Published in final edited form as:

Gastrointest Endosc. 2012 March ; 75(3): 683–687. doi:10.1016/j.gie.2011.10.009.

Jejunal Tube Extensions via Percutaneous Endoscopic Gastrostomy and Delayed Small-Bowel Perforations: A Case Series

Laura H. Rosenberger, MD, MS¹, Timothy Newhook, MD¹, David M. Mauro, MD², Sara A. Hennessy, MD¹, and Robert G. Sawyer, MD¹

¹Department of Surgery, University of Virginia Health System, Charlottesville, Virginia

²Department of Radiology, University of Virginia Health System, Charlottesville, Virginia

Introduction

In patients who cannot tolerate oral feedings or maintain adequate nutrition, supplemental enteric or intravenous nutrition must be provided. Enteric nutrition is the preferred method over total parenteral nutrition when the gastrointestinal tract is intact with functional motility and absorptive capabilities.^{1, 2} Enteric feeding maintains the bowel's mucosal structure and integrity, maintains immune-secretory function, improves wound healing, and lowers infection rates and subsequent morbidity.^{3, 4}

The first operation on the stomach, the gastrotomy, was initially performed to extract “bizarre and sundry objects” swallowed by the mentally deficient and circus performers.⁵ The concept of the gastrostomy followed soon thereafter as a portal of introduction, rather than extraction, and is credited to Dr. Egeberg, in 1837. A decade later, Sedillot performed the first successful gastrostomy and subsequently numerous surgeons including Stamm, Witzel, Dupage, and Janeway, improved various open operative techniques for gastrostomy creation.^{5, 6, 7}

In 1980, the novel technique of percutaneous endoscopic gastrostomy (PEG), or the “sutureless gastrostomy”, was introduced.⁸ More than 215,000 PEGs are now placed annually for adult enteral nutrition with minimal associated morbidity and thus has become the preferred method for gastrostomy at our institution.⁹

© 2011 American Society for Gastrointestinal Endoscopy. Published by Mosby, Inc. All rights reserved.

Corresponding Author: Laura H. Rosenberger MD, MS, LHR2M@virginia.edu, Department of Surgery, University of Virginia, PO Box 800679, Charlottesville, VA 22908, Cell: 434-760-5027.

L.H. Rosenberger: Analysis & interpretation, drafting of article, critical revision, final approval

T. Newhook: Analysis & interpretation, drafting of article

D.M. Mauro: Analysis & interpretation, drafting of article

S.A. Hennessy: Critical revision, final approval

R.G. Sawyer: Conception & design, analysis & interpretation, critical revision, final approval

Conflicts of interest: Drs. Newhook, Mauro, Hennessy have no conflicts of interest to disclose.

Drs. Rosenberger and Sawyer are currently working on a modification of the PEG tube. At this time there is no patent application, external funding, or licensure agreement. Dr. Sawyer is also a consultant for Merck, Pfizer, Astellas, and Johnson & Johnson.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Distal feeding, via a jejunostomy or jejunal tube extension, is used for patients with gastroparesis, gastric outlet obstruction, abnormal anatomy after esophagectomy or gastrectomy, and for patients with significant gastroesophageal reflux at high risk for aspiration.^{4, 10–13} Many techniques are used for minimally invasive distal enteric feeding, predominantly with jejunal tubes maneuvered endoscopically or fluoroscopically, with varying rates of success and complications. Herein, we present our institution's most common technique for jejunal feeding tube advancement and three cases of associated small-bowel perforations.

Jejunal Extensions

The PEG is preferentially preferred over Stamm gastrostomy at our center due to the avoidance of general anesthesia, reduced procedural time and cost, and a high rate of successful placement. We place over 450 PEGs per year using a standard “push” technique consistent with that originally described by Gauderer and colleagues in 1980.⁸ This technique includes endoscopic gastric insufflation, guide wire insertion through a transabdominal catheter, PEG placement over the oral end of the guide wire, and tube advancement through the esophagus terminating with the internal bumper snug against the gastric mucosa. After gastrostomy creation, jejunal tube extensions may be introduced immediately thereafter, as there is no further manipulation of the gastrostomy tube or track. Our center converts approximately 40 gastrostomy tubes to gastrojejunostomy tubes by fluoroscopic jejunal tube extensions annually.

For those patients requiring distal feeding, jejunal feeding tube extensions are frequently advanced with fluoroscopic guidance by the radiology department. Our standard jejunal extension tube is the 12-French (Fr), PEG-Jejunal feeding tube extension (Cook Medical Inc, Bloomington, IN) that comes as either 60 centimeters (cm) or 95 cm in length. These 12-Fr jejunal tubes require at minimum a 24-Fr gastrostomy tube for passage through the lumen. If the gastrostomy tube is smaller, serial dilation of the tract may be performed to upsize the gastrostomy tube if there is a well-healed gastrocutaneous fistula.

