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Review Article

Recent update of percutaneous radiologic jejunostomy

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ABSTRACT

Although percutaneous radiologic jejunostomy has not been widely accepted as a primary insertion technique due to the technical difficulty for inexperienced operators, it may be a crucial procedure for patients with previous gastrectomy or an otherwise inaccessible stomach, particularly in patients who are not candidates for a surgical jejunostomy. Targeting the appropriate target jejunal loop and affixing the bowel with a t-fastener anchor are the most important and challenging technical steps. Technical success rate ranged from 92% to 100% based on 19 to 106 patients in several representative reports, with major complications ranging from 3.9% to 13.0%.

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Keywords: Enteral nutrition; Enterostomy; Jejunostomy

Introduction

Although gastrostomy and gastrojejunostomy tube insertion are the most popular and reliable method for long-term enteral nutrition, some patients cannot undergo gastrostomy or gastrojejunostomy due to a history of gastrectomy, gastric outlet obstruction, or inadequate window for gastric access due to an intrathoracic stomach or overlying colon.¹ In these cases, patients may require jejunostomy tube insertion via open surgery, laparoscopic surgery, endoscopic, or radiologic techniques.

Jejunostomy tubes insertion is most commonly performed using surgical techniques, often as an adjuvant procedure during major upper gastrointestinal tract surgery in patients with expected complicated postoperative recovery, particularly those needing subsequent chemotherapy or radiation therapy. Open jejunostomy tube insertion is the historically gold standard method and is performed with high success and low complication rates. More recently, laparoscopic jejunostomy tube insertion has become popular, also with high success and low complication rates.²

Percutaneous radiologic jejunostomy (PRJ) has not been widely accepted as a primary method for jejunostomy tube insertion due to the technical complexity, which is considerably more difficult than gastrostomy tube insertion.¹ Firstly, the jejunal lumen is markedly smaller than the stomach, which prevents ease of insertion of multiple T-fasteners around the jejunal access, which

is easily accomplished with gastric access. Secondly, given the numerous loops of jejunum, ileum, and colon that are overlapping and difficult to differentiate, it can be difficult to identify a suitable loop of anteriorly located proximal jejunum that does not have an interposed loop of decompressed bowel between the target loop and the anterior abdominal wall. Finally, it can be quite difficult to puncture a relatively decompressed and mobile small bowel loop. Distension of small bowel with air or fluid tends to distend all loops of bowel both proximal and distal to the target loop, which can make identification of a proximal loop even more difficult. However, despite these challenges, multiple reports have shown high technical success rates.^{3–6} In this review article, indication, devices and techniques, outcomes, and complications are presented.

Indications and Contraindications

In patients with inadequate food consumption for recovery or sustenance, enteral feeding is the ideal first option. Whereas gastric feeding is optimal via nasogastric tube or gastrostomy, in patients with gastroparesis, gastric outlet obstruction, pancreatitis, and severe esophageal reflux with aspiration, post-pyloric feeding may be needed. While gastrojejunostomy tube insertion has shown a high technical success and safety, patients with prior gastrectomy or suboptimal stomach positioning behind the

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ribs, within the thorax (hiatal hernia), or with colon interposed between the stomach and anterior abdominal wall may be inappropriate for gastric access. Furthermore, approximately 10% to 15% of patients with a gastrojejunostomy tube will have recurrent migration of the tip into the stomach, making this method suboptimal. Thus, jejunostomy tube insertion may be required as the final means for enteral feeding. While surgical jejunostomy tube insertion is often first line, patients may not be candidates if they have had extensive prior abdominal surgery and intestinal adhesions or if they have excessive comorbidities for general anesthesia. In fact, a prior study comparing surgical to PRJ techniques showed that prior major abdominal surgery was associated with a higher complication rate for a surgical

approach, but not for a percutaneous radiologic approach.³ This was thought to be due to abdominal adhesions that helped minimize bowel mobility, which is advantageous for percutaneous radiologic insertion but not surgical insertion. Conversely, obesity was found to be a significant risk factor for major complications with percutaneous jejunostomy tube insertion but not surgical insertion. Ascites will often result in some degree of bowel wall edema, which can make the bowel loop more difficult to puncture and dilate. With recent innovations in placement technique, there are now fewer contraindications (Table 1).

