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Endoscopic Ultrasound-Guided Pancreatic Duct Intervention

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Endoscopic ultrasound-guided pancreatic duct intervention (EUS-PDI) is an emerging endoscopic approach allowing access and intervention to the pancreatic duct (PD) for patients with failed endoscopic retrograde pancreatography (ERP) or patients with surgically altered anatomy. As opposed to biliary drainage for which percutaneous drainage is an alternative following failed endoscopic retrograde cholangiopancreatography (ERCP), the treatment options after failed ERP are very limited. Therefore, endoscopic ultrasound (EUS)-guided access to the PD and options for subsequent drainage may play an important role as an alternative to surgical intervention. However, this approach is technically demanding with a high risk of complications, and should only be performed by highly experienced endoscopists. In this review, we describe an overview of the current endoscopic approaches, basic technical tips, and outcomes using these procedures. **Clin Endosc 2017;50:112-116**

Key Words: Drainage; Endoscopic ultrasound; Pancreas; Pancreatic duct intervention

INTRODUCTION

Endoscopic retrograde pancreatography (ERP) is considered the first-line, standard treatment for treating main pancreatic duct (MPD) obstruction, stricture or disruption.¹ Although ERP is widely performed, it is an especially challenging procedure when the gastroduodenal anatomy has been surgically altered and the papilla is not easily accessible, or when advancement of the guidewire through the papilla or anastomosis is not possible.² These challenges are mainly faced in cases of failed cannulation due to high-grade stricture, inability to identify the pancreatocojunostomy, and inability to reach the pancreatocojunostomy. Endoscopic ultrasound-guided pancreatic duct intervention (EUS-PDI) is an emerging endoscopic approach allowing access and intervention to the MPD for patients with failed ERP or with surgically altered anatomy. The development of EUS-PDI plays an important role as

an alternative to surgical intervention. On the other hand, this approach remains technically demanding with a high risk for complications, and so these procedures should only be performed by highly experienced endoscopists.^{3,4} Proper patient selection is of utmost importance, and indication and relative contraindications must be carefully assessed (Table 1). There are multiple studies with small numbers of cases that have described this technique,⁵⁻¹⁷ however no large prospective, well-controlled studies have been performed. In this review, we describe an overview of the current endoscopic approaches, basic technical tips, and outcomes using these procedures.

TECHNIQUE OF EUS-PDI

EUS-PDI can be divided into two main approaches that are performed to achieve endoscopic ultrasound (EUS)-guided pancreatic duct (PD) drainage: EUS-guided antegrade drainage and EUS-guided rendezvous technique. When the papilla or anastomosis in surgically altered anatomy is not accessible, EUS-guided rendezvous approach is not applicable.

EUS-guided antegrade drainage

EUS-guided antegrade drainage is performed by accessing the MPD under EUS-guided puncture and creating a

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Table 1. Indications and Relative Contraindications to Endoscopic Ultrasound-Guided Pancreatic Duct Intervention

Indications
1. Stenosis of the PJA with or without fistula
2. MPD hypertension secondary to PD stricture or stones in the MPD, or IPMN
3. MPD disruption
4. Failed ERCP (Inaccessible and difficult to access the papilla or anastomosis)
Relative contraindications
1. Unable to visualize PD on EUS
2. Multifocal PD strictures
3. Intervening vessels in the access route
4. Thrombocytopenia (<50,000)
5. Coagulopathy (international normalized ratio >1.5)
6. Hemodynamic instability

PJA, pancreatico-jejunal anastomosis; MPD, main pancreatic duct; PD, pancreatic duct; IPMN, intraductal papillary mucinous neoplasia; ERCP, endoscopic retrograde cholangiopancreatography; EUS, endoscopic ultrasound.

tract with subsequent antegrade placement of a stent across the pancreatic-gastric anastomosis, pancreatic-duodenal anastomosis, MPD stricture, papilla, or pancreatico-jejunal anastomosis (PJA).^{5,6,9,15,18,19} This approach can be subdivided into transluminal, transpapillary, or trans-anastomotic based on whether the stent traverses the site of ductal obstruction, papilla or anastomosis. Since an EUS-guided rendezvous technique is not feasible when the papilla or anastomosis cannot be accessed or passed with a wire, the antegrade approach is applied in such cases.

EUS-guided rendezvous technique

EUS-guided rendezvous achieves transpapillary or trans-anastomotic drainage using a rendezvous technique.^{7,20-26} This is achieved by retrograde stent placement from the papilla or anastomosis into the MPD via another endoscope. This procedure requires access to the papilla or anastomosis that has been traversed with a guidewire. In cases with surgically altered anatomy, this often requires balloon-assisted enteroscopy.