A patient with a preexisting gastrostomy tube is placed supine on the fluoroscopy table. The external adaptor or connector on the gastrostomy tubing is removed or cut off. A curved 5-Fr, 100 cm (0.038 inch), Soft-Vu, Hockey Stick catheter (AngioDynamics, Latham, NY) is introduced through the gastrostomy tube and advanced to a post-pyloric, duodenal position. A 260 cm (0.035 inch) curved tip Rosen guide wire (Cook Medical Inc, Bloomington, IN) or a 260 cm (0.035 inch) stiff Amplatz guide wire (Cook Medical Inc, Bloomington, IN), is subsequently advanced into the duodenum via the Hockey Stick catheter. Using the curved tip catheter for directional change, the guide wire is negotiated through the duodenum into the proximal jejunum. All advancement of the guide wire and catheter is performed under fluoroscopic visualization. If necessary, contrast material may be injected through the catheter to provide visualization of the gastrointestinal tract. After passage through the C-loop of the duodenum, visualization of a directional change downward indicates passage beyond the ligament of Treitz. Once distal to the ligament by a few centimeters, the Hockey Stick catheter is removed, and the 12-Fr jejunal tube extension is advanced over the guide wire. The guide wire is removed, and the position of the jejunal extension tip is confirmed by injection of contrast material. The hub of the jejunal extension is attached to the PEG tubing and secured using a cable tie. Jejunal tube feeding may be initiated immediately since tube positioning has been confirmed fluoroscopically and procedural-related complications are extremely low.

This simple method of fluoroscopically placed jejunal feeding tube extension can be performed immediately after PEG placement, and does not require a well-healed gastrocutaneous fistula tract, sedation, or motility agents.

Cases Series

Patient #1

A 42-year-old male admitted for drug induced hepatitis, hepatorenal syndrome, and acute renal failure, subsequently had a stroke and massive myocardial infarction requiring mechanical ventilation. He received a 24-Fr PEG for nutritional support by the surgical endoscopy service. Five days after PEG placement, the patient was febrile, had an elevated white blood cell count, and had abdominal distention prompting a computed tomography (CT) of the abdomen. CT revealed a retracted PEG tube terminating in the peritoneal cavity with a large volume of tube feeds intraperitoneally. The patient underwent an exploratory laparotomy, abdominal washout, and Stamm gastrostomy. After surgery, a 12-Fr jejunal feeding tube extension was advanced through the Stamm gastrostomy tube under fluoroscopic guidance by the radiology department.

Twelve days after jejunal extension and initiation of tube feeds, the patient became tachycardic, with fluid drainage from an abdominal drain suspicious for tube feed material. A CT scan with jejunostomy contrast injection revealed intraperitoneal extravasation of contrast suggesting a small-bowel perforation. (Figure 1) The patient underwent exploratory laparotomy revealing non-ischemic small bowel and a perforation in the proximal jejunum, just distal to the ligament of Treitz. The tip of the jejunal feeding tube was found protruding through the perforation. The site of perforation was repaired primarily and covered with an omental patch. The patient recovered from his initial hepatitis and medical complications.

Patient #2

A 58-year-old male with a history of obesity, hyperlipidemia, and significant alcoholism was admitted to our facility with severe pancreatitis. A 24-Fr PEG tube was placed by the surgical endoscopy service and the following day a fluoroscopically placed jejunal tube extension was advanced by the radiology department. The patient subsequently underwent a cystgastrostomy for a pancreatic pseudocyst; however, he subsequently developed infected necrotizing pancreatitis and septic shock. The patient underwent pancreatic debridement and partial pancreatectomy.

Eleven days after surgery, and 23 days after the PEG-Jejunal tube placement, the patient had a worsening clinical status leading to a CT scan. (Figure 2) Extravasation of contrast was visualized from the jejunal tube into the peritoneal cavity. The patient underwent exploratory laparotomy revealing healthy-appearing small bowel and a jejunal perforation with the tip of the jejunal feeding tube protruding through the jejunal wall just distal to the ligament of Treitz. The jejunal extension was removed, the perforation repaired primarily, and an open jejunostomy placed. The patient was ultimately discharged to a rehabilitation facility.

