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Case report

# A method for percutaneous radiologic gastrostomy tube placement without sedation as a bridge to lung transplantation ☆,☆☆

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ABSTRACT

Gastrostomy tube placement is an appropriate option for long-term nutritional support for patients who cannot tolerate oral intake. Common indications for a gastrostomy tube include head and neck tumors and neurological disorders. Several methods for gastrostomy tube insertion exist (eg, surgical, endoscopic, and radiologic) that require sedation or general anesthesia, which can pose risks of cardiopulmonary compromise and postsurgical pulmonary complications. Unlike other methods, our practice uses a percutaneous balloon-assisted gastrostomy tube insertion method for which we can perform without sedation. We report a case of a percutaneous radiologic gastrostomy procedure for a patient with end stage lung disease as a bridge to lung transplantation, who is not a candidate for sedation and is high-risk for general anesthesia. Through enteral feeds administered through the successfully placed gastrostomy tube, the patient showed steady improvement in weight gain over the course of several months before approval for listing by the lung transplant selection committee. Our case highlights how gastrostomy tube placement can be safely performed in patients who are not sedation candidates using the minimally invasive balloon-assisted gastrostomy tube insertion method and local anesthetic.



## Introduction

Pulmonary cachexia in patients with emphysema and chronic obstructive pulmonary disorder (COPD) refers to significant weight loss as a result of caloric deficiency and a chronic inflammatory state that results in hypermetabolism at rest [1]. Consequent loss of skeletal muscle mass and mechanical inefficiencies with respiration contribute to dyspnea and exercise intolerance [2,3]. A vicious cycle may then ensue whereby

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**Fig. 1 – Axial chest CT with IV contrast upon referral. Axial chest CT with IV contrast demonstrates cachexia and advanced primarily upper lobe emphysema without focal consolidation, masses or pulmonary nodules.**

patients may tire of eating quickly, which promotes further weight loss through reduced caloric intake. Gastrostomy tube placement is an effective means for providing long-term nutritional support in patients with functioning guts who cannot tolerate oral intake [4,5]. In particular, patients with end stage lung disease and pulmonary cachexia require optimization of nutritional status to prevent morbidity and mortality associated with the stress and caloric needs of lung transplantation [6–8]. Compared to surgical and endoscopic placement, percutaneous radiologic gastrostomy tube placement can be done with local anesthetic only, which limits the risk of aspiration and cardiopulmonary compromise in patients with reduced pulmonary function [5]. Here, we present a case of a nonsedation and high-risk general anesthesia patient with pulmonary cachexia and end stage lung disease secondary to COPD who requires a percutaneous gastrostomy tube placement with local anesthetic via minimally invasive radiologic methods as a bridge to lung transplantation.

## Case report

The patient was a 67-year-old woman with $CO_2$ retention, pulmonary hypertension and ambulatory desaturation secondary to severe COPD who was referred to our hospital for consideration of lung transplantation. On initial evaluation, she reported progressive worsening of respiratory function and marked compromise to quality of life despite optimal medication treatment. She was on 4L/min of $O_2$ per nasal cannula both at rest and with mild exertion and required some assistance with activities of daily living, particularly bathing and feeding. The patient is ASA class IV and Mallampati score II. Chest CT showed advanced upper lobe predominant emphysema with bilateral apical, medial right upper lobe and bilateral basilar scarring without focal consolidation, pulmonary nodules, or masses (Fig. 1).

Chest X-ray demonstrated lung hyperinflation with flattening of hemidiaphragms consistent with diagnosis of obstructive lung disease. Quantitative ventilation-perfusion testing revealed heterogenous distribution of radiopharmaceutical throughout the lungs with decreased perfusion to the right lung. Pulmonary function tests were as follows: FVC was 1.31L or 44% of predicted, FEV1 was 0.43L or 19% of predicted, and DLCO was 2.45 mL/min/mm Hg or 12% of predicted. On presentation of this patient to the lung transplant selection committee, the major barrier to listing identified was malnourishment with a BMI of 16.9 kg/m$^2$ (height 1.61 m, weight 44.0 kg) and inability to gain weight. Interventional radiology was consulted for percutaneous radiologic placement of gastrostomy tube (G-tube).

Prior to the procedure, written, informed consent was obtained. The patient was placed in supine position on the procedure table and administered 5 mg of diazepam (Valium, Hoffman-La Roche, Basel, Switzerland). A 5 French Kumpe catheter (Cook Group, Bloomington, IN) was advanced into the stomach from the nose (Fig. 2A).

