New Approaches to Percutaneous Gastrostomy

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ABSTRACT

Novel approaches to percutaneous gastrostomy have evolved because of catheter clogging and displacement, which is commonly seen with currently available gastrostomy catheters. Low-profile button gastrostomy catheters, designed to be inserted into mature tracts, have recently been inserted into fresh gastrostomy tracts. Catheter clogging rarely occurs with these low-profile devices. Catheter displacement remains a problem but new buttons can be inserted at the patient's bedside without the need for a return visit to the radiology department. A 90 to 100% success rate has been shown for placement of gastrostomy buttons. Pull-type endoscopic gastrostomy catheters can be placed radiologically using a standard puncture of the stomach and cannulation of the gastroesophageal junction. A guide wire is manipulated up the esophagus and out the mouth. The pull-type gastrostomy catheter is then attached and pulled down through the esophagus and out through the anterior abdominal wall. These catheters have very good retention devices and rarely become dislodged. Catheter clogging is also rarely seen, provided larger devices are used. Radiological placement of percutaneous endoscopic gastrostomy tubes has been termed the "hybrid method" and has been shown to be cheaper than endoscopic and other fluoroscopic methods of gastrostomy.

KEYWORDS: Percutaneous gastrostomy, button gastrostomy

Objectives: Upon completion of this article, the reader will be able to (1) outline the new approaches to percutaneous gastrostomy that include the use of various "button" gastrostomy catheters and devices, and (2) describe the per oral placement of "pull-type" endoscopic gastrostomy catheters.

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Since their development about 25 years ago by Ponsky and Gauderer, percutaneous gastrostomy tubes have become well-accepted means of providing enteric access for patients with inadequate oral intake.¹ Originally conceived as a way to supply hydration and nourishment to neurologically impaired children, today

gastrostomy tubes are frequently placed in the adult patient population. Percutaneous gastrostomy is a widely accepted method of enteral nutrition because of its low morbidity and high success rate and the fact that it can be performed under local anesthesia and sedation. Several different placement techniques have been described and

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include surgical, endoscopic, percutaneous radiologic, and varying combinations of all three. Familiarity with the advantages and disadvantages of each type maximizes the potential benefit to patients. We discuss the new approaches to gastrostomy tube insertion under fluoroscopic guidance, including the technique of insertion, results from the literature, and gastrostomy-related complications.

GASTROSTOMY CATHETERS

Initially, Foley catheters or abscess drainage-type catheters were used for gastrostomy. In our experience these catheters have an increased incidence of tube leakage, breakage, and migration. In early reports, Deutsch and colleagues routinely used large-calibre (16-F) nephrostomy catheters with self-retaining locking pigtail loop.² Hicks and associates³ abandoned the use of Foley catheters in favor of smaller (12- to 14-F) Cope-loop catheters due to a high complication rate associated with Foley catheters. Peritubal leakage, catheter occlusion, and dislodgment were the most frequent complications associated with traditional gastrostomy catheter placement. These problems forced the development of new approaches to optimal gastrostomy tube type and insertion. New developments such as gastrostomy button placement or endoscopic tube placement (hybrid gastrostomy) were introduced to achieve problem-free long-term enteral feeding.

BUTTON GASTROSTOMY

Button gastrostomy catheters were primarily designed to be inserted into mature gastrostomy tracts. Recently, button placement has been reported as a single-step gastrostomy procedure.⁴⁻⁸ In particular, button gastrostomy tubes are a useful alternative to the traditional gastrostomy tube for the pediatric population⁷ and adult patients with neurologic disease.⁸ Patients favor its low-profile design and more aesthetic nature.

Buttons are also more difficult for confused patients to remove, and because of their short tube length, buttons are less prone to clogging.