Patient #3

A 26-year-old male with dermatomyositis, requiring chronic immunosuppression, presented to the emergency department with sudden onset abdominal pain and acute toxic colitis of unknown etiology. He underwent emergent total abdominal colectomy with end ileostomy. Postoperative prolonged ventilator support was complicated by pneumonia requiring tracheostomy and PEG placement for enteral nutrition. The surgical endoscopy service inserted a 24-Fr PEG tube followed by immediate advancement of a 60 cm jejunal extension

by endoscopic guidance. The patient recovered and was ultimately discharged to a rehabilitation facility on postoperative day (POD) 29 and 10 days after PEG-jejunal tube placement.

Nineteen days after PEG-jejunal tube placement, the patient presented to the emergency department with fever, abdominal distension, and low urine output. A CT scan revealed erosion of the jejunal extension tube through the wall of the jejunum. (Figure 3) He underwent an exploratory laparotomy revealing the end of the jejunal tube extraluminally, having perforated the proximal jejunum, which was without signs of ischemia or necrosis. The defect in the jejunum was oversewn primarily, and a jejunostomy feeding tube was placed 50 cm distal to the perforation. The patient was discharged to a rehabilitation facility on POD 15.

Discussion

Early reports by Bisgard in 1942 described blind advancement of a Levine tube into the jejunum after gastric resections and gastrostomy placement, for distal feeding.¹⁴ This method of jejunal tube extension was felt to be superior to the operative jejunostomy by not fixing the jejunum to the abdominal wall, thereby minimizing adhesions causing future small-bowel obstructions. This blind technique has since been replaced by the assistance of endoscopy and fluoroscopy. In 1973, angiographic equipment was innovatively used to intubate the jejunum via a gastrostomy tract.¹⁵ The angiographic catheter and guide wire was used much like our practice today.

Innumerable reports were subsequently published regarding various techniques for jejunal tube extensions using combinations of fluoroscopy and endoscopy. A number of techniques required the removal of the gastrostomy tube, with firm adherence of the stomach to the anterior abdominal wall, before intubation with catheters, wires, or an endoscope, delaying jejunal tube placement.^{15–19} Many techniques use endoscopy (transorally or via gastrostomy) for visualization and use of the working port with foreign body forceps or grasping forceps to manipulate a jejunal tube through the pylorus.^{2, 18–22} Frequently the endoscopically placed jejunal tubes terminate in the duodenum or migrate proximally with endoscope withdrawal or time. Some reports used both endoscopy and fluoroscopy in concert¹⁹, whereas others have implemented a technique using only fluoroscopy after previous gastrostomy placement, such as our technique described above.^{1, 15–17, 23} It appears all methods of placement have very low rates of procedural related complications; however, with novel procedural techniques and equipment come new complications.

Complications

Pressure erosions with necrosis of the gastric wall, including the buried bumper syndrome, have been described frequently since the introduction of PEG tubes, since they rely on traction between internal and external bumpers to approximate the stomach to the anterior abdominal wall.^{7, 22, 24–26} Thus, this complication occurs far more frequently than with open gastrostomy. As we transition from large bore, soft, “red-rubber” operative jejunal tubes to firmer jejunal tube extensions, we may also note more frequent small-bowel perforations attributed to pressure ulceration and necrosis from these newer devices.

Numerous studies describe small-bowel perforations secondary to stiff nasoduodenal and nasojejunal tubes^{28–31}, whereas only a single case has been reported where an operative feeding jejunostomy tube eroded directly through the bowel wall.²⁷ Siegle described three cases of distal duodenal perforations from nasojejunal feeding tubes terminating in the distal duodenum. He concluded the perforation occurs from peristalsis and pulsion of the tube into a relatively fixed portion of duodenum.²⁸ He also observed the flexible polyvinyl tubes

change consistency in the bowel lumen, becoming stiff, and hardening in just 6 to 12 hours. This observation was also noted by Flores, in which a polyurethane tube perforated the third portion of the duodenum.³¹ Flores reviewed 21 additional cases of small-bowel perforations due to transpyloric feeding tubes, many of which occurred in neonates with low body weight without evidence of necrotic bowel at laparotomy. He concluded polyvinyl tubes have the highest risk of perforation, although also described with silicone and polyurethane tubes. The most significant cause of perforation is pressure necrosis due to direct trauma by the distal tip propelled by peristalsis against the small-bowel wall.

Our center identified three cases of jejunal perforations by tube extensions within a six month time interval. We estimate this complication occurs on average only once or twice per year leading to an approximate bowel perforation rate of 2.5 to 5.0%. During this time period we did not alter any equipment or the technique used for tube advancement.