The medial margins of the liver and spleen edge were identified with ultrasound and marked. The transverse colon was opacified with barium, which had been given the day prior to the procedure. The patient was administered 1 mg IV glucagon to slow gastric motility. The stomach was inflated with air via the catheter. A subcostal site for the gastrostomy was identified, and the skin and superficial soft tissues were anesthetized using a 25-gauge needle with 10 mL of 1 % lidocaine. Subsequently, under fluoroscopic guidance, a 25-gauge needle was inserted into the gastric body, intraluminal position was confirmed with free aspiration of air, and the gastric wall was anesthetized with 10 mL of 0.25% benzocaine. Two T- fasteners were then used to anchor the anterior wall of the gastric body to the anterior abdominal wall. A 2 cm dermatotomy was created using an 11-blade scalpel in between the T-fasteners, and curved forceps were used for blunt dissection. Again, under direct fluoroscopic guidance, a single wall 18-gauge needle was advanced through the dermatotomy into the gastric lumen in between the T-fasteners. Air was easily aspirated, and contrast was injected to confirm position (Fig. 2B).

An 0.035 stiff Amplatz wire (Cook Group, Bloomington, IN) was inserted through the 18-gauge needle into the stomach. The needle was exchanged over the wire for a 9 mm x 80 mm Conquest balloon (Bard, Murray Hill, NJ). A 20 French MIC G-tube (Avanos Medical, Alpharetta, GA) was advanced over the balloon, and the balloon was inflated in order to dilate the tract (Fig.s 2C and D).

The balloon was deflated while the G-tube/balloon combination was simultaneously advanced over the wire into the stomach. Once the tube was in the stomach, the retention balloon on the G-tube was inflated with sterile water and the Conquest balloon and wire were removed. Injection of contrast confirmed appropriate placement of the G-tube within the gastric lumen with no extravasation (Fig. 2E). The G-tube was connected to a gravity drainage bag for overnight decompression.

The patient reported 0/10 pain 1 and 2 hours after the procedure and was subsequently discharged without outpatient pain control. For the following 2 months after successful

