Efficacy and Safety of Percutaneous Radiological Gastrostomy (PRG) as a Rescue Measure for Enteral Feeding in Patients with Advanced Head, Neck, and Upper Digestive Malignancies

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Abstract

Background Percutaneous radiologic gastrostomy is an established mode of enteral feeding for nutritional support for patients with dysphagia from upper digestive tract malignancy. Its role as a rescue measure in patients with advanced malignancy, presenting with absolute dysphagia and failure of nasogastric tube insertion has not been well established.

Purpose This study was performed to assess technical success and long-term outcomes of percutaneous radiologic gastrostomy (push type) for nutritional support for patients with absolute dysphagia as a last ditch nonsurgical rescue effort for enteral access.

Materials and Methods This was a prospective observational study of 31 patients who underwent push-type percutaneous radiologic gastrostomy over a period of 2 years (March 2017–March 2019). The study was a part of a larger trial approved by the institutional ethics committee. Patients were followed till the removal of tube, death, or 1 year, whichever was earlier. Gastrostomy tube-related problems and complications were documented. Descriptive summary statistics were employed to analyze the success rate and complications.

Keywords
- gastrostomy
- head and neck cancer
- esophageal cancer

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Results Thirty-one patients with mean age 56 years (26–78 years) including 18 males and 13 females with head and neck squamous cell cancer and esophageal cancer presenting with absolute dysphagia or significant dysphagia with failed nasogastric or endoscopic enteral access were included. Overall technical success was 93.5% (29/31), achieved in 26/31 patients with just fluoroscopy guidance and 3/5 patients with computed tomography guidance. One major (3.3%) and two minor (6.5%) complications were encountered. Five out of 29 gastrostomy tubes had to be exchanged, after a mean of 44 days (1–128 days) after insertion.

Conclusion Percutaneous radiologic gastrostomy is a safe and effective intervention even as a rescue measure in patients with absolute dysphagia from advanced upper digestive tract malignancies.

Introduction

Head and neck squamous cell cancer (HNSCC) is the second most common (10.4%) cancer in India.[1] Standard of care is a combination of surgery, radiation, or chemotherapy. Majority of these patients have dysphagia at presentation depending on the tumor location and stage.[2] Additionally, these patients are at risk of developing dysphagia during treatment, whether it is surgical, chemotherapy, or radiation (►**Fig. 1**). Possible mechanisms include posttreatment edema, nerve damage, mucositis, and fibrosis.[3] Patients with advanced upper digestive tract malignancy, particularly esophageal cancers present with significant dysphagia. Apart from being malnourished at presentation, they are at risk to lose further weight during treatment and therefore frequently require accessory nutritional support. There is no clear consensus in literature on optimal enteral feeding method for these patients.[4]

Our institutional protocol includes rescue/reactive nasogastric tube feeding in patients with head and neck cancer having significant dysphagia, either at presentation or during treatment. This is driven by several factors including cost, background living conditions of the patient, and safety of the procedure. We treat a lot of economically disadvantaged patients who present with advanced malignancies. Therefore, the standard practices and protocols differ from institutions in the west. In such patients presenting with absolute dysphagia or large tumor (T3/T4 disease) burden, nasogastric tube insertion may fail. For the same reason, these patients are also not candidates for percutaneous endoscopic gastrostomy (PEG). Unsurprisingly and unfortunately, these patients are not surgical candidates as well and do poorly with general anesthesia. Percutaneous radiologic gastrostomy (PRG) is often a last resort/rescue for these patients. Although the safety and efficacy of prophylactic gastrostomy has been well established in patients with patent upper digestive tract,[5] the data on rescue gastrostomy is limited. Even radiologic gastrostomy, which typically has a higher success rate, is technically challenging in this patient subset and requires several modifications. The procedure is often a palliative measure to reduce the rate of cancer cachexia. We planned to evaluate the safety and efficacy of PRG as a rescue measure for enteral feeding in this subset of patients.