In our three cases, perforation occurred at 11, 12, and 19 days after jejunal tube placement, suggesting an unlikely association with procedural technique or initial introduction. All three cases perforated five to ten cm distal to the ligament of Treitz, an area where the proximal jejunum is still relatively fixed. We presume the distal tip of the jejunal tube terminated against the bowel mucosa causing pressure necrosis. This has led us to reexamine our insertion techniques and the use of the Amplatz wires. Although easier to manipulate through the duodenum and proximal jejunum, the stiff Amplatz wire may damage the mucosa of the duodenal-jejunal flexure creating an initial insult for a delayed perforation. Although Rosen wires have a curved tip they are still relatively stiff, inflexible guide wires. Lastly, the distance of wire insertion beyond the ligament of Treitz should also be extended further than a few centimeters.

We continue to support immediate jejunal tube extension after gastrostomy placement when distal enteric feeding is indicated. We recommend the use of more flexible guide wires, such as the Rosen or Bentson wire (Cook Medical Inc, Bloomington, IN), which has a flexible tip and floppy distal segment to maintain the bowel's mucosal integrity during insertion. We recommend placement and confirmation of the jejunal tube extension at least 15 to 20 cm distal to the ligament of Treitz, where the bowel is freely mobile. A final consideration is that reduced bowel integrity in critical ill patients may allow easier necrosis and perforation, requiring special attention to patient selection and distal tip termination. This particular patient population may benefit from operative jejunal tubes rather than relying on PEGs with jejunal tube extensions.

Conclusion

Undoubtedly, small-bowel perforations from jejunal tubes remain a rare complication considering the high frequency of nasoduodenal and jejunal tube extensions placed in the inpatient setting for enteric nutrition. Although some of the reported perforations may be confounded by reduced bowel integrity, we should not overlook the possible initial damage by stiff guide wires used for placement, the location of the distal tip of the feeding tube, and the transformation of the flexible, soft feeding catheter into a stiff, fine-tipped device contributing to pressure ulceration, necrosis, and perforation in a fixed portion of bowel.

Acronyms

PEG	Percutaneous endoscopic gastrostomy
Fr	French (i.e. 12-French, 12-Fr)
Cm	Centimeters

CT Computed tomography
 POD Post – operative day

References

- McLean GK, Rombeau JL, Caldwell MD, Ring EJ, Freiman DB. Transgastrostomy jejunal intubation for enteric alimentation. *AJR Am J Roentgenol.* 1982; 139:1129–1133. [PubMed: 6816032]
- MacFadyen BV, Catalano MF, Rajman I, Ghobrial R. Percutaneous endoscopic gastrostomy with jejunal extension: a new technique. *Am J Gastroenterol.* 1992; 87:725–728. [PubMed: 1590308]
- Heyland DK, Drover JW, MacDonald S, Novak F, Lam M. Effect of postpyloric feeding on gastroesophageal regurgitation and pulmonary microaspiration: results of a randomized controlled trial. *Crit Care Med.* 2001; 29:1495–1501. [PubMed: 11505114]
- Fan AC, Baron TH, Rumalla A, Harewood GC. Comparison of direct percutaneous endoscopic jejunostomy and PEG with jejunal extension. *Gastrointest Endosc.* 2002; 56:890–894. [PubMed: 12447304]
- Cunha F. Gastrostomy: its inception and evolution. *Am J Surg.* 1946; 72:610–634.
- Waslljew BK, Ujiki GT, Beal JM. Feeding gastrostomy: complications and mortality. *Am J Surg.* 1982; 143:194–195. [PubMed: 6174050]
- Steffes C, Weaver DW, Bouwman DL. Percutaneous endoscopic gastrostomy. New technique-old complications. *Am Surg.* 1989; 55:273–277. [PubMed: 2497666]
- Gauderer MWL, Ponsky JL, Izant RJ Jr. Gastrostomy without laparotomy; a percutaneous endoscopic technique. *J Pediatr Surg.* 1980; 15:872–875. [PubMed: 6780678]
- Gauderer MWL. Percutaneous endoscopic gastrostomy-20 years later: a historical perspective. *J Pediatr Surg.* 2001; 36:217–219. [PubMed: 11150469]
- Wolfer JA. Jejunostomy with jejunal alimentation. *Ann Surg.* 1935; 101:708–725. [PubMed: 17856506]
- Lewis BS. Perform PEJ, not PED. *Gastrointest Endosc.* 1990; 36:311–313. [PubMed: 2114341]
- Maple JT, Peterson BT, Baron TH, Gostout CJ, Wong Kee Song LM, Buttar JS. Direct percutaneous endoscopic jejunostomy: outcomes in 307 consecutive attempts. *Am J Gastroenterol.* 2005; 100:2681–2688. [PubMed: 16393220]
- Zopf Y, Rabe C, Bruckmoser T, Maiss J, Hahn EG, Schwab D. Percutaneous endoscopic jejunostomy and jejunal extension tube through percutaneous endoscopic gastrostomy: a retrospective analysis of success, complications, and outcome. *Digestion.* 2009; 79:92–97. [PubMed: 19279384]
- Bisgard JD. Gastrostomy-jejunal intubation. *Surg Gynecol Obstet.* 1942; 74:239–241.
- Harris BH, Vassy E, Klecker R. Transgastric jejunal intubation. *Surg Gynecol Obstet.* 1973; 137:288. [PubMed: 4198777]
- Salky B, Kreel I, Gelernt I, Bauer J. Nonoperative conversion of tube gastrostomy to feeding jejunostomy. *Am J Surg.* 1982; 143:387–388. [PubMed: 6802011]
- Strife JL, Dunbar JS, Rice S. Jejunal intubation via gastrostomy catheters in pediatric patients. *Radiology.* 1985; 154:249. [PubMed: 3917303]
- Strodel WE, Eckhauser FE, Dent TL, Lemmer JQ. Gastrostomy to jejunostomy conversion. *Gastroint Endosc.* 1984; 30:35–36.
- Lewis BS, Mauer K, Bush A. The rapid placement of jejunal feeding tubes: the Seldinger technique applied to the gut. *Gastroint Endosc.* 1990; 36:139–141.
- Gottfried EB, Plumser AB. Endoscopic gastrojejunostomy: a technique to establish small bowel feeding without laparotomy. *Gastrointest Endosc.* 1984; 30:355–357. [PubMed: 6439594]
- Ponsky JL, Aszodi A. Percutaneous endoscopic jejunostomy. *Am J Gastroenterol.* 1984; 79:113–116. [PubMed: 6421149]

