Strategies in Managing Chronic Pancreatitis–Placement of Direct Percutaneous Endoscopic Jejunostomy Feeding Tubes

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ABSTRACT: Patients with chronic pancreatitis (CP) often have maldigestion and malnutrition. Nutrition support during acute and CP traditionally has been provided by parenteral nutrition. In acute pancreatitis, jejunal feeding may accelerate resolution of the inflammatory process, protect against infection, and improve outcomes at a reduced cost when compared with parenteral nutrition. Jejunal feeding may also be beneficial for patients with CP. Prolonged jejunal access may be achieved *via* a direct percutaneous endoscopic jejunostomy (DPEJ). This article will review the rationale and evidence for jejunal feeding, indications and contraindictions for DPEJ placement, and the technique and outcomes of DPEJ in patients with CP.

Chronic pancreatitis (CP) is defined as an inflammatory disease of the pancreas characterized by persistent and often progressive lesions.[1] Patients with CP often have moderate to severe maldigestion and malnutrition. Abdominal pain, sitophobia (aversion to food), nausea, vomiting, and postprandial satiety contribute to poor oral intake. Gastric dysmotility and mechanical partial gastric and duodenal obstruction also contribute to malnutrition and limit oral intake. Complications of CP including pseudocysts, ascites, and recurrent flares of acute or CP often worsen with eating. Maldigestion because of pancreatic exocrine deficiency may be treated with enzyme supplements or elemental formulas, but unpleasant odor or taste may result in intolerance. Various combinations of these factors lead to significant weight loss and clinical decline. Nutrition during acute pancreatitis and CP has traditionally been provided by total parenteral nutrition (TPN) in an effort to rest the pancreas and allow resolution of the inflammatory process.[2] However, recent data suggest that jejunal feeding through nasoenteric tubes accelerates resolution of the inflammatory process, protects against infection, and results in decreased costs and improved outcomes in acute pancreatitis.[3–8] The pathophysiology of CP also suggests that enteral feeding into the jejunum may be beneficial and less expensive compared with TPN. Prolonged jejunal access in CP may be accomplished using direct percutaneous endoscopic jejunostomy (DPEJ).

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Rationale for Jejunal Feeding in CP

The most prevalent feature of CP is abdominal pain. The cause of abdominal pain is incompletely understood and often multifactorial, as noted above. Pain is frequently exacerbated by meals as a result of pancreatic acinar cell stimulation. Cholecystokinin (CCK) is a potent stimulator of pancreatic secretion. CCK releasing factor (CCK-RF) is a trypsin-sensitive protein that regulates the release of CCK. In the absence of oral intake, CCK-RF is degraded in the duodenum by trypsin. In the presence of oral intake, ingested intact protein competes with CCK-RF for trypsin, increasing the amount of CCK-RF in the duodenum. In response to increased CCK-RF levels, CCK levels rise and may lead to increased pancreatic secretion and pain.[1] Pancreatic secretion is also stimulated by triglycerides and fatty acids in the duodenum. Maximal stimulation occurs with long-chain fatty acids, whereas decreased stimulation occurs with medium-chain triglycerides.[9]

These mechanisms suggest pancreatic stimulation may be decreased by ingesting medium-chain triglycerides, degrading CCK-RF through high doses of exogenous pancreatic enzymes, or avoiding orally ingested protein (specifically intact protein). Support for this premise is the report that orally administered Peptamen (Nestle, Deerfield, IL), which contains primarily medium-chain triglycer-

ides and hydrolyzed peptides, increases CCK levels significantly less than a standard polymeric formula in healthy volunteers.[10]

TPN is another method to reduce stimulation of the exocrine pancreas and has been used in acute and CP in order to rest the pancreas. Parenteral nutrient infusion does not seem to significantly stimulate pancreatic secretion.[11,12] The degree of pancreatic stimulation with enteral feeding appears to decrease as the level of nutrient infusion descends in the gastrointestinal tract. Oral or gastric feedings markedly increase pancreatic secretion by stimulation of the cephalic, gastric, and intestinal phases of exocrine pancreatic secretion. In contrast, jejunal infusion is associated with either no increase or insignificant increases in volume, bicarbonate, and protein content in most canine and human studies.[13,14] Elemental or semielemental formula compared with standard polymeric diets may result in even less pancreatic stimulation, regardless of the level of nutrient infusion.[15] In CP with exocrine insufficiency, semielemental and elemental formulas are also absorbed better than polymeric formulas. Although the concept of that decreasing pancreatic stimulation in these settings makes physiologic sense, the benefits of pancreatic rest in the management of CP and its complications have never been definitely demonstrated.