Methodology

This was a prospective study to assess the technical success and long-term outcomes of PRG as a rescue measure for enteral feeding in patients having advanced upper digestive tract malignancies. Institutional ethics committee approval was obtained as a part of larger randomized controlled trial comparing PRG with nasogastric tube insertion. This trial was funded by an institutional intramural grant. During the course of the trial, we realized that a large subset of patients referred to us were those with advanced malignancies and T3/T4 disease who had failed an attempt of nasogastric tube insertion. We present our experience with rescue PRG in these patients. Patients with advanced HNSCC and esophageal cancer with absolute dysphagia or prior failed attempts of nasogastric tube placement/endoscopic gastrostomy were considered for this study. Patients with Eastern Cooperative Oncology Group (ECOG) status 2 at presentation or uncorrectable coagulopathy were excluded.

After inclusion, all patients underwent a contrast-enhanced computed tomography (CT) scan of neck, chest, and abdomen, if they already did not have one within 4 weeks of planned procedure. The information available from the CT was used to scrutinize and prepare for anticipated difficulties as detailed in ►**Table 1**.

As a first step of the procedure, a nasogastric catheter was placed by crossing the neoplastic mass/stricture using a combination of angiographic catheters and wires, and access to stomach was gained with 5 or 6 Fr catheters for insufflation. Procedure was usually done under moderate analgesia with intravenous fentanyl and local anesthesia in the presence of an anesthesiologist due to the high risk of aspiration in these patients. Prophylactic antibiotics were administered in all patients. Push-type PRG was done after T-fastener gastropexy using the technique adapted from Thornton et al[6] and described in ►**Table 2** with illustrations in ►**Fig. 2A–H**. If this was not successful, a CT-guided approach adapted from Tyng et al[7] was employed as detailed in ►**Table 3** and illustrated in ►**Fig. 3A–C**. We placed 20 Fr balloon retention gastrostomy tubes in all patients, which is large enough to allow for a home-based liquefied diet meeting nutritional requirements without additional formula cost. Patients who underwent PRG were admitted

Fig. 1 Clinical photograph showing extensive stomatitis and mucositis of the oral cavity after chemoradiation for head and neck squamous cell cancer (HNSCC) of tongue. Patient had advanced dysphagia at presentation.

overnight for observation. Tube feedings were started 8 hours after gastrostomy placement and serial abdominal clinical exams were done to check for potential immediate complications. Primary outcomes included technical success and complication rates. Patients were followed, till the removal of tube, death, or 1 year whichever was earlier. All delayed tube-related complications were recorded and addressed.

Video 1

Fluoroscopy clip in 45 degrees left anterior oblique (LAO) projection showing indentation of gastric wall as a radiographic density over the needle tip followed by needle entry into gastric lumen and contrast instillation opacifying-dependent gastric rugal folds. Online content including video sequences viewable at: https://www.thieme-connect.com/products/ejournals/html/10.1055/s-0042-1750154.

Results

The study was funded by an institutional intramural grant. A total of 34 patients were included in the study with eventual exclusion of 3 patients due to being lost to follow-up. Mean age was 56 (26–78) years with 18 male and 13 female patients. Twelve patients presented with absolute dysphagia with an average duration of 4 days (1–16 days) and 19 patients presented with previous failed attempts of nasogastric/endoscopic enteral access and dysphagia to both solids and liquids. Sixteen patients had ECOG score of 1 and 15 patients had ECOG score of 2. Eighteen patients had HNSCC, while 13 patients had esophageal cancer. Technical success was achieved in 29 out of 31 patients. Technical success could be achieved with fluoroscopy in 26 out of 31 and with an eventual step-up CT guidance in 3 out of 5 patients, who had failed an attempt under fluoroscopy. In all these patients, we failed to cross the tumor to get initial nasogastric access for insufflation. Dilute contrast was used to inflate balloon for identification on future radiologic procedures (►**Fig. 3C**).