EUS-PDI PROCEDURE

First, the MPD is visualized and carefully assessed with a linear echoendoscope. A therapeutic channel echoendoscope is preferred to allow for broader usage of accessories and insertion of larger caliber stents. Under combined fluoroscopic

and EUS guidance, access into the MPD through the stomach or duodenum is achieved using a 19-gauge or 22-gauge fine aspiration needle.¹² Then, under fluoroscopic guidance, a pancreatogram is performed and a guidewire can be passed into the MPD. An 0.035-inch or 0.025-inch guidewire can be passed through a 19-gauge needle while 22-gauge needles require 0.018-inch guidewires. From this point onward, the approach between antegrade drainage and the rendezvous technique differs. The rendezvous technique is performed after the guidewire is successfully advanced across the papilla or anastomosis and coiled in the small intestine. The echoendoscope is then removed leaving the guidewire in place. Depending on the anatomy, a standard therapeutic duodenoscope, colonoscope, or balloon-assisted enteroscope is then advanced to the papilla or the anastomosis, where the PD can be accessed with the guidance of the EUS placed wire to perform retrograde interventions.

For antegrade PD drainage, the echoendoscope is used throughout the procedure for placement of a stent into the MPD via the stomach or the duodenum. Once guidewire access is achieved into the MPD, dilation of the transmural tract is performed. This can be done using the sheath on the fine needle aspiration (FNA) needle, tapered catheters, or cautery-assisted devices such as a needle knife or small caliber ringed catheter. Once catheter access to the MPD is achieved, the tract can be dilated using hydrostatic balloons prior to stent placement.

TECHNICAL TIPS

Currently there are no standard strategies for performing EUS-PDI, however here are our tips to consider when performing this procedure.^{19,27-29}

Access point

There are no data comparing the stomach and duodenum as access sites. In most cases, the patient's individual anatomy will dictate the approach. It is important to consider the distance between the EUS transducer and MPD, the presence of intervening vessels and the optimal angle between the needle and the MPD,⁸ although puncture through the antrum of the stomach may often prove more challenging due to the thicker muscle layer.

Needle size

Needle size can be 19-gauge or 22-gauge. 25-gauge needles are generally not used as there are no guidewires currently that can be passed through them. 19-gauge needles are more commonly used since this enables the use of 0.035 or 0.025-

inch guidewires. Choosing sharp tip needles over curved needles is important.

Guidewires

Choice of guidewire depends on the caliber of the needle used for MPD access and intent of the procedure. We generally prefer a stiffer, hydrophilic wire such as a 0.025, 0.032, 0.035-inch angled or straight guidewire especially when there is a long distance between the stomach wall and the duct, fibrotic pancreatic parenchyma, or a non-dilated MPD. When rendezvous is being performed, 0.035-inch stiff guidewires are suitable and may facilitate passage of the wire across a stenotic anastomosis or papilla.

Tract dilators

Dilators with stiff, tapered tips or 6.5-french electrical cautery dilators are preferred. Tapered endoscopic retrograde cholangiopancreatography (ERCP) cannulas, hydrostatic balloon catheters with ultra-tapered tips and bougie dilators with tapered tips are devices that can also be used. The use of diathermic catheters remains controversial since this may increase the risk of pancreatitis due to cautery effect.

Stents

Both straight, double pigtail plastic stents, or metallic stents can be used. Dedicated plastic stents for EUS-guided pancreatic drainage have been developed.³⁰ Fully-covered self-expanding metal stents (SEMS) are also reported to be effective in this setting.³¹ Uncovered metal stents should be avoided as there is a risk of pancreatic juice leakage between the stomach and pancreas. Currently, there is no consensus on the most suitable stent and thus the choice of stent will depend on each patient's anatomy.

Rendezvous technique

EUS-guided injection of the MPD with methylene blue and contrast through a needle may assist in identifying the papilla or anastomosis. If contrast passes into the intestine, traditional ERP can be performed.^{12,32} If contrast does not pass, an EUS-guided antegrade approach should be attempted.

OUTCOMES OF EUS-PDI

EUS-PDI is highly effective at achieving successful PD drainage but is associated with significant rates of complications. This procedure is technically demanding. Taking publication bias into account, actual success rates are likely lower than are reported. A limitation of this technique is that

it has only been described in retrospective studies with small sample sizes. Although there are several studies reporting outcomes using EUS-PDI, overall the data are quite limited.

Fujii-Lau and Levy recently performed a systematic review of studies that focused only on EUS-guided PD access while excluding case reports.²⁷ They identified 222 patients who underwent EUS-PDI and demonstrated a 77% rate of technical success with a clinical success rate of 70% using either the antegrade or rendezvous technique. Complications developed in 19% of the patients, and included abdominal pain (7.7%), pancreatitis (3.1%), bleeding (1.8%), perforation (0.9%), peripancreatic abscess (0.9%), stripping of the guidewire coating (0.9%), and one patient each who developed fever, pneumoperitoneum, pseudocyst, pseudocyst with an aneurysm, and perigastric fluid collection (0.5%).