TYPES OF BUTTON GASTROSTOMY

Button gastrostomy catheters are shorter in length than traditional gastrostomy catheters, and consist of a low-profile tip (internal anchor) and a surface button (external anchor). The selection of the type of button gastrostomy depends mainly on availability and operator preference. Currently there are two main groups of gastrostomy buttons. The first group has a mushroom tip (Bart Button, Abbott, Sligo, Ireland), and the second has a retention balloon (Mic-Key[®]G[™], Ballard Medi-

Figure 1 Button-type retention balloon catheters. The Vygon button (Ballard Medical Systems, Draper, UT) is shown on the left and the Cubby (CORPAK Medical Systems, Wheeling, IL) on the right.

cal Systems, Draper, UT), (CORFLO-Cubby, CORPAK Medical Systems, Wheeling, IL). See Figure 1.

Mushroom-Retained Gastrostomy Buttons

The tip of the mushroom-type button has no end hole and can be introduced only by stretching the tip with an obturator. The antireflux valve is in the internal part of the tube, which contributes to the lower profile of the external anchor. They are more durable and have better longevity when compared with the retention balloon-type buttons (Fig. 2). However, we have not been able to place these mushroom buttons in fresh tracts due to the facts that they have no end hole and the mushroom tip, despite being stretched by the obturator, remains quite

Figure 2 Mushroom-type button (Abbott Laboratories, Sligo, Ireland). The mushroom button does not have an end hole and is best reserved for mature gastrostomy track.

bulky. At present, we believe that the mushroom button catheter is best reserved for mature tracts.

Retention Balloon-Type Gastrostomy Buttons

In contrast, the balloon retention catheters have an opening at the tip, which makes them easier to place. In the vast majority of patients they can be replaced when necessary by a nonmedical caregiver.

The CORFLO Cubby low-profile gastrostomy device is a silicone balloon-retention gastrostomy catheter whose surface both offers comfort and reduces stomal irritation. It has an extremely short tip and ergonomically designed right angle for bolus feeding connectors. It is available in six sizes (12- to 24-F) with a variety of shaft lengths between 1.0 and 4.5 cm. The MIC-Key[®] GTM gastrostomy buttons are similar to CORFLO Cubby buttons and also come in a variety of lengths (2 to 4.5 cm.) and sizes (12- to 24-F.)

INSERTION TECHNIQUE

When inserting a button gastrostomy catheter, patient preparation is similar to that of a standard gastrostomy procedure. We believe that gastropepy is mandatory.⁸ We insert four T-fasteners (Boston Scientific, Natick, MA) into the gastric antrum at the corners of a 2-cm square around the site of the proposed gastrostomy catheter insertion site. Tract length calculation is of critical importance when placing gastrostomy catheters. This is performed by inflating a standard angioplasty balloon catheter within the gastric lumen. We use a 6-mm × 40-mm angioplasty catheter balloon for a 14-F button, a 7-mm × 4-cm angioplasty balloon catheter for a 16-F button, or an 8-mm × 4-cm angioplasty balloon catheter for an 18-F button. The angioplasty balloon catheter is inserted over a 0.035-inch Super-Stiff guide wire (Boston Scientific, Galway, Ireland). The inflated balloon is pulled back until it abuts the anterior abdominal wall. The catheter is held at the skin insertion site between the operator's thumb and forefinger. The catheter is then deflated and withdrawn over the guide wire. The balloon is reinflated and the distance between the operator's finger and the proximal end of the balloon is measured. This distance yields the tract length. The gastrostomy tract can then be dilated using the same angioplasty balloon catheter.

A button gastrostomy, which is 5 mm longer than the measured tract length, is chosen for placement. Telescoping a 6- to 8-F dilator into the button gastrostomy catheter as well as applying abundant lubrication (Instillagel; Farco-Pharmo, Cologne, Germany) over both the dilator and the gastrostomy catheter help to slide the button into the stomach over the guide wire. At this point the guide wire is removed. After placement, the gastrostomy retaining balloon is inflated with the

recommended amount of water or saline, and an intragastric position is confirmed by injecting contrast material through the dilator, which is pulled back so that its tip lies in the lumen of the button catheter (Fig. 3).