One patient developed signs of peritonitis 12 hours after procedure and was found to have extragastric peritoneal placement on follow-up CT (►**Fig. 4**). This patient underwent exploratory laparotomy and repair of gastric perforation, and a surgical jejunostomy placement with a week-long hospital course before being discharged in a stable condition. Two patients develop peristomal infections which required short-term readmission (less than 3 days) and treatment with intravenous antibiotics (►**Fig. 5**). These complications are categorized as per the new Society of Interventional Radiology (SIR) adverse event severity scale[8] in ►**Table 4**. Five out of 29 gastrostomy tubes had to be replaced after a mean of 44 days (1–128 days) after insertion due to variable reasons including balloon deflation during maneuvering in 2 patients (►**Fig. 6**), accidental balloon deflation by needle during peristomal collection aspiration in 1 patient, occlusion refractory to flushing in 1 patient, and tube catheter breakage/dysfunction leading to leakage in 1 patient. These tubes could be easily exchanged since we left the T-fasteners in place, which would spontaneously dissolve over 2 weeks and the tract would usually be reasonably matured after 2 weeks. As seen in ►**Fig. 6**, if balloon deflation and tube dislodgement occur while the T-fasteners are intact, a new tube could easily be threaded over a stiff wire access. In one

Table 1 Findings on contrast-enhanced CT which are potential problems for a safe percutaneous gastric access

• Presence of cirrhosis, portal hypertension and associated abdominal wall, gastric/esophageal varices
• Presence and amount of ascites or peritoneal deposits/tumor extension particularly along the anterior wall of the stomach
• Large hiatal hernia or prior foregut surgeries like gastric bypass or gastrectomy
• Organs interposed between stomach and anterior abdominal wall, like colon, enlarged spleen or liver, distended small bowel, which may complicate the percutaneous puncture of stomach. Although stomach will usually distend resulting in caudal and anterior shift of the anterior wall, a rough estimate ensuring a safe percutaneous access is usually helpful
• Any vascular abnormalities with special emphasis on course of superior epigastric and right gastroepiploic artery or abdominal wall varices

Abbreviation: CT, computed tomography.

Table 2 Our step-by-step approach for push-type fluoroscopy-guided percutaneous gastrostomy insertion

Step 1	Outline of the left lobe of liver is marked on skin using ultrasound followed by cleaning and draping the left epigastric region. Stomach is insufflated with room-air through the nasogastric catheter till distension under intermittent fluoroscopy. Three access sites in the shape of a small triangle are marked on the skin directly above the body of the stomach equidistant from either curvature. These should be between left hepatic lobe outline and palpable left costal margin
Step 2	On fluoroscopy, position of colon away from the access sites is confirmed. The C-arm is rotated so that X-ray tube is angled at $>$ 45 degrees away from the operator and after adequate local anesthesia, 3 T-fasteners are inserted into the stomach at respective access sites under fluoroscopy guidance with a controlled brisk push (►**Fig. 2A**, ►**Video 1**, online only)
Step 3	In-stomach positioning is confirmed by aspirating air into a syringe filled partially with contrast and then further confirmed by injecting small volume of contrast with opacification of dependent (fundal) gastric rugal folds (►**Video 1**, online only)
Step 4	After 3-point fixation/gastropexy of the stomach (►**Fig. 2B, C**), an 18-G needle is inserted in the center of the triangle repeating the intragastric confirmation protocol, followed by insertion of a $>$ 0.032'' stiff Amplatz guidewire
Step 5	The guidewire is coiled within the fundus and body of stomach to get better purchase into the lumen of the stomach (►**Fig. 2D**). The access site is further widened using a through-and-through stab of a number 11 blade and sometimes even wider. This is a crucial step and the incision should be around 1.5 cm wide without approaching any of the gastropexy sites
Step 6	The sequential dilator (►**Fig. 2E**) or multiple graded dilators with the widest having diameter 2–4 Fr more than the expected size of gastrostomy tube are used to dilate the tract over a stiff Amplatz guidewire. The access angle can be made more acute while dilating and the dilators should be directed toward left shoulder/gastric fundus for better purchase. Dilatation of the tract should be done under fluoroscopy
Step 7	After dilatation with 24 Fr sequential dilator, the 20 Fr gastrostomy catheter is inserted through the outer peel-away sheath. The outer sheath should have reasonable purchase in the stomach maintaining the acute entry angle and should not be peeled open before completely negotiating the gastrostomy catheter into the stomach (►**Fig. 2F**). If there is only 2 Fr difference in the size of peel away sheath and catheter (24—22 Fr combination), the catheter might benefit from inner coaxial stiffer dilator support for negotiating a tighter sheath, all over a stiff guidewire. Losing access at this point could lead to peritonitis and it is critical to maintain stiff guidewire access. We had one case of balloon damage due to aggressive insertion attempts and therefore a sheath-catheter diameter difference of 4 Fr is preferred
Step 8	After negotiating gastrostomy catheter for a reasonable length within the stomach, the peel away sheath is slowly peeled off while advancing or maintaining gastrostomy catheter to about half the length of sheath. After ensuring catheter insertion beyond the outer sheath, gastrostomy balloon is inflated with dilute iodinated contrast up to 6–10 mL based on catheter size
Step 9	The outer sheath is completely peeled off and the gastrostomy catheter is pulled till the inner balloon is flushed with gastric wall. A retainer on the outside is slid over the catheter till its flush with the skin around the stoma
Step 10	Contrast is injected through one of the side ports of gastrostomy tube and opacification of gastric rugal folds confirms intragastric positioning. The gastrostomy site is cleaned and taped. The outer retainer should be just snug to skin and should not pucker the skin or be too tight. Note the appropriate centimeter mark of outer retainer on the tubing and communicate this to the nursing staff