Table 1 Indications and Contraindications of Primary Radiologic Jejunostomy

Indication	Contraindication	
	Absolute	Relative
Previous gastric surgery (i.e., gastrectomy)	Unsatisfactory percutaneous access route	Ascites
Abnormal gastric position	Peritoneal dialysis	Uncorrectable coagulopathy
Chronic aspiration from gastric feedings (i.e., gastroparesis, GERD)	Morbid obesity	Mild to moderate obesity
Gastric outlet obstruction	Portal enteropathy, enteritis	
Pancreatitis, pancreatic injury or surgery to bypass the pancreatic duct and allow the pancreas to heal	Massive ascites	
After major upper GI tract surgery (i.e., esophagectomy)		
Feeding distal to a gastric or jejunal injury or fistula		

GERD, gastroesophageal reflux disease; GI, gastrointestinal.

Fig. 1. A 56-year-old female with prior sleeve gastrectomy in need of enteral feeding. (A) After air insufflation of jejunum through a 5-Fr catheter introduced through the nostril, fluoroscopic image demonstrates puncture of a loop of proximal jejunum with a T-fastener needle with injection of iodinated contrast confirming appropriate puncture. (B) Insertion of guidewire through the needle after deployment of one T-fastener. (C) Insertion of a 4-Fr vascular sheath, through which additional T-fasteners were deployed. (D) Final image after insertion of the 12-Fr balloon-retained jejunostomy tube shows good contrast opacification of the bowel without evidence of extraluminal contrast.

Devices and Techniques

The patient fasts from the evening prior to the procedure, and informed consent is obtained. For sedation and pain relief, intravenous midazolam and fentanyl citrate can be combined. Prophylactic antibiotics for enteric organism coverage can be administered, such as a combination of cefazolin (2,000 mg; Yuhan, Seoul, Korea) with metronidazole (500 mg; Alvogen Korea, Seoul, Korea).

Several techniques for PRJ tube insertion have been reported in the literature that primarily differ with regard to image guidance technique: fluoroscopy with air insufflation targeting, fluoroscopy with radiopaque target, ultrasound-guided with fluid targeting, or a hybrid approach. Each technique has advantages and disadvantages. The most crucial criteria is enabling targeting and puncture of a loop of bowel that is subjacent to the anterior abdominal wall, to ensure that no other loops of bowel are transgressed by the needle. It is ideal to insert the tube as proximal as possible, in order to maximize the length of bowel that can provide absorption of the feeds.

The largest published study to date consists of 106 patients who underwent PRJ using a 12-Fr balloon-retained jejunostomy tube using fluoroscopy with air insufflation targeting (Fig. 1).³ Approximately 30 seconds after intravenous injection of 1 mg of

glucagon to minimize peristalsis, the jejunum is insufflated with air through a nasojeunal tube or a 5-Fr angiographic catheter to distend and visualize air-filled jejunum until an adequate anterior loop is identified just under the abdominal wall. Manual palpation under fluoroscopy is utilized to identify appropriate loops of bowel, as air-filled bowel loops immediately under the anterior abdominal wall are easily compressible and deformable with manual compression. Once an appropriate anterior loop of bowel is identified, a 5-mm incision is made, and a T-fastener needle is used to access the bowel using a rapid thrust. Successful puncture is confirmed by injection of iodinated contrast medium. The T-fastener is deployed through the needle into jejunum with a guidewire. A second T-fastener is deployed either through a 4-Fr vascular sheath or the outer portion of a triaxial dilator. After serial dilation, a 15-Fr peel-away sheath is then inserted. During all dilation steps, it is crucial to exert tension on the T-fastener thread, in order to stabilize the jejunal wall. A custom-length (balloon-to-tip length of approximately 20–25 cm) 12-Fr balloon-retained MIC jejunostomy tube (Avanos Medical, Alpharetta, GA, USA) is inserted over the guidewire through a 15-Fr peel-away sheath. The balloon is inflated with 3 mL of a fluid mixture consisting of saline solution and approximately 0.5 mL of iodinated contrast medium to aid in fluoroscopic visualization. After cinching the disc to the skin to ensure a slight amount of