Results

The success rate of button gastrostomy insertion approaches 90 to 100% as shown by recent papers.⁷⁻¹² Lyon and coworkers,⁸ using interventional radiology techniques, described a 98% technical success rate in de novo placement of button gastrostomy catheters in fresh tracts. Borge and associates reported a 93% success rate when placing button catheters in mature gastrostomy tracts.¹⁰ The major difficulties encountered when placing these types of catheters include suboptimally dilated immature gastrostomy tracts and underestimation of tract length.

Reported complications with button gastrostomy catheters are comparable to those described for other gastrostomy tubes. Serious complications such as gastrocolocutaneous fistula and peritonitis have been reported. Fatalities have been described with underestimated mature tract length leading to tract rupture on filling the retention balloon.¹³

Operators who commonly use button gastrostomy catheters believe that they are less prone to occlusion.^{8,9} Patients with recurrent catheter dislodgment require review and modification of the tube. These patients may benefit from larger-bore catheters with retention balloons, or possibly more-durable silicone-type feeding catheters.¹¹

PER ORAL PLACEMENT OF PULL-TYPE ENDOSCOPIC GASTROSTOMY CATHETERS

Long-term problems associated with gastrostomy catheters with pigtail or balloon-type retention mechanisms encouraged some authors to deal with these problems by inserting endoscopic catheters under fluoroscopic guidance. These percutaneous endoscopic gastrostomy (PEG) tubes have secure retention devices and do not tend to become dislodged.

The percutaneous pull-type gastrostomy approach allows placement of larger-bore self-retaining tubes. This technique combines the advantages of fluoroscopic guidance with those of pull-type gastrostomy tubes, which are typically placed by endoscopists. This procedure has been termed a hybrid PEG/PRG gastrostomy.

Patient preparation for the hybrid procedure is similar to that for PRG, but all patients must receive prophylactic intravenous antibiotics prior to the procedure. The stomach is punctured with an 18-G Seldinger

Figure 3 The placement of a balloon-retention button gastrostomy catheter, in a fresh gastrostomy track. (A) After T-fastener gastropexy, stomach puncture is performed with the T-fastener needle and a Super-Stiff guide wire inserted in the stomach. A balloon angioplasty catheter is inserted over the guide wire, and the balloon inflated in the stomach lumen. The balloon is then pulled back against the anterior abdominal wall and the operator grips the shaft of the balloon at the skin insertion site between thumb and forefinger. (B) The balloon is deflated and removed over the guide wire. The balloon is reinflated outside the patient's abdomen, and the track length is obtained by measuring the distance between the thumb and forefinger of the operator's hands to the proximal marker on the balloon. An extra 5-mm track length is allowed as per the manufacturer's instructions. (C) The balloon is then reinserted into the track and inflated to dilate the percutaneous track. (D) The balloon has been inflated in the track. Note the waist (arrow). Balloon inflation until the waist disappears is necessary for complete track dilation. A single large dilator may be necessary in some cases if balloon dilatation is not adequate. (E) The balloon is mounted on a small-calibre dilator for insertion over the guide wire into the stomach. Abundant lubrication is used to facilitate easy passage of the balloon. If the balloon does not "pop" into the stomach, a dilator is used for final track dilatation. (F) A lateral view shows the balloon button (arrow) within the air-filled gastric lumen. Confirmation of intragastric position is achieved by pulling the dilator back into the lumen of the button and injecting contrast material.

Figure 4 Hybrid PEG catheter placement. (A) The stomach is inflated and punctured with a Seldinger needle. A 6- to 8-F vascular sheath is inserted. (B) A 5-F angiographic catheter is used to cannulate the gastroesophageal junction, and catheter and guide wire are negotiated out through the mouth (arrow). (C) A gooseneck snare is manipulated from the mouth, through the catheter, and out through the sheath in the anterior abdominal wall. (D) The gooseneck snare is used to pull a long suture (provided in the kit) through the sheath and out through the mouth. The loop suture on the end of the gastrostomy tube (arrow) is attached to the long suture, pulled through the stomach. (E) The gastrostomy tube is then pulled through the patient's mouth and out through the skin of the anterior wall. The proximal end of the tube is tapered, so that it pulls easily through the anterior abdominal wall. (F) The end of the catheter is then cut to an appropriate length and a hub attached. There is an outer bumper, which is also pushed down over the shaft of the catheter to keep the tube firmly in place.