22. DiSario JA, Foutch PG, Sanowski RA. Poor results with percutaneous endoscopic jejunostomy. *Gastrointest Endosc.* 1990; 36:257–260. [PubMed: 2114338]
23. Ho CS. Percutaneous gastrostomy for jejunal feeding. *Radiology.* 1983; 149:595–596. [PubMed: 6414046]
24. Boyd JW, DeLegge MH, Shamburek RD, Kirby DF. The buried bumper syndrome: a new technique for safe, endoscopic PEG removal. *Gastrointest Endosc.* 1995; 41:508–511. [PubMed: 7615233]
25. Venu RP, Brown RD, Pastika BJ, Erikson LW. The buried bumper syndrome: a simple management approach in two patients. *Gastrointest Endosc.* 2002; 56:582–584. [PubMed: 12297784]
26. Braden B, Brandstaetter M, Caspary WF, Seifert H. Buried bumper syndrome: treatment guided by catheter probe US. *Gastrointest Endosc.* 2003; 57:747–751. [PubMed: 12709714]
27. Stylianides NA, Date RS, Pursnani KG, Ward JB. Jejunal perforation caused by a feeding jejunostomy tube: a case report. *J Med Case Reports.* 2008; 2:224. [PubMed: 18590544]
28. Siegle RL, Rabinowitz JG, Sarasohn C. Intestinal perforations secondary to nasojejunal feeding tubes. *AJR Am J Roentgenol.* 1976; 126:1229–1232. [PubMed: 179386]
29. Chou TD, Ue ST, Lee CH, Lee TW, Chen TM, Wang HJ. Duodenal perforation as a complication of routine endoscopic nasoenteral feeding tube placement. *Burns.* 1999; 25:86–87. [PubMed: 10090391]
30. Tong Z, Li W, Wang X, Ye X, Li N, Li J. Duodenal perforation due to a kink in a nasojejunal feeding tube in a patient with severe acute pancreatitis: a case report. *J Med Case Reports.* 2010; 4:162. [PubMed: 20509898]
31. Flores JC, Lopez–Herce J, Sola I, Carrillo A. Duodenal perforation caused by a transpyloric tube in a critically ill infant. *Nutrition.* 2006; 22:209–212. [PubMed: 16459234]

Figure 1.
CT scan revealing extraluminal jejunal tube extension (short arrow) and air in the mesentery (long arrow).

Figure 2.
CT scan revealing extraluminal jejunal tube extension (short arrow) and contrast in the mesentery (long arrow).

Figure 3.
CT scan revealing intraluminal contrast (short arrow) and the jejunal extension tube perforating the small bowel with the tip intraperitoneally (long arrow). Large quantities of intraperitoneal fluid collection is visualized (asterisks), expectedly tube feeds.