharynx prior to the procedure and by giving the patient intravenous antibiotics (13,14). Investigators have shown that the risk of wound infection can be reduced by giving a first generation cephalosporin antibiotic intravenously immediately before and several hours after the procedure (13,14). A wide skin incision will allow the tube to pass through more easily and lessens the chances of infection because of less trauma/tension on the tissues and better local drainage. One must closely follow the incision site to look for signs of early infection. If one can identify an infection early, it can be treated with antibiotics alone or, if needed, in conjunction with a small drainage incision around the G-tube site. Early detection and prompt treatment may prevent having to perform wide drainage and tube removal.

Migration of the G-tube's internal bumper into the gastric or abdominal wall has been described (15) and is most likely to occur with the devices that have an internal crossbar bumper (these are more likely to exert focal pressure that will lead to erosion into

the mucosa than flat or mushroom bumpers). This migration can be prevented by performing a second passage of the endoscope immediately after the G-tube has been placed to ensure the bumper is seated correctly and can be turned easily after the external bumper has been secured. Apposition of the gastric and abdominal walls promotes tract development and may allow earlier maturation, but there is no benefit in having these structures drawn tightly together. The external bumper should be loosened or removed after 10 to 14 days, especially if the patient is gaining weight rapidly. The bumper needs to be left in place longer in patients who are severely malnourished or on immunosuppression (prednisone) because the tract may take longer to mature and seal in these patients.

Determining the location of the stomach can be difficult in obese patients, patients status post a partial gastrectomy, patients with their stomach high up under the ribs and when using some of the video endoscopes that do not produce enough light to transilluminate reliably the stomach and abdominal wall. In these situations, ultrasound, computed tomography and plain films of the abdomen may help confirm the location of the stomach and determine if there are any overlying loops of bowel. Occasionally the stomach cannot be reached from the skin with the needles provided in the gastrostomy kits because they are not long enough. The direction one passes a needle into the stomach is not always straight in; one occasionally needs to aim slightly to moderately upward (toward the head) to achieve the correct angle for entry into the gastric lumen. This can be easily determined by the endoscopist prior to needle insertion if he closely observes the finger's indentation on the gastric lumen and only accepts the direction of aim when he is sure the finger is producing the maximum direct effect on the gastric lumen.

Gastroparesis occasionally is seen after gastrostomy placement. This usually is caused by placing the G-tube in the antrum rather than in the body

of the stomach. The G-tube should be placed in the body of the stomach if at all possible to avoid any potential problems with altered gastric motility and emptying.

COMPLICATIONS

Numerous complications have been described from placing enterostomy tubes (16-19); these include infection (from local to systemic), tube occlusion, tube extrusion, mechanical failure of the tube, bleeding, aspiration pneumonia, pneumoperitoneum, leakage of gastric contents or feedings into the peritoneum, bowel obstruction, gastroparesis, leakage onto the abdominal wall and death. Minor complications occur in 10 to 20% of patients, while major morbidity occurs in 5 to 8%. Death rates are hard to evaluate since most patients having a PEG are very ill and are often elderly. The reported death rates due to the procedure itself consistently seem to be around 1%.

INDICATIONS

Most PEGs are placed because the patient is not able to ingest enough calories by mouth. The majority of these patients have some type of neurological impairment. Another common reason is that the patient has recurrent aspiration pneumonia caused by aspiration of ingested food and liquid. Mechanical obstruction of the oropharynx or esophagus (especially cancers that are going to be treated with radiation or chemotherapy) can also be a good reason for a gastrostomy. Patients with upper small bowel or gastric outlet obstructions that cannot be surgically relieved may benefit from decompression via a PEG. The PEJ usually is considered for patients with excessive gastroesophageal reflux to prevent aspiration pneumonia. A PEJ may also be useful for patients with severe gastroparesis.

Gastrostomy tubes are generally easier to manage than nasogastric tubes and better tolerated by the patient, but this should not mean that everyone needing enteral nutrition (and unable to use the standard oropharyngeal route) needs a PEG. Many patients will have transient problems that interfere

with feeding and can be best managed by a small calibre nasogastric tube. There are patients who are extremely ill and who will need long term feeding via a tube if they survive, but they should not have a PEG or PEJ placed until their status as a likely long term survivor has been clearly established. The ethics of placing PEG tubes in patients who cannot participate in medical care decisions need to be carefully considered on a case-by-case basis.

CONTRAINDICATIONS

PEGs are relatively contraindicated in patients with known severe gastroesophageal reflux. A PEJ should be considered though reflux may not be totally prevented, even with the feeding tube placed well into the small bowel (10,11). Obesity is also a relative contraindication to PEG placement since the stomach may be harder to identify and the introducer needle in the PEG kit is not very long. One must be cautious about PEG and PEJ placements in demented patients because they may pull the tube out before the tract has matured and cause peritonitis.

Ascites of any amount will make PEG placement moderately risky. The stomach may be difficult to locate, the ability of the stomach to form a good seal with the abdominal wall can be a long, delayed process and there may be prominent varices in the body of the stomach which could bleed if they are inadvertently pierced with the introducer needle. The infection risk also is increased in patients with cirrhosis and ascites.