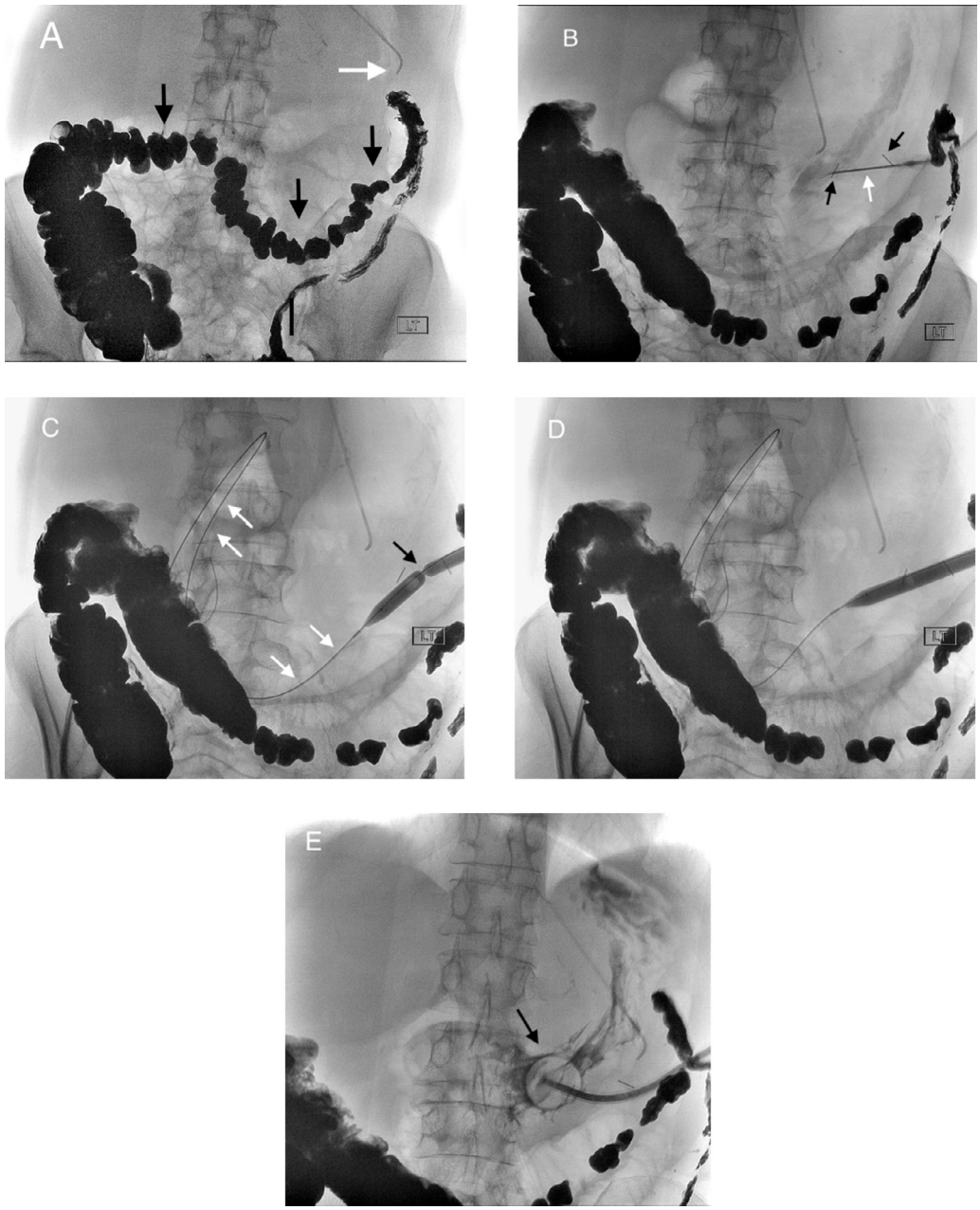


**Fig. 2 – (A) Preprocedure radiograph of abdomen. Radiograph prior to the procedure illustrates opacification of the transverse colon via barium given the night before (black arrows). A 5 French Kumpe (white arrow) used to insufflate the stomach with air is also visualized with its tip in the gastric fundus. (B) Gastropexy and gastric access via 18 gauge needle. Gastric body is insufflated with air through the 5 French Kumpe catheter. Two T-fasteners (black arrows) are used for gastropexy to anchor the stomach to the abdominal wall. An 18-gauge needle (white arrow) is inserted into the stomach through a dermatotomy with injection of contrast to confirm intraluminal position of the needle tip. (C) Wire access and start of tract dilation with balloon angioplasty. A guidewire (white arrows) is advanced into the stomach, and a Conquest balloon with an overlying G-tube is used to cannulate the stomach. Tract dilation with the balloon demonstrates a waist at the body wall (black arrow). (D) End of tract dilation with balloon angioplasty. Continuous inflation of Conquest balloon demonstrates complete dilation of the tract with an effacement of the waist at the gastric body wall. (E) Postprocedure radiograph of abdomen. Postprocedure image illustrates insertion of G-tube with an inflated retention balloon (black arrow) and injection of contrast to confirm intraluminal position.**

gastrostomy tube placement, the patient reported continued shortness of breath with eating and diarrhea with the tube feeding regimen: Osmolite 1.5 (Abott Laboratories, Chicago, IL) at 75mL/hr for 8 hours nightly. The patient saw a loss of 1.4 kg in weight and a drop in BMI to 16.4 kg/m$^2$ during this time period. She was subsequently admitted to the hospital for titration of tube feed rate and formula. The patient was successfully discharged the next day on Nutren 1.5 (Nestle Health Science, Vevey, Switzerland) at 60mL/hr for 12 hours nightly. Working with a registered dietician and nutritionist, the patient relied on a combination of dietary intake and nocturnal tube feeds for a consistent weight gain of 4.5 kg — total weight of 47.2 kg and BMI of 18.1 kg/m$^2$—over 3 months. The patient was subsequently approved for lung transplantation by the selection committee.

## Discussion

Gastrostomy tube placement is a widely accepted method of administering enteral feeds in patients who cannot tolerate oral intake [4,5]. The most common indications for gastrostomy tube placement include obstructive tumors of the head and neck and neurologic disorders that present with high risk of aspiration, such as amyotrophic lateral sclerosis, multiple sclerosis and stroke [4]. However, patients with end stage lung disease may also benefit from a G-tube before and after lung transplantation. Prior to transplant, patients with pulmonary cachexia secondary to obstructive lung disease may experience significant muscle wasting and worsening dyspnea and exercise tolerance [5]. Mostert et al. and Shoup et al. have demonstrated that patients with COPD and low body weight report decreased health-related quality of life as measured by St George's Respiratory Questionnaire [9,10]. Additional research is needed to elucidate the efficacy of long-term nutritional support in improving health related quality of life in this subset of patients. Still, these preliminary findings point toward enteral tube feeds as a potential option for alleviating respiratory symptoms in those with end stage lung disease. With respect to post-transplant patients, several studies have demonstrated an increase in mortality in those with low BMIs [11,12]. In particular, Madill et al. describe elevated mortality in lung transplant recipients with BMIs at the extremes of measurement ($<$17 kg/m$^2$ or $>$25 kg/m$^2$) compared to the reference. With respect to adverse outcomes, it is well documented that malnourishment also increases the risk of several post-transplant complications, including rejection, infection, poor wound healing, renal insufficiency, and hyperglycemia [6]. Therefore, establishing a means for nutrition is paramount to supporting patients in both the pretransplant and post-transplant period.