Nonetheless, the goals of management of CP are to minimally stimulate the exocrine pancreas and to provide optimal nutrition support. TPN may provide this, but is not the best choice in the outpatient setting because of high costs and metabolic and infectious complications. Jejunal feeding (especially with elemental diets) results in clinically insignificant stimulation of the pancreas in most cases and is not associated with the cost and complications of TPN. The benefits of enteral jejunal feeding compared with parenteral nutrition support have been clearly demonstrated in acute pancreatitis. Randomized controlled trials of nasojejunal feeding *vs* TPN have demonstrated decreased infectious complications, overall complications and costs, faster resolution of inflammatory markers, and shorter intensive care unit (ICU)/hospital stays.[3,4,6,16] Jejunal feeding also avoids many of the limitations of oral feeding noted above, including nausea and vomiting resulting from gastric dysmotility and anatomic narrowing of the gastric outlet and duodenum and intolerance to exogenous enzymes or elemental formulas.

Parenteral nutrition has also been found to be useful in the management of complications of CP, including necrosis, pseudocysts, ascites, and fistula. Unfortunately, most of these studies have been confined to anecdotal retrospective small case series and have not compared TPN with enteral nutrition support. Patients with pseudocysts or subfulminant inflammatory fluid collections are often managed medically with TPN to allow for maturation before more invasive intervention. However, TPN-related complications have been reported to occur in up to 35% of patients with pseudocysts managed with parenteral nutrition.[17] Given the low level of pancreatic stimulation with distal enteral infusion, it seems reasonable to manage these complications of CP with an initial trial of jejunal feeding and use parenteral nutrition only if enteral feeding fails.

Nasoenteric feeding tubes are uncomfortable, often become clogged or dislodged, and are unattractive in the outpatient setting. Percutaneous access is indicated when enteral feeding is required for >30 days.[18] Prolonged jejunal access may be obtained with percutaneous endoscopic gastrostomy with a jejunal extension (PEGJ) and DPEJ tubes. However, the narrow caliber jejunal tubes in PEGJs cause many of the same problems as nasojejunal tubes including clogging and dislodgement. Two retrospective studies comparing DPEJ and PEGJ have demonstrated significantly prolonged tube function with DPEJs.[19,20]

Evidence for Jejunal Feeding in CP

The literature on the use of jejunal feeding in the management of CP and its complications is sparse in the form of mostly uncontrolled, retrospective series published in abstracts. In a very small pilot study, 6 patients with CP and postprandial pain received oral Peptamen in addition to a low-fat diet. After 10 weeks, pain scores were reduced 70%.[10] Some patients developed nausea, vomiting, and bloating, suggesting that jejunal feeding may have been better tolerated than the oral route. In a small retrospective study, patients with a necrotizing exacerbation of CP supported with nasojejunal feeding had fewer endoscopic and surgical interventions and improved healing compared with patients supported with parenteral nutrition.[21] In a larger retrospective study of 74 patients with refractory acute pancreatitis, significantly fewer patients who were discharged to home with nasojejunal feeding tubes were readmitted for recurrent pancreatitis than those discharged on oral diet.[22] In the only prospective study of nutrition management of pancreatic complications, patients with pseudocysts were randomized to TPN or enteral nutrition infused into the proximal jejunum. The mean period of nutrition support was 19 and 24 days, respectively. Regression of pseudocysts and rate of complications were not different, but total costs were 25% less in the enteral nutrition group.[23] Another retrospective study reported on 13 patients with acute pancreatitis and CP, 11 of whom had pseudocysts. Twelve of the patients had PEGJ tubes and 1 had a DPEJ tube placed. All patients tolerated jejunal feeding, and the hospital costs of enteral feeding were significantly lower than the projected cost of parenteral nutrition.[24] A further study from the same investigators reported on 33 patients discharged to home with PEGJ or nasoje-

junal feedings for resolving pancreatitis. Seventy-seven percent of these patients achieved their nutritional goals, with the mean enteral feeding duration 105 ± 70 days. Interestingly, almost all (97%) of the patients were managed with standard polymeric formulas, though 42% required pancreatic enzyme supplementation.[25] Although very preliminary, these data suggest that enteral feeding into the jejunum is feasible, safe, and less expensive than TPN in the management of selected patients with CP and its complications. There are no data on whether a trial of nasojejunal feeding should be attempted to confirm tolerance and symptom relief before DPEJ placement, although this concept seems reasonable.