Patients who have had partial gastrectomies may have a PEG successfully placed in the residual gastric pouch. However, the pouch may be difficult to enter because of its small size or location above the rib margin. There is also a higher risk that a loop of bowel will be adherent to the gastric remnant from the prior surgery. Occasionally one must enter the efferent or afferent limb of a gastrojejunostomy or gastroduodenostomy due to the location of the stomach.

Patients who are poorly nourished are often in need of a PEG to improve their condition, but the risk of com-

plications – especially nonhealing of the gastrostomy tract – is higher. This is also true of patients who are immunocompromised and especially those on prednisone.

SURGICAL VERSUS ENDOSCOPIC GASTROSTOMY TUBES

A surgically placed G-tube may be associated with a high amount of morbidity and mortality (6 to 72%) of which some may be related to the severity of the underlying conditions in these patients; however, the author and others have felt that the use of general anesthesia increases the rate of complications. When compared prospectively, a surgical gastrostomy (Stamm method) performed with local anesthesia and minimal sedation is equal to a PEG (20-22). Both have total complication rates of about 25%. However, the time to perform a PEG is considerably less, as is the cost especially since the introduction of G-tubes that do not require a second endoscopy to remove the tube if it should fail or no longer be needed.

REFERENCES

1. Mamel JJ. Percutaneous endoscopic gastrostomy. *Am J Gastroenterol* 1989;84:703-10.
2. Gauderer MWL, Ponsky JL, Izant RJ. Gastrostomy without laparotomy: A percutaneous endoscopic technique. *J Pediatr Surg* 1980;15:872-5.
3. Ponsky JL, Gauderer MWL. Percutaneous endoscopic gastrostomy: A nonoperative technique for feeding gastrostomy. *Gastrointest Endosc* 1981;27:9-11.
4. Hogan RB, DeMarco DC, Hamilton JK, Walker CO, Polter DE. Percutaneous endoscopic gastrostomy – To push or pull. A prospective randomized trial. *Gastrointest Endosc* 1986;32:253-8.
5. Russell TR, Brotman M, Norris F. Percutaneous gastrostomy: A new simplified and cost-effective technique. *Am J Surg* 1984;148:132-7.
6. Halkier BK, Chia-Sing H, Yee ACN. Percutaneous feeding gastrostomy with the Seldinger technique: Review of 252 patients. *Radiology* 1989;171:359-62.
7. Saini S, Mueller PR, Gaa J, et al. Percutaneous gastrostomy with gastrostomy: Experience in 125 patients. *Am J Radiol* 1990;154:1003-6.

8. Coleman CC, Coons HG, Cope C, et al. Percutaneous enterostomy with the Cope suture anchor. *Radiology* 1990;174:889-91.
9. Foutch PG, Talbert GA, Gaines JA, Sanowski RA. The gastrostomy button: A prospective assessment of safety, success and spectrum of use. *Gastrointest Endosc* 1989;35:41-4.
10. Kaplan DS, Murthy UK, Linscheer WG. Percutaneous endoscopic jejunostomy: Long-term follow-up of 23 patients. *Gastrointest Endosc* 1989;35:403-6.
11. DiSario MA, Foutch PG, Sanowski RA. Poor results with percutaneous endoscopic jejunostomy. *Gastrointest Endosc* 1990;36:257-60.
12. Wolfsen HC, Kozarek RA, Ball TJ, Patterson DJ, Botoman VA. Tube dysfunction following percutaneous endoscopic gastrostomy and jejunostomy. *Gastrointest Endosc* 1990;36:261-3.
13. Jonas SK, Niemark S, Panwalker AP. Effect of antibiotic prophylaxis in percutaneous endoscopic gastrostomy. *Am J Gastroenterol* 1985;80:438-43.
14. Wag A, Miskowitz P. The efficacy of prophylactic antibiotics in percutaneous gastrostomy. *Gastrointest Endosc* 1987;33:165.
15. Behrle KM, Dekovich AA, Ammon HV. Spontaneous tube extrusion following percutaneous endoscopic gastrostomy. *Gastrointest Endosc* 1989;35:56-8.
16. Shellito PC, Malt RA. Tube gastrostomy. Techniques and complications. *Ann Surg* 1985;204:180-5.
17. Ditesheim JA, Richards W, Sharp K. Fatal and disastrous complications following percutaneous endoscopic gastrostomy. *Am Surg* 1989;55:92-6.
18. Larson DE, Burton DD, Schroeder KW, DiMaggio EP. Percutaneous endoscopic gastrostomy. Indications, success, complications, and mortality in 314 consecutive patients. *Gastroenterology* 1987;93:48-52.
19. Kirby DF, Craig RM, Tsang T-K, Plotnick BH. Percutaneous endoscopic gastrostomies: A prospective evaluation and review of the literature. *J Parenter Enteral Nutri* 1986;10:155-9.
20. Shellito PC, Malt RA. Tube gastrostomy. Techniques and complications. *Ann Surg* 1985;201:180-5.
21. Grant JP. Comparison of percutaneous endoscopic gastrostomy with Stamm gastrostomy. *Ann Surg* 1988;207:598-603.
22. Stiegmann GV, Goff JS, Silas D, Pearlman N, Sun J, Norton L. Endoscopic versus operative gastrostomy: Final results of a prospective randomized trial. *Gastrointest Endosc* 1990;36:1-5.