Alternative forms of nutritional support besides gastrostomy include total parenteral nutrition (TPN) and nasogastric tube feeds, both of which are associated with significant risk of complications, particularly in patients in whom long-term feeding is expected. TPN is linked with central line sepsis, metabolic imbalances, and intestinal motility disorders secondary to gut mucosal atrophy [13,14]. Due to the latter 2 complications, parenteral nutrition is preferred predominantly in patients with impaired intestinal absorption. While nasogastric tube feeds are a form of enteral nutrition, long-term use, defined as beyond 6 weeks, is associated with increased incidence of tube migration, acute rhinosinusitis, nasal ulceration, esophageal stricture, and gastroesophageal reflux with risk of aspiration [14]. Compared to gastrostomy, nasogastric tube feeds also have a significantly higher rate of mechanical failure [15]. While the complication rate of gastrostomy tube placement varies widely, a consensus based on several case series shows a relatively low overall mortality, major complication, and minor complication rate. The most prominent of which include wound infection and tube malfunction [5]. Therefore, G-tubes are the preferred modality of long-term nutritional support in patients with functioning guts.

There are 3general methods for gastrostomy tube placement: surgical, endoscopic, and radiologic. While surgical gastrostomy has a technical success rate of 100%, it also carries a higher risk of mortality and major complications, including severe aspiration and peristomal infection, compared to percutaneous radiologic methods [16,17]. Furthermore, surgical gastrostomy requires general anesthesia while percutaneous radiologic gastrostomy can be performed with local anesthetic only. This factor is especially important given the risk of cardiopulmonary compromise and peri-operative complications — including atelectasis and pneumonia — associated with sedation especially in patients with limited pulmonary function [18]. Unlike endoscopic placement, percutaneous radiologic placement cannot be performed at the bedside. However, the use of sedation and the inevitable contamination of pulling a tube through the oral cavity most likely contribute to higher rates of aspiration and wound infection in endoscopic gastrostomy procedures [5,17].

Within the scope of percutaneous radiologic gastrostomy, methods vary widely. One major distinction is the use of a "pull" or a "push" method [19]. Pull methods are performed by first gaining access into the air-insufflated stomach. A catheter is then advanced from the stomach through the esophagus into the oral cavity. A guidewire is pushed through the catheter, and a G-tube is fastened to the other end near the oral cavity. The G-tube is then pulled antegrade through the mouth, esophagus, and abdominal wall and fastened with a mushroom-end abutting the inner gastric wall. Push methods begin similarly with the advancement of a needle into an air-insufflated stomach. However, the catheter is then advanced over a guidewire inserted through the needle and anchored to the abdominal wall. Dilation is done to create the appropriate size of the gastric and abdominal wall lumen for insertion of the G-tube without causing pressure necrosis or leak.

At our institution, we advocate for a push method with gastropexy, using 2 T-fasteners, and balloon dilation for patients needing a bridge to lung transplantation. Pull methods been described as more secure as these G-tubes cannot be deflated or ejected with a food bolus [20]. However, we prefer the push technique given its reduced risk of wound infections, likely due to the passage of pull method G-tubes through the oropharynx [21]. Although long-term use of T-fasteners has been linked to skin excoriation and superficial infection, some studies suggest gastropexy may limit tube displacement [22,23]. In our practice, we have patients return to clinic 2 weeks after the procedure for T-fastener removal to limit the

risk of dermatologic complications. In addition, because serial dilation may increase the risk of spilling gastric contents into the peritoneum, thus requiring an urgent laparotomy, we practice balloon dilation to limit additional manipulation of the gastric wall.

Current literature describes a multitude of methods for radiologic gastrostomy placement: push vs pull, with gastropexy vs without gastropexy, and serial dilation vs balloon dilation. While other institutions may describe tract dilation via balloon angioplasty, none detail the use of this technique in conjunction with gastropexy and only local anesthetic. For example, Fujita et al. described using the push balloon-assisted gastrostomy in patients with head and neck cancer while Bendel et al. demonstrated a 100% success rate using the coaxial balloon technique with sedation and without gastropexy [24,25]. Here we describe the first nonsedation case using the balloon-assisted gastrostomy tube push technique. Our practice uses sedation for the vast majority of our gastrostomy tube patients. However, in select patients that are not sedation candidates and are high-risk anesthesia candidates, including those with amyotrophic lateral sclerosis and obstructive tumors of the head and neck, we routinely perform without sedation. Being able to perform gastrostomy tube placement with only local anesthesia is a clear advantage, especially for those with significant pulmonary compromise. In short, we posit that our technique for gastrostomy tube placement is a safe and effective method for patients with end stage lung disease requiring nutritional support prior to transplantation.

## Patient consent

The authors obtained written and informed consent from the patient for submission of this manuscript for publication.

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