patient, the tube fell out after a bout of aggressive coughing and could not be exchanged due to coronavirus disease-related travel restrictions. A rescue nasogastric tube was placed in a nearby local hospital instead, and the patient died after 1 week, allegedly owing to acute depression related to stigma and nasopharyngeal irritation from the tube. One patient was noted to have aspiration pneumonia during CT gastrostomy procedure, which was possibly due to recent onset absolute dysphagia and possibly unrelated to the procedure itself (►**Fig. 7**). One patient was noted to have gastric emphysema after CT-guided procedure, presumably from insufflation with needle opposed to the gastric wall, which remained clinically silent (►**Fig. 3A**). Among the patients who received a successful gastrostomy tube placement, 12 patients received further treatment with curative intent (surgery/definite chemoradiotherapy) while 19 patients received palliative treatment (palliative radiotherapy).

Discussion

PRG has been traditionally considered equally safe and effective as PEG and their choice depends on local practice patterns.[9,10] Nasogastric tube insertion and endoscopic

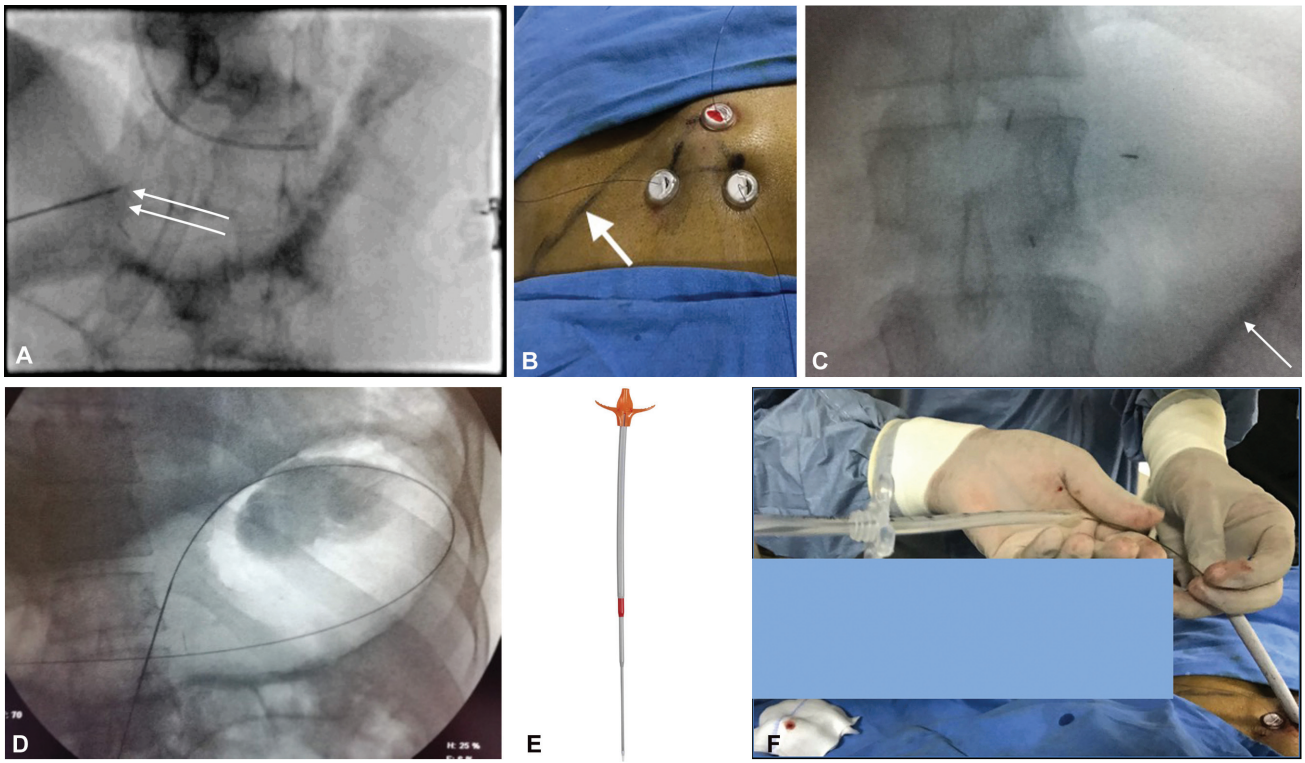

Fig. 2 (**A**) Oblique fluoroscopic image at roughly 45 degrees left anterior oblique (LAO) angulation with puncture needle indenting the gastric wall density (arrows) before giving away and entry of needle in the stomach. This confirmation of gastric wall indentation and entrance is important for technically robust procedure. The access can also be acquired in cross-table lateral projection. (**B**) Clinical photograph showing orientation of 3 T-fasteners in the configuration of a triangle. Note the marker delineation of right lobe of the liver (arrow). (**C**) Fluoroscopic image showing orientation of 3 T-fasteners in a triangle configuration. Notice the greater curvature (arrow) further away from positioning of T-fasteners which is important to prevent injury to gastroepiploic arteries. (**D**) Fluoroscopic image showing Amplatz stiff guidewire coiled within and outlining the fundus of the stomach and looping back toward the body. This is another confirmation of intragastric