Percutaneous Radiologically-Guided Gastrostomy (PRG): Safety, Efficacy and Trends in a Single Institution

Dear Editor,

Percutaneous radiologically-guided gastrostomy (PRG) was first described in animal studies in 1983,[1] shortly after the first publication of percutaneous endoscopic gastrostomy (PEG) in human subjects in 1980.[2] Since then, PEG has been more widely adopted and considered the preferred standard of care.[3] Despite this difference in popularity, a recent meta-analysis[4] failed to show superiority of one technique over the other in terms of safety and efficacy.

Gastrostomy catheter insertion is usually indicated for long-term enteral nutrition in patients with difficulty maintaining adequate nutrition orally.[3] This includes patients with obstructive lesions of the upper aerodigestive tract or neurological conditions that impair swallowing.

PEG requires per-oral insertion of a flexible endoscope into the stomach, with transillumination through the upper abdominal wall to guide percutaneous placement of the gastrostomy catheter.[3] In contrast, PRG does not require endoscopy, instead relying on sonographic or fluoroscopic guidance. In our centre, all PRGs were inserted via the retrograde abdominal approach where T fasteners are inserted under fluoroscopic guidance into an inflated stomach before introducing the gastrostomy tube retrogradely[4] (Fig. 1). We perform the PRG under local anaesthesia only or with moderate to deep sedation.

Proponents of PRG state a higher technical success rate over PEG,[5,6] no absolute contraindication[7] and less procedural sedation required.[6-8] However, several studies have concluded that PRG results in a higher complication rate and mortality in comparison to PEG.[9-12] This study aimed to examine the safety and efficacy of PRG insertion performed in our centre.

Materials and Methods

We performed a retrospective review of 85 patients receiving PRG in our centre between February 2003 and February 2017. Study approval was obtained from our institutional review board. Our centre offers both PEG and PRG services, with patients cared for under a multidisciplinary team approach. Patients were referred for PRG insertion based on the discretion of the referring clinician, as well as when PEG was contraindicated. Medical records and procedural images were reviewed, and the data assessed for primary outcomes of procedure success, mortality related to the procedure and mortality within 30 days from any cause.

Complications occurring within 30 days and related to the procedure were also measured and further subdivided into major and minor complications. We followed the Common Terminology Criteria for Adverse Events (CTCAE), v4.0,[13] created by the United States' Department of Health and Human Services. Major complications (CTCAE grade 4) were defined as life threatening and requiring immediate and aggressive intervention, including but not limited to, severe persistent haemorrhage, peritonitis, bowel perforation, and pulmonary, cardiac and neurological events. Minor complications (CTCAE grades 1-3) were defined as not life threatening and requiring little or no intervention, such as tube dislodgement, tube blockage or superficial cellulitis.

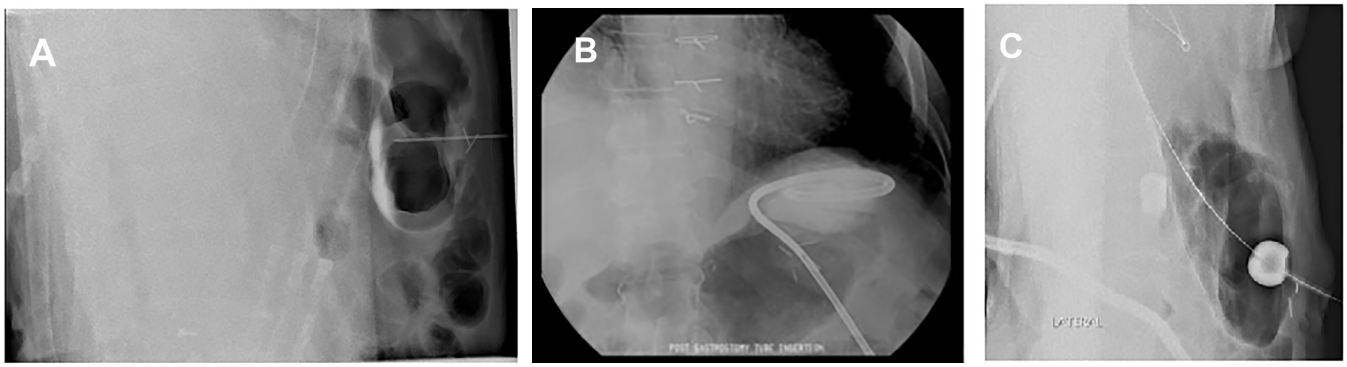

Fig. 1. A: Lateral view showing the T fasteners opposing the anterior gastric wall to the abdominal wall, which were inserted via earlier similar punctures after gastric distention. Final needle puncture before gastrostomy insertion. Note the contrast in the stomach, which was injected after each puncture for confirmation. B: Postcatheter insertion of loop gastrostomy tube. C: Postcatheter insertion of balloon gastrostomy tube.