Indications/Contraindications for DPEJ Placement in CP

DPEJ placement is indicated when prolonged (>30 days) jejunal access is needed to manage CP and its complications. Extended jejunal feeding provides for minimal pancreatic stimulation while maintaining nutrition support. It seems reasonable to attempt jejunal feeding through a DPEJ whenever parenteral nutrition had previously been contemplated in the management of CP, reserving TPN for intolerance/failure of jejunal feeding. Specific areas of CP where jejunal feeding through a DPEJ may be useful include pain, complications, and malnutrition (Table 1). Pain is the most common symptom of CP requiring hospitalization. Pain may also limit oral intake, resulting in malnutrition. Both may be treated with DPEJ placement. Prolonged enteral nutrition using DPEJ may be required in management of an inflammatory fluid collection, necrosis, or pseudocysts for observation until resolution or maturation before invasive intervention. DPEJ support may be used to rest the pancreas in the treatment of pancreatic ascites or fistula. If jejunal feeding access was not obtained at the time of surgical intervention for pancreatitis, DPEJ can be placed and used during the recovery period.

Table 1
Indications for DPEJ in CP

Pain
Exacerbated by oral intake
Requiring multiple hospitalization
Resulting in malnutrition
Complications
Inflammatory fluid collection
Pseudocyst
Ascites
Fistula
Post-pancreatic surgery (if surgical jejunostomy not placed)
Malnutrition
Intolerance of exogenous pancreatic enzymes
Intolerance of supplemental nutritional formulas

DPEJ can also be used when malnutrition occurs with limitation of oral intake because of pain or intolerance of exogenous pancreatic enzymes, elemental formulas, or medium-chain triglycerides. As stated earlier, in patients without known tolerance to jejunal feeding, a trial using a nasojejunal feeding tube may be instituted to confirm symptom relief before DPEJ placement, although this has never been formally tested.

Contraindications to DPEJ use in CP are few. Inability to place DPEJ usually occurs because of inability to pass the scope into the jejunum or inability to achieve transillumination.[26] Ascites is a relative contraindication to PEG or DPEJ, but PEG placement has been described with drainage of ascites and management of recurrent ascites until gastric and abdominal wall apposition.[27] The other primary contraindication for DPEJ use in CP would be intolerance manifested by continued pain or worsened clinical outcome despite jejunal feeding. Elemental formulas enriched in medium-chain triglycerides may be substituted in this setting if standard polymeric formulas were initially used.

DPEJ Technique

Percutaneous jejunal access may be obtained using endoscopic (DPEJ or PEGJ), radiographic or surgical means. Surgical jejunostomy can be performed at the time of operation for pancreatitis or its complications by both the laparoscopic or open techniques. However, these techniques need general anesthesia and are associated with considerable morbidity and even mortality.[28] In addition, pancreatic surgery is often reserved for failure of medical management. Interventional radiologists may be able to achieve direct jejunal puncture using a combination of fluoroscopic and ultrasonographic assistance, but clinical experience with these techniques is limited. Radiologic placement is most successful in reestablishing jejunal access achieved by other means. Endoscopic jejunal access has been traditionally performed by the PEGJ technique.[18] It consists of passing an 8F to 12F jejunal extension tube through an existing or concomitantly placed PEG. Although technical success with this procedure is high, functional success is disappointing, with a high incidence of tube malfunction because of tube migration, kinking, and occlusion.[29,30] This has led to the development of the DPEJ technique to help alleviate these problems.