needle, and a standard 0.035-inch guide wire is coiled in the fundus of the stomach. We do not perform a gastropexy when using this approach. A 7-F vascular sheath is inserted over the guide wire, and a curved 5-F angiographic catheter is used to catheterize the gastroesophageal junction. A 0.035-inch hydrophilic guide wire is inserted through the esophagus and out through the mouth. The catheter is then removed, and a 4-F gooseneck snare inserted (Amplatz Goose Neck Snare Kit, Boston Scientific, Galway, Ireland) from the mouth so that it exits at the abdominal puncture site. A long suture (Flexiflo[®], DURA-PEG[™] Kit; Abbott Laboratories, Sligo, Ireland) is then firmly attached to the snare and both are pulled through the sheath and out through the mouth. Both the snare and catheter are removed at this point. The suture is attached to a loop suture on the end of the gastrostomy tube and the gastrostomy tube is then pulled down through the esophagus until it exits at the skin surface. The retention bumper is pulled firmly against the anterior abdominal wall, and a further external anchor is pushed down over the outside end of the tube. The catheter is then cut to the desired length and the feeding port attached. The position of the tube is checked by injecting contrast material through the tube (Fig. 4).

There are two main types of endoscopy tubes that are used for these hybrid procedures, namely, those with a mushroom retaining device, and those with a bumper device. We use the Flexiflo[®] DURA-PEG[™] with a reinforced webbed bumper. Its design incorporates a tapered dilator with a diameter that is never any larger than the diameter of the tube shaft, thus avoiding over dilatation of the gastrostomy tract.

Results

Szymiski and colleagues evaluated placement of large-bore, self-retaining, pull-type gastrostomy tubes under radiologic guidance in 64 patients and reported a 98% success rate.¹⁴ Major complications occurred in 3 patients (5%), and these were due to exit site infection and prolonged bleeding. One of these patients subsequently developed necrotizing fasciitis. In addition, there was a single case of tube migration and one case of inadvertent tube removal. Over an 18-month follow-up period, no pull-type catheters required exchange. In addition, 7 jejunal extension tubes were placed, 5 of which were positioned during the initial procedure.

In a pediatric population of 85 children and young adults, Cahill and associates described pull-type gastrostomy tube placement.¹⁵ They then proceeded to perform jejunostomy tube placements in 57 of these 85 children within 24 hours of the primary gastrostomy insertion. The authors established the "push-pull" gastrostomy technique as a procedure of choice in this group

of patients in whom the classic antegrade method is not possible.

Clark and coworkers described a 97% success rate with radiologic per oral gastrostomy placement in their group of 30 patients.¹⁶ They had four minor complications, which included one lip laceration, one exit site infection, and two inadvertent tube dislodgments. They did not encounter any major complications either during or after the procedure.

Laasch and colleagues prospectively compared PEG ($N=50$) with radiologically inserted gastrostomy (RIG) ($N=50$) and the hybrid gastrostomy technique ($N=60$), which they referred to as PIG (per oral image-guided gastrostomy).¹⁷ Their technical success rate was reported as 98%, 100%, and 100%, respectively. There were 24 patients in their group in whom PEG insertion could not be performed. Tube replacement was required in 12% of the PEG procedures and 20% of the RIG procedures due either to tube blockage or displacement. None of the PIG catheters required replacement at the time of publication. Laasch and colleagues concluded that PIG was superior to both of the two more traditional methods, combining a 100% technical success rate with better long-term results.

In addition, they also found the hybrid method of gastrostomy placement to be cheaper than either endoscopic or fluoroscopic techniques. This was due to the more expensive nature of RIG tubes and the use of T-fasteners, which is not required in the hybrid technique.

CONCLUSION

At this point in time, the interventional radiologist is in a unique position. Standard gastrostomy tubes, gastrostomy button catheters, or PEG tubes can be placed by the interventional radiologist. The choice of gastrostomy catheter can be decided after discussion with the patient or the patient's family or caregiver.

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