positioning. (**E**) Sequential dilator available in push gastrostomy kits. The outer most dilator acts as a peel away sheath. (**F**) Clinical photograph showing advancement of gastrostomy tube within the outer peel away sheath over a stiff guidewire. Notice the thumb tip covering the sheath tip to prevent decompression of stomach distended with air. Notice that the sheath has reasonable purchase within the stomach with tip directed toward the fundus of stomach.

Table 3 Our step-by-step approach for push-type CT-guided gastrostomy insertion

Step 1	After cleaning and draping the left epigastric region, between the left hepatic lobe marker and palpable left costal margin, a 22 Fr Chiba needle is used to gain access into the stomach and inject air to achieve optimal gastric distension (►**Fig. 3A**)
Step 2	Under CT guidance and after adequate local anesthesia, T-fastener needles are inserted into the stomach in an aforementioned triangular configuration under fluoroscopy guidance with a controlled brisk push
Step 3 through Step 10	These steps are similar to above, although under CT guidance (►**Fig. 3B, C**)

Abbreviation: CT, computed tomography.

gastrostomy is significantly more common due to limited availability of trained interventional radiologists. Among the techniques of PRG, a push technique was preferred in this subset owing to luminal compromise secondary to obstructive nature of the malignancy limiting per-oral passage of tube. Also, per-oral endoscopic/radiologic feeding tube placement has been associated with a minimal (0.5%) albeit serious risk of PEG site seeding/metastases[11] in upper aerodigestive tract cancer. PRG has been shown to be safe and efficacious for enteral access with a success rate as high as 98% in patients who have previously failed endoscopic gastrostomy placement, elucidating many specific scenarios by Thornton et al.[12] The scenarios elucidated are mostly related to altered postsurgical and unfavorable anatomy. We achieved a similar success rate of 93.5% (29/31) in our study despite working with a sicker group of patients with advanced malignancy and an occlusive/near-occlusive mass. Advanced recanalization techniques were employed to cross