Results

Patients recruited were 76.5% male with a mean age of 63.9 years (Table 1). The most common indication for PRG (Table 1) was oro-pharyngeal obstruction due to nasopharyngeal tumour (35.3%). Neurological indications such as cerebrovascular accident and motor neuron disease only accounted for 12.9% of PRG insertions. Various malignancies obstructing the upper aerodigestive tract such as laryngeal and oesophageal tumours accounted for all remaining insertions.

Table 1. Patient Characteristics Including Demographic Data, Procedure-Related Statistics and Indications for Procedure

Patient Characteristics	**n**	**(%)**
General		
Age (years, mean [SD])	63.9	(14.3)
Sex		
Male	65	(76.0)
Female	20	(24.0)
Prior NG feeding (n = 55, 64.7%)		
>30 days duration	34	(61.8)
Procedure-Related	**n**	**(%)**
Technical success	85	(100.0)
Type of G tube (balloon)		
Balloon catheter*	69	(81.2)
Non-balloon catheter†	16	(18.8)
Number of gastropexy tags		
2 tags	57	(67.1)
3 tags	28	(32.9)
Type of anaesthesia (n = 78)		
LA only	47	(60.3)
LA + sedation	31	(39.7)
Indications	**n**	**(%)**
Malignancy		
Nasopharyngeal tumour	30	(35.3)
Oropharyngeal tumour	5	(5.9)
Laryngeal tumour	14	(16.5)
Oesophageal tumour	13	(15.3)
Gastric tumour	1	(1.2)
Sinonasal tumour	3	(3.5)
Salivary gland tumour	2	(2.4)
Thyroid tumour	1	(1.2)
Lung tumour	4	(4.7)
Neurology		
Dementia	2	(2.4)
Motor neuron disease	3	(3.5)
Parkinson disease	3	(1.2)
Stroke	1	(1.2)
Olivopontocerebellar atrophy	1	(1.2)
Glioblastoma multiforme	1	(1.2)
Miscellaneous		
Boerhaave syndrome	1	(1.2)

G: Gastrostomy; LA: Local anaesthesia; NG: Nasogastric; SD: Standard deviation
*Balloon catheters used were 16-18F.
†Non-balloon catheters used were 14F.

Prior to PRG insertion, 55 patients (64.7%) were already on naso-enteric tube feeding (Table 1). Thirty four of these 55 patients received naso-enteric feeds for more than 30 days, with a median time of 57 days (range 5-1628 days) continuously receiving naso-enteric nutrition.

A 100% technical success rate was achieved with zero procedure-related mortality, and 30-day all-cause mortality at 10.9% (Table 2). Only 3 major complications (3.5%) occurred (described below), minor complications were relatively low as well, with an infection rate of 8.2%, tube dislodgement rate of 7.1% and tube occlusion rate of 3.5%.

In 1 patient with a non-inflated stomach due to Boerhaave syndrome, computed tomography (CT) guidance was successfully utilised for imaging guidance after a failed endoscopic nasogastric (NG) tube insertion. An initial puncture was performed using the AccuStick introducer system (Boston Scientific, Marlborough, MA, United States) under ultrasound guidance allowing partial inflation of the stomach. Two anchors were then placed under CT guidance, with the catheter then inserted between the anchors over a guide wire (Fig. 2). The patient was successfully fed for 1 month through the gastrojejunostomy tube before terminal discharge. The decision for conservative management was made in view of the high risk involved in surgical intervention and the patient's advanced age and multiple comorbidities.