Fig. 2. A 61-year-old male with prior intrathoracic esophagectomy in need of enteral feeding. (A, B) Anteroposterior and lateral fluoroscopic images show the most superficial puncture target (arrows) of the inserted 7.5-Fr multifunctional coil catheter in the jejunum. (C) A Chiba needle (arrows) was then inserted into the target jejunum closest to the abdominal wall after contrast and air injection through the catheter. (D) After exchange of the Chiba needle with a 6-Fr Neff catheter over a 0.018-inch guidewire (not shown), a suture anchor (arrowheads) was pushed into the jejunum by a 0.035-inch Amplatz guidewire (arrows). (E) Tract dilation was performed with serial dilators (arrows). (F) A 14-Fr pigtail-type tube was inserted into the jejunal lumen, and the image shows good contrast opacification of the bowel without evidence of extraluminal contrast.

tension between the balloon and retention disc, all T-fasteners are cut, except for one that is secured to the retention disc. By doing so, slippage of the disc is prevented, which ensures optimal apposition of the balloon to the jejunostomy site, and also ensures secure jejunopexy.

Hu et al⁴ reported a hybrid fluoroscopy technique, utilizing both air insufflation and radiopaque catheter targeting technique in 51 patients with insertion of a pigtail-type jejunal tube (Fig. 2). Intravenous administration of 20 mg hyoscine butylbromide (Buscopan; Boehringer Ingelheim, Ingelheim, Germany), which is an anticholinergic antispasmodic agent, is used to inhibit bowel motility. The jejunum is first catheterized through the nose or mouth using a 150-cm, 7.5-Fr multifunctional coil catheter (S&G Biotech, Yongin, Korea) under fluoroscopic guidance. Approximately 5 to 10 mL of water-soluble contrast medium and 200 to 300 mL of air are then injected through the catheter to delineate and insufflate the jejunum. Under frontal and lateral fluoroscopy of the abdomen, the tip of the catheter should be ideally located in an air-filled proximal jejunal loop that is sufficiently close to the anterior abdominal wall, which will serve as a radiopaque target. The jejunum is punctured with a 21-gauge Chiba needle (Cook, Bloomington, IN, USA) with the inserted catheter tip as a target. The position of the needle within the jejunal lumen is confirmed fluoroscopically by injecting a small amount of water-soluble contrast medium through the needle. After confirming the proper intraluminal positioning of the needle, a 0.018-inch guidewire is advanced as far as possible into the jejunal lumen to allow the insertion of a 6-Fr Neff catheter (Cook). A single suture anchor (Cook) is then deployed into the jejunal lumen through the Neff catheter with use of a 0.035-inch hydrophilic guidewire. The Neff catheter is then removed, leaving the guidewire in place. During tract dilation with 8 to 14-Fr dilators over the 0.035-inch guidewire, traction is maintained on the suture to stabilize the jejunum, then, a 14-Fr locking loop catheter (Wills Oglesby percutaneous gastrostomy set; Cook) is inserted.

In other smaller series, other authors have reported the insertion of fluoroscopically visible targets into the jejunum, such as snares and balloons, to aid in the puncture of a loop of jejunum; however, advancement of these devices into a proper loop of jejunum can be difficult.⁴⁻⁶ Furthermore, it can be challenging to know whether there may be intervening loops of bowel that are at risk of transgression, particularly when adhesions are present.

Although fluoroscopy is the primary imaging method for guidance, ultrasound can also be used as the primary technique for jejunal puncture, using saline infusion into the jejunum in order to distend loops of jejunum and aid in visualization.⁷ Small bowel that is distended with fluid can be visualized with great detail under ultrasound, when located directly under the abdominal wall. This technique also allows definitive confirmation that no intervening structures, such as decompressed loops of bowel are being traversed en route to the target jejunal loop.

While jejunopexy is critical to prevent the loss of intestinal access during dilation steps, the benefit of multiple anchors is uncertain.⁴ Since the jejunal wall is thinner than the stomach wall, dilation of the intestinal wall may require less T-fastener suture tensile strength. However, loss of intestinal access after prior dilation steps can be highly problematic if it results in intestinal leakage, with very low likelihood to re-access the same loop of bowel if it is mobile. A single T-fastener anchoring device appears to be adequate in most PRJ procedures,⁴ although the use of two is common as well.³ Dense adhesions and abdominal wall scar tissue can make dilations steps extremely difficult, with increased likelihood for breakage of the T-fastener suture; in such cases, balloon

dilation of the tract with a noncompliant balloon will help facilitate insertion of a peel-away sheath.