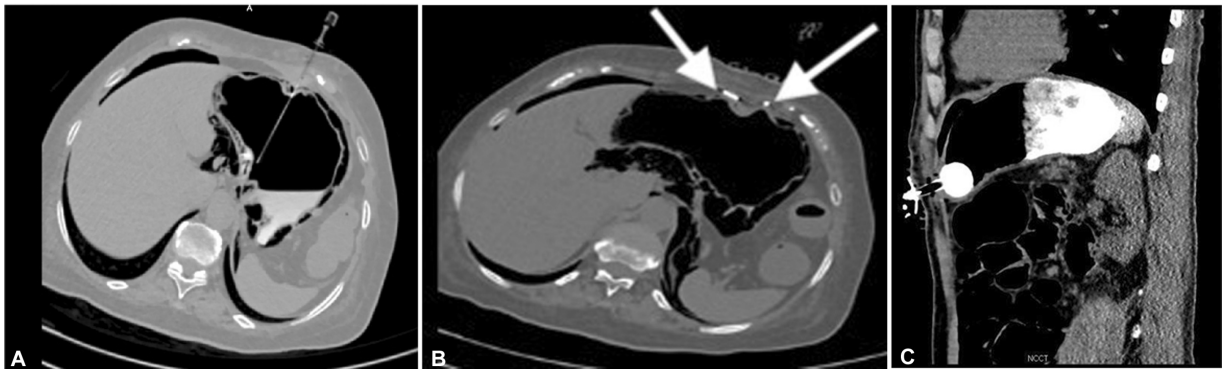

Fig. 3 (**A**) Axial computed tomography (CT) image through upper abdomen in lung window showing tip of the Chiba needle within the stomach distended with air. Moderate gastric emphysema and air within the lesser sac is also seen which were inadvertent due to needle tip positioning within and across gastric wall briefly during manipulation. (**B**) Axial CT image through upper abdomen showing tethering of gastric wall of anterior abdominal wall at the sites of gastropexy (arrows). (**C**) Sagittal reconstruction CT after CT-guided gastrostomy. The balloon of the gastrostomy tube (filled with dilute contrast) is noted within the stomach with mild nondependent pneumoperitoneum superiorly and layering contrast in the fundus of the stomach.

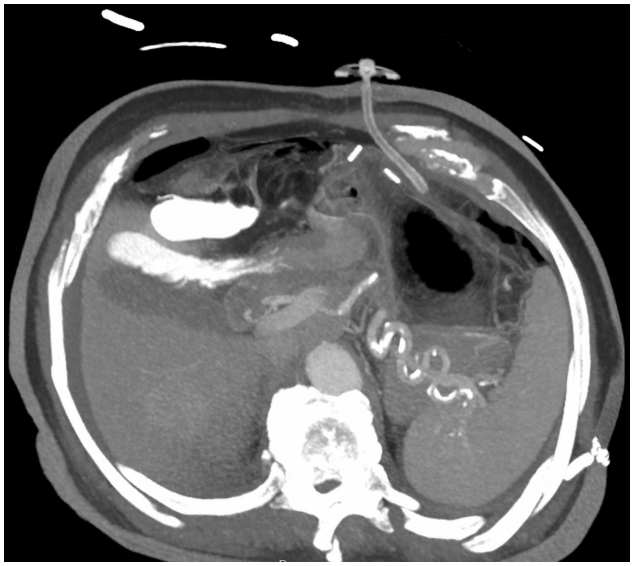

Fig. 4 Maximum intensity projection (MIP) axial computed tomography (CT) image showing deflation of the balloon previously filled with dilute contrast and tip of the gastrostomy tube lying outside the stomach with the T-fasteners noted in expected position. Only two T-fasteners were noted in this case and the third T-fastener was compromised during the procedure.