One patient suffered from severe bleeding which occurred as a result of injury to the left gastroepiploic artery during the procedure and required exploratory laparotomy with

Table 2. Complications and Mortality Postprocedure

Complications	**n**	**(%)**
Major		
Severe bleeding*	1	(1.2)
Persistent pneumoperitoneum†	1	(1.2)
Gastric fundus perforation	1	(1.2)
Minor		
Infection	7	(8.2)
Tube dislodgement	6	(7.1)
Tube occlusion	3	(3.5)
Mortality	**n**	**(%)**
30-days mortality	9	(10.6)
Procedure-related mortality	0	(0.0)

*Severe bleed requiring laparotomy due to inadvertent ligation of aberrant right gastroepiploic artery.
†Persistent pneumoperitonium resulting in peritonitis.

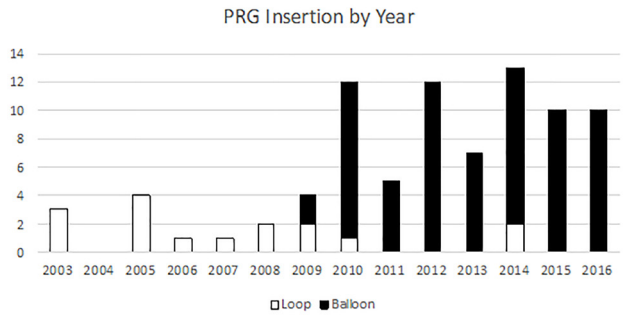

Fig. 2. Graph showing the number of percutaneous radiologically-guided gastrostomy (PRG) per year, further separated by type of gastrostomy tube (loop or balloon). Increasing trend of gastrostomy adoption is seen, as well as gradual transition from loop to balloon catheter over the years.

surgical haemostasis. Another 80-year-old patient had persistent pneumoperitoneum postprocedure, also requiring laparotomy, where it was found that there was poor anchoring of the stomach to the anterior abdominal wall with no evidence of the expected inflammatory reaction and healing around the catheter track. The catheter was therefore removed and omental patch repair performed, and the patient made an uneventful recovery with return to full NG feeding. A case of gastric fundus perforation was discovered during the procedure, and was likely caused by the guide wire. The small perforation was successfully clipped during endoscopy on the same day.

Discussion

Our results show PRG to be highly effective with a low complication rate and procedure-related mortality. This is largely in keeping with current literature.[5-7,12,14,15] A 2016 Cochrane analysis[4] documented a range of major complication rate of 1.4% to 5.6%, which is in line with our own study finding of 3.5%. High technical success rate is also seen in other studies,[6,9,16] with authors reporting similar success rates of 99% to 100%.

The most common indication for PEG has historically been cerebrovascular accident,[3,5] including within our own centre.[17] In contrast, nasopharyngeal tumours was the commonest indication for PRG in our study. This reflects the usefulness of PRG in patients who may be considered more difficult PEG candidates due to oral or upper gastrointestinal tract obstruction,[15] where passage of a flexible endoscope per-orally may be technically challenging.

Several other indications favoured PRG over PEG. These include—but are not limited to—poor transillumination of the abdominal wall in patients with obesity or high subcostal stomach[14] and rare cases of tumour seeding at the PEG exit site for patients with head and neck cancer.[9] In patients with altered anatomy, PRG may also be preferred, as preprocedural radiological planning would allow for modified approaches where appropriate. This is well illustrated by our patient with Boerhaave syndrome.

The rising trend of adoption of PRG in our centre is likely due to increased physician and patient awareness and outreach by interventional radiologists. The increased usage of balloon catheters (Fig. 3) is likely due to the interventional radiologists' preference and the trend worldwide to use these devices.

PRG, however, remains a secondline intervention before PEG in many centres.[3,5] One meta-analysis of 15 peer reviewed studies comparing PEG and PRG[18] demonstrated similar 30-day mortality of 10.5% (95% CI, 6.8%-14.3%) for PRG insertion compared to our own study's 30-day mortality of 10.6%. In comparison, PEG insertion was found to have statistically significantly lower 30-day mortality of 5.5% (95% CI, 4.0%-6.9%). However, retrospective study designs and lack of randomisation prevented conclusive recommendations advocating for one method over the other in this and other analyses.[5,12] It is also our view that this apparently higher mortality amongst patients receiving PRG insertion may be a result of patient selection rather than factors intrinsic to the procedure itself. Patients referred for PRG insertion in our centre tend to be generally more ill and unfit for procedural sedation. Further prospective studies may be required to definitively answer this important clinical question.