The DPEJ technique is similar to PEG placement. A long endoscope (colonoscope or enteroscope) is advanced into the small bowel. Endoscopic transillumination is performed from within the jejunum rather than from the stomach. A trocar is passed through the anterior abdominal wall directly into the jejunum. Once this direct access is achieved, a standard "pull-type" gastrostomy tube is inserted (Figs. 1 and 2). Although diagrammatically similar

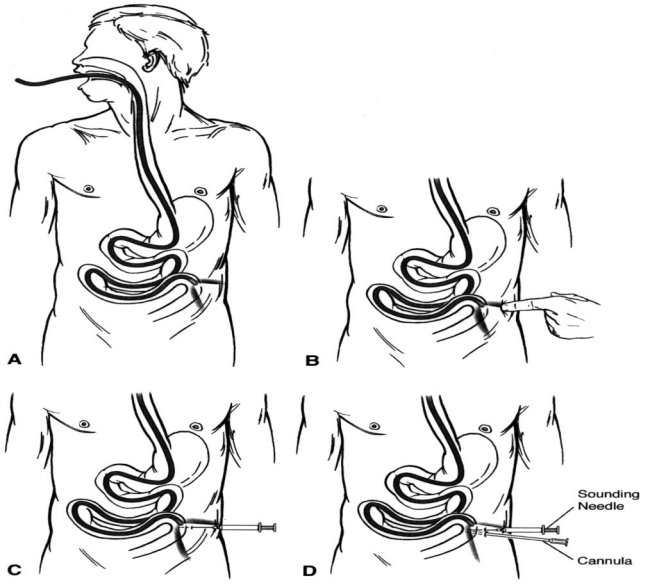

Figure 1. Schematic of DPEJ procedure. *A*, The enteroscope is advanced until transillumination is achieved. *B*, A discrete indention should be reproducible with direct depression at the site of transillumination. *C*, The sounding/anesthesia needle is inserted at the site of depression/transillumination and advanced until it is seen to enter the jejunal lumen under endoscopic visualization. *D*, The needle/cannula is inserted alongside the sounding needle. Reprinted from *Techniques in Gastrointestinal Endoscopy,* Vol. 3, Ginsberg GG. Direct percutaneous endoscopic jejunostomy, 42–49. © 2001, with permission from Elsevier.

to PEG placement, DPEJ placement is more difficult to perform.

The direct, transabdominal, jejunal puncture requires special attention. Some recommend using a 21-gauge 1.5-inch anesthesia administration needle as a sounding device to direct the trocar puncture into the jejunum. The needle puncture should be performed using a purposeful stabbing motion. Maintaining the sounding needle in place by securing it with a snare helps to stabilize the segment of jejunum and allows proper orientation for insertion of the larger 14-gauge trocar/needle cannula assembly alongside of the indwelling sounding needle. A kit has been developed expressly for DPEJ placement that combines the sounding needle and trocar, allowing a single puncture. A 120-inch insertion wire is inserted through the cannula and grasped by transferring the snare from the sounding needle to the cannula/wire. The procedure is completed as described for PEG placement. Fluoroscopic and ultrasonographic guidance has been described to increase success, but the authors have not found these techniques to be particularly useful. A separate decompression PEG may be placed at the same procedure for management of gastric outlet obstruction or gastroparesis that may accompany CP.

It may be beneficial to initially leave the DPEJ tube unclamped to vent the small bowel to allow decompression of the air insufflated during placement. However, enteral feeding may begin immediately at 50 mL per hour and adjusted to goal as tolerated.[31] Feeding may be started with standard polymeric formulas, but minimal pancreatic stimulation and improved nutrient absorption may best accomplished with semielemental or elemental formulas high in medium-chain triglycerides.

The patient's body habitus, specifically the thickness of the abdominal wall fat pad and the amount of omental fat, affect the ability to achieve transillumination. Therefore, the procedure is more likely to be successful in thinner patients. Prior abdominal surgery and, in particular, digestive tract surgeries wherein a portion of the gut has been removed or rerouted will increase the likelihood of success. DPEJ can be placed through prior surgical jejunostomy sites and through well-healed abdominal incision scars.[31]