Fig. 5 Clinical photograph showing erythema, swelling, and peristomal purulent discharge concerning for peristomal infection.

the mass/narrowing under fluoroscopy and CT guidance as a last-ditch effort to place a successful enteral access in these patients.

Peritoneal placement as encountered in one of our patients is a complication mostly seen in push technique of gastrostomy and has been found in around 1.3% of

Table 4 Details of periprocedural complications as per SIR AE severity scale

Complications	Peritoneal mal-/displacement[1]	Peristomal infection[2]
Part A	Moderate AE requiring exploratory laparotomy	Mild AE requiring intravenous antibiotics for subcutaneous abscess
Part B	A. Causality: Category 3 B. Patient and procedural risk modifier: Category 2 C. Preventability: Category 2 D. AE management: Category 1	A. Causality: Category 3 B. Patient and procedural risk modifier: Category 2 C. Preventability: Category 2 D. AE management: Category 1

Abbreviations: AE, adverse event; SIR, Society of Interventional Radiology.

Fig. 6 Clinical photograph showing deflation of the retention balloon and external dislodgement of the gastrostomy catheter with all three T-fasteners intact and a healthy stoma. A gastrostomy catheter could be easily repositioned over a stiff guidewire under fluoroscopy.

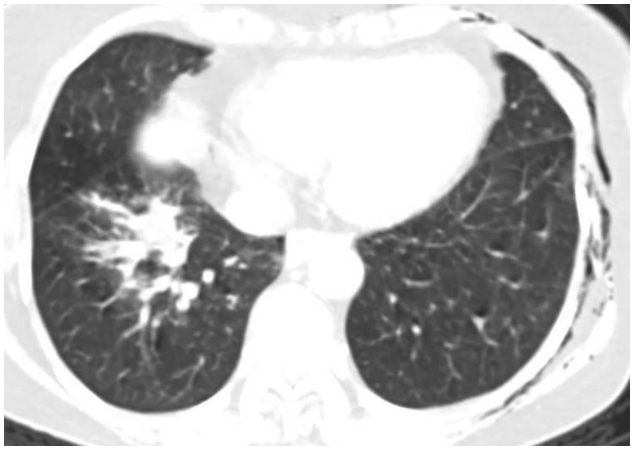

Fig. 7 Axial computed tomography (CT) through lung base showing area of peribronchial consolidation in right lung base consistent with aspiration pneumonia. Also noted is subcutaneous emphysema along left chest wall which can be seen postprocedure and is benign.

patients.[13] Our rate of 3.3% (1/31) is slightly higher than quoted in other large-scale studies which is possibly attributable to larger caliber (20 Fr) of the tube used in our study.

Deep stomal infection is more frequent in per-oral approach than a direct approach used in push-type PRG because of contamination by oral flora.[14] Working with a sicker group of patients, we routinely used preprocedural antibiotics which is in accordance with the SIR practice guidelines for push-type gastrostomy tube placement.[15] Strijbos et al also found PRG to have a higher procedural success rate than endoscopic alternative, although with higher postoperative pain.[10] There were some practical difficulties we encountered during the procedure. At the onset of our study we had difficulty in inserting the soft pliable 20 Fr gastrostomy tube, especially in negotiation of segment with deflated balloon even after adequate dilatation with 24 Fr sheath. In one of the patients, the balloon got damaged while inserting the tube and we had to replace the catheter. A few things which helped were using copious amount of jelly while inserting the gastrostomy tube, giving a deep skin incision at the site of gastrostomy insertion, and using a long 9 Fr sheath dilator to provide internal coaxial push to the gastrostomy catheter. Although similar to the other CT procedures that we perform routinely, CT-guided gastrostomy was a new procedure for us and our lack of prior experience might be attributable to our lower success rate with this procedure (60%, ⅗). We also had a relatively less aggressive approach with CT guidance, probably resulting in a lesser overall major complication rate (3.3%) as compared with that reported by Thornton et al.[12]

Conclusion

PRG is a safe and effective intervention even as a rescue measure in patients with absolute dysphagia from advanced upper digestive tract malignancies. Trained interventional radiologists are crucial to these procedures for their complexity and frequent use of CT guidance for success.

Conflict of Interest
None declared.

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