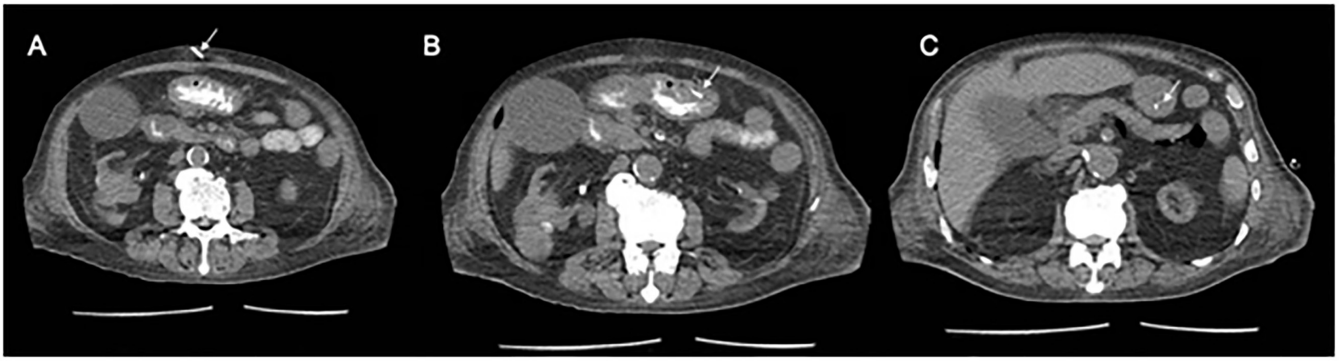

Fig. 3. Selected intraprocedural computed tomography (CT) of percutaneous radiologically-guided gastrostomy (PRG) insertion for a patient with Boerhaave syndrome, showing the course of the wire (white arrow). A: Through the skin and subcutaneous tissue. B: Through the non-distended stomach wall. C: In the lumen of the gastric fundus. The stomach was then inflated via a catheter which was threaded over this wire to resume the usual steps of PRG insertion.

The majority of our patients were on continuous NG feeding for longer than 30 days prior to PRG insertion, exceeding the recommendation for duration of naso-enteric feeding before conversion to gastrostomy.[3] This likely reflects late physician referral for conversion to gastrostomy. Physicians anticipating patients in need of long-term enteral nutrition should seek early referral for gastrostomy tube insertion within 2 to 3 weeks of continuous NG feeding rather than leaving gastrostomy as an option of "last resort". The benefits of gastrostomy over long-term NG feeding include lower rate of aspiration and extubation in elderly patients[19] as well as improved nutrition with slower initial weight loss in patients with head and neck cancers.[20] In addition, patients who are already malnourished from disease and feeding difficulties naturally will benefit less from any procedure and have higher procedural-related risks.

As shown in the earlier example, CT fluoroscopy and ultrasound have allowed the puncture of the non-distended stomach in conditions where a NG tube insertion is not possible. These conditions include complete upper digestive tract obstruction,[21] patients with failed endoscopy[22] as well as following Roux-en-Y gastric bypass surgery.[23]

One other recent advancement has seen the transition to a 1-step direct low-profile catheter insertion. Previously, the standard balloon tube was first inserted to allow the catheter track to mature, before a percutaneous tube change to a low-profile catheter was performed at a later stage. Low-profile catheters are flushed to the skin, and as such last longer than standard balloon tubes due to a lower risk of dislodgement,[24] while also providing greater comfort and more acceptable appearance to the patient.[25]

This study has several limitations. As a retrospective study, patients were selected based on physician referral and differences in technique depended on the interventional radiologist performing the procedure. While we found no statistically significant differences in outcomes when comparing procedural techniques employed, such as use of balloon or loop catheter, number of gastropexy tags applied or use of procedural sedation, this could be due to the small sample size. Further analysis with a larger sample size across several centres would provide further insight into how differences in procedural technique may account for differences in outcome.

Conclusion

In conclusion, PRG should be considered as a useful alternative to PEG. The results of this study demonstrated 100% technical success, zero procedure-related mortality and a low complication rate. The inability to insufflate the stomach is no longer an absolute contraindication to PRG. We recommend that physicians make earlier referrals for patients with a projected course of enteral nutrition which may exceed 30 days rather than to wait until later stages of their disease, so they can benefit from gastrostomy feeding early. As with most other care models, a multidisciplinary approach is the key to select the best enteral feeding methods for different groups of patients. Thus, members within this team should be aware of the strengths and weaknesses of each technique.

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