Outcomes

Reported technical success rates of PRJ were 92% to 100% based on 19 to 106 patients in several representative reports.³⁻⁶ Pooling patients from the largest studies, the mean technical success rate of these four reports was as high as 97.0% (195/201).³⁻⁶

The reported causes of technical failures were inability to insufflate the jejunum secondary to failure to pass the catheter and failed puncture of the undistended jejunum or failure to introduce the Neff catheter into the jejunum,⁶ failure to identify an acceptable loop of jejunum or failure to insert the tube as a result of loss of guidewire access,³ or placement of the tube into the descending colon, initially misidentified as jejunum.⁵ Therefore, inability to insufflate the target jejunal loop or loss of guidewire access during catheter or tube insertion were the main causes of technical failure.

Compared with laparoscopic jejunostomy, PRJ showed comparable technical success rates (95% for laparoscopic jejunostomy vs 97% for PRJ) and comparable major procedural complications (6% for laparoscopic jejunostomy vs 5% for PRJ) in one report.³ The authors also reported that patients with obesity have better outcomes with laparoscopic jejunostomy whereas patient with prior major abdominal surgery have better outcomes with PRJ, presumably because intestinal adhesions complicate surgical isolation of a target loop, whereas adhesions minimize intestinal mobility, which is favorable for PRJ.

Complications

Reported major complication rates of PRJ were 3.9% to 13.0% based on 19 to 103 patients in several representative reports. The mean major complication rate of these four reports was 5.6% (11/196).^{3,4,6}

The most feared complication is leakage of bowel contents into the peritoneal cavity, either from an inadvertent puncture of bowel separate from the primary access site, or from around the tube primary access site, which can result in peritonitis, sepsis, and death. Localized collections can be managed with percutaneous drainage procedures, but cases that entail continuous leakage will require laparotomy with washout and surgical closure of the defect. Due to a tiny amount of leakage that may occur during the procedure, it is prudent to provide prophylactic antibiotic coverage for enteric organisms. The leakage may also cause severe pain and ileus, which can be managed with antibiotics, delayed jejunostomy feeding, and percutaneous drainage procedures. Pericatheter leakage may occur more often with a 17-gauge needle puncture than a 21-gauge needle puncture when multiple punctures are performed.⁶ In one series, 20% of patients had transient ileus that resolved by post-procedure day 2, 45% had benign pneumoperitoneum that resolved uneventfully (presumed related to intraprocedural leakage of air from the puncture site), and in cases where the jejunostomy tube were inserted in a retrograde direction, no issues with feeding or complications were identified, suggesting that the direction of the tube relative to peristalsis is unimportant.⁸

Another type of complication that the operator should be aware of, is traversal of a decompressed loop of bowel en route to the target loop.³ In this case, the complication was identified by small bowel obstruction at the site of insertion due to the jejunopexy firmly compressing the transgressed loop. Once identified,

mini laparotomy was performed to release the tethering, repair bowel defects, and insert a new tube. Such a complication can be avoided with meticulous choosing of a target loop that is just under the abdominal wall. Ultrasound may also be of value to identify intervening decompressed bowel loops.

Minor complications such as superficial skin infection, superficial cellulitis and puncture site pain can occur in 5.3% to 8.7%, and can be managed conservatively.^{4–6}

Postprocedural and Follow-up Care

Patients are generally kept nil per os and nothing per jejunostomy tube for at least 24 hours, in case of ileus resulting from peritonitis resulting from intra-procedural spillage of intestinal contents. Premature feeding can result in bowel distension, which may facilitate pericatheter leakage into the peritoneal cavity. Post-procedure antibiotics may be helpful for prophylaxis. If no pain is experienced by the patient and there is no significant pneumoperitoneum on abdominal radiograph the next day, feeding is initiated gradually. The T-fastener anchor suture can be cut one week after catheter placement or left until tract formation has occurred in 4 to 6 weeks.

Conclusions

Although PRJ can be challenging to perform, for experienced operators it has a high technical success rate and low major complication rate. For patients who are poor candidates for surgical jejunostomy tube placement, PRJ is a crucial method for patients with a previous gastrectomy or an inadequate window for gastric access who may be otherwise relegated to parenteral nutrition.

Conflicts of Interest

No potential conflict of interest relevant to this article was reported.

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