Recently, an international, multicenter, retrospective study on the safety and efficacy of EUS-PDI after failed ERP was published.³³ 80 patients who underwent EUS-PDI at 4 academic centers in 3 countries were analyzed. Technical success was achieved in 89% and clinical success in 81% of patients. The success rate in this study was higher than previously reported, which is likely due to increased operator experience and improvements in endoscopic equipment. The transpapillary or trans-anastomotic approaches to stent placement via rendezvous wire access seemed to be the more successful technique, with a trend toward an increased likelihood of complete symptom resolution after adjusting for sex, diagnosis, anatomy, prior failed ERP, and technical success, but that was not statistically significant. Immediate adverse events (AEs) (<24 hours) occurred in 20% of patients, with 15% experiencing major complications (6 patients with post-ERCP pancreatitis, 4 who developed pancreatic fluid collections, one with a MPD leak, and one with an intestinal perforation. Delayed AEs (>24 hours) occurred in 11% of patients (all of whom also had immediate AEs—2 pancreatitis, 1 MPD leak, and 4 abscesses treated with antibiotics). The method of approach (antegrade vs. rendezvous) was not a predictor of immediate or delayed AEs, however this could have been due to the small sample size.³³

While EUS-PDI has been shown to be effective, it appears to be limited by its high rates of complications. However there have been no comparative studies between EUS-PDI and standard ERP. A recent international, multicenter, retrospective study was performed to compare these 2 modalities in terms of technical success, clinical success, and AE rates in patients with post-Whipple anatomy. 66 patients underwent 75 procedures (40 EUS-PDI and 35 ERP). Technical success of EUS-PDI was 92.5% compared with 20% in the ERP group (odds ratio [OR], 49.3; $p < 0.001$). Clinical success was achieved in 87.5% of EUS-PDI procedures compared with

23.1% in the ERP group (OR, 23.3; $p < 0.001$). However, AEs occurred more commonly in the EUS-PDI group (35% vs. 2.9%, $p < 0.001$). Procedure time and length of stay were not significantly different between the 2 groups. AEs included abdominal pain requiring hospitalization, intraabdominal abscesses and jejunal ulceration secondary to pancreatic stent placement.³⁴ Although there were no severe AEs with EUS-PDI in this study, the overall complication rate of 30% is very high. Even with the low technical success rates of 20%, ERP should remain a first-line treatment, even in patients with surgically altered anatomy, based on its superior safety profile. This is especially true considering the low case volume of EUS-PDI being performed, even at experienced, expert centers. It is also very important to emphasize that although this procedure may eventually become standard, improved accessories are needed. Finally, based on its technical difficulty and overall rarity, it is challenging to develop true expertise.

Potential contributing factors of treatment failure include small PD diameter, fibrotic pancreatic parenchyma, short length for guidewire insertion, lack of dedicated devices, lack of technical standard, and failure to navigate the guidewire through the site of obstruction, across the papilla or PJA.^{3,28} Other factors that make this procedure challenging include difficulty maintaining the position of the echoendoscope along the axis of the MPD and the difficult angle at which the PD is accessed. Despite the theoretical concerns of puncturing a small caliber PD, it is only stent placement that appears to pose a challenge. In a multicenter, retrospective study, the method of approach (antegrade vs. retrograde) was not a predictor of technical success after controlling for prior failed ERP, altered anatomy, and diagnosis.³³

The lack of long-term clinical outcomes needs to be emphasized. It is difficult to determine the need for re-intervention and to predict long-term clinical outcomes after initial successful intervention. Will et al. reported that 29% of patients having EUS-PDI ultimately required surgical intervention during a follow-up period of 4 weeks to 3 years.¹⁰ Stent dysfunction, including stent migration and occlusion, requiring multiple endoscopic interventions have been reported in up to half of the patients in several case series.^{9,13} The use of double pigtail plastic stents with scheduled stent replacement may reduce the rate of stent dysfunction, especially in cases requiring prolonged stent duration.

CONCLUSIONS

Although the technical and clinical success rates of EUS-PDI are improving, it remains a challenging procedure with a high risk of complication. More studies are needed to

evaluate the safety, efficacy and long-term outcomes while we await improved and innovative devices. As opposed to biliary access where percutaneous drainage is an alternative for failed ERCP, treatment options after failed ERP are limited. Considering the major limitations in alternative treatment options after failed ERP, EUS-PDI has the potential to become standard-of-care by avoiding more invasive and involved surgical interventions.

Conflicts of Interest

The authors have no financial conflicts of interest.

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