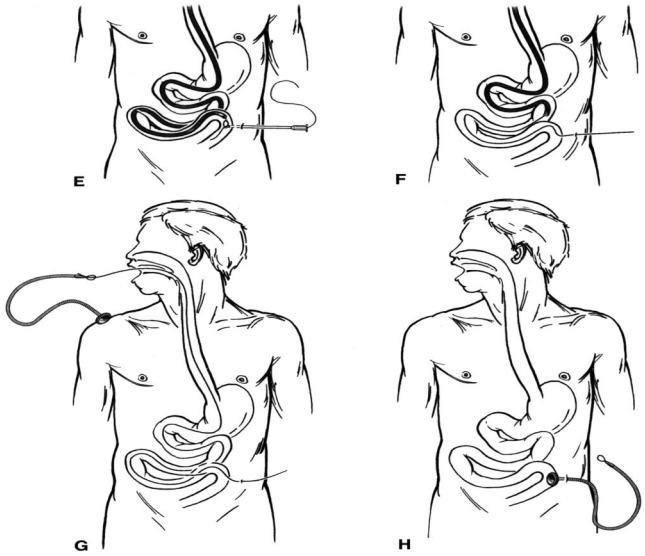

Figure 2. Schematic of DPEJ (continued). *E*, With the needle removed from within the indwelling cannula, the insertion wire is advanced through the cannula and grasped by the awaiting snare that extends from the tip of the endoscope. *F*, *G*, The scope is then removed, and the insertion wire is withdrawn with is so that one end of the insertion wire extends from the mouth and the other end extends from the abdominal wall. *G*, *H*, The attachment loop of the pull type gastrostomy feeding tube is tethered to the mouth end of the insertion wire and the assembly is pulled internally until the feeding tube has traversed the jejunal and abdominal walls and is pulled up snugly. Reprinted from *Techniques in Gastrointestinal Endoscopy,* Vol. 3, Ginsberg GG. Direct percutaneous endoscopic jejunostomy, 42–49. © 2001, with permission from Elsevier.

Outcome of DPEJ placement

Placement of DPEJ and PEGJ appears to be safe and feasible in patients with acute pancreatitis and CP. There are 3 retrospective series on DPEJ outcomes in noncritical care settings involving 231 patients.[32–34] Technical success is reported in 72% to 88% of patients. Failures were often caused by luminal obstruction that prevented passage of the endoscope or inability to transilluminate. Major complications requiring surgery occured in 2% of patients and included bleeding, abdominal wall abscesses, and colon perforations. Less severe peristomal infections developed in 7% of patients, enteric ulcers in 5%, and leakage in 8%. DPEJs were functional for 1 to 17 months, with a mean 113 days in cancer patients, most of whom succumbed to their underlying disease with a functional jejunal feeding tube. Sixty-four percent of cancer patients died with a functioning tube in place, and 26% resumed oral intake and had the tube removed.[32] There are no documented episodes of aspiration of feeding solution. DPEJ appears to provide significantly more stable jejunal access than PEGJ tubes, which have a high rate of proximal migration and other malfunction, as noted previously. Gastric access for decompression may be achieved by placement of a separate PEG rather than PEGJ. Tube-related malfunctions similar to those observed with PEG may still occur with DPEJ.

DPEJ placement is also feasible in the ICU setting. All of 17 mechanically ventilated patients from a cancer center had successful DPEJ placement, with a single reported complication.[35] There are only 2 reports of DPEJ placement in 3 patients specifically with pancreatitis. Two of 36 patients had successful DPEJ placement in the retrospective series by Rumalla and Baron.[33] In the previously noted report, 12 patients with pancreatitis mostly complicated by pseudocysts had successful PEGJ placement, and a single patient had successful DPEJ placement.[24]

Conclusion

Patients with CP and its complications need aggressive nutrition support. This has been traditionally provided by TPN. Outcomes in acute pancreatitis are improved with enteral compared with parenteral nutrition. The pathophysiology of CP suggests that enteral feeding should be applicable in most situations. Enteral feeding distal to the ligament of Treitz appears to result in minimal pancreatic stimulation, and this may be decreased further by using low-fat elemental formulas. Prolonged jejunal access in CP is best maintained by placement of DPEJ. Advances in techniques and equipment have made DPEJ placement efficient and technically successful, with low morbidity. Prolonged enteral feeding using a DPEJ may be beneficial in the management of pain, malnutrition, and other complications of CP. Although there are only isolated reports in the literature, the available data suggest that enteral feeding through a DPEJ is an appropriate initial means of nutrition support in the management of CP. Further studies are needed to better define the success, complications, and outcomes of DPEJ compared with parenteral nutrition in the management of CP.

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