Interventional Endoscopic Ultrasound-Guided Cholangiopancreatography

Jennifer L. Maranki, MD, Michel Kahaleh, MD, and Vanessa M. Shami, MD

CONTENTS

Abstract

Interventional endoscopic ultrasound-guided cholangiopancreatography (IEUCP) is an alternative to percutaneous drainage or surgery in patients with obstructive jaundice who have failed conventional ERCP. The techniques of biliary and pancreatic drainage are described. The literature regarding this novel technique including complications is reviewed. Due to the technical complexity associated with this procedure, it should be reserved for endoscopists with advanced training in EUS and ERCP at tertiary medical centers.

Key Words: Biliary obstruction, Pancreatic obstruction, Endoscopic ultrasound-guided cholangiopancreatography, Rendezvous, Endoscopic ultrasound, Biliary decompression, Pancreatogastric fistula, Hepaticogastrostomy, Choledochoduodenostomy

From: *Clinical Gastroenterology: Endoscopic Ultrasound*,
Edited by: V. M. Shami and M. Kahaleh, DOI 10.1007/978-1-60327-480-7_16,

INTRODUCTION

Endoscopic retrograde cholangiopancreatography (ERCP) with stent placement is the procedure of choice for biliary decompression in patients with obstructive jaundice (1–3) and for strictures of the pancreas that are due to chronic pancreatitis (4–6) and other causes (7). Among experienced endoscopists, biliary and pancreatic duct decompression is successful in 90–95% of cases (8, 9). Failure to cannulate the bile duct may result from anatomic variation due to prior surgery, periampullary diverticula, tortuous ducts, impacted stones, or tumor infiltration (10–12). Pancreatic duct cannulation is typically successful in 90% of cases (9). Failures commonly result from pancreatic inflammation or surgically altered anatomy (12).

Following initial failed ERCP, the recommended next step is a reattempt by a more experienced endoscopist at a tertiary referral center (13, 14). Alternative means of achieving biliary decompression include percutaneous transhepatic drainage (PTC) (15–17), and surgical intervention (18). Both surgery and PTC followed by percutaneous or endoscopic drainage are associated with significant morbidity (19–21).

The evolution of the linear array echoendoscope as well as the ability to accurately guide a needle into the interventional field has greatly expanded the therapeutic potential of endoscopic ultrasound (EUS). EUS provides detailed imaging by approximating the frequency transducer to the area of interest. In the past decade, EUS has developed into a useful technique for fine needle aspiration (FNA) (22), pancreatic pseudocyst drainage (23–25), and celiac plexus block and neurolysis (26–32). Anatomically, the biliary tree and the pancreatic duct are in close proximation to the stomach and duodenum, thereby allowing visualization of the ducts from the EUS transducer. The natural progression was to extend the capabilities of EUS to the pancreaticobiliary system. The first cases describing Interventional EUS-guided cholangiopancreatography (IEUCP) were reported by Wiersema and colleagues in 1996 and involved 11 patients who had previously failed standard ERCP (33). More recently, IEUCP has been shown to be a feasible technique in achieving drainage of the respective system**.**

Patient Selection

Patients who present with biliary or pancreatic duct obstruction who have undergone and failed conventional ERCP at a tertiary care center by an experienced endoscopist are considered for candidacy for EUS-guided ERCP. Thorough imaging of the pancreaticobiliary tree, as well

as surrounding structures with CT or MRI is vital to identify the level of obstruction and outline the patient's anatomy. Since these procedures are typically longer in duration than standard ERCP, patients must undergo general anesthesia.

Endoscopist Selection

Since EUS-guided ERCP is a technically challenging procedure that bears a fair amount of risk when compared to conventional ERCP, ensuring adequate expertise in EUS and ERCP is mandatory. This goal can be accomplished either with a single operator who is highly skilled at both EUS and advanced endoscopy, or by two different endoscopists, one with experience in EUS, and the other in therapeutic ERCP. Furthermore, the procedure should be performed at a tertiary care center with experienced pancreatobiliary surgeons and interventional radiologists on hand in the event of a complication.

Patient Preparation

All patients should receive periprocedural antibiotics. Secondary to the longer duration and complexity of the procedure, patients should undergo general anesthesia for the procedure.

Techniques

Conventional ERCP should initially be reattempted on all patients. If it is unsuccessful again, then an EUS-guided technique should be considered. Patients should be consented specifically for the procedure.

A linear array echoendoscope with a working channel of at least 3 mm should be selected as this size accommodates stent placement when the procedure is performed in antegrade fashion. The Olympus GF-UCT 140 and the Pentax EG 38UT have working channels of 3.7 and 3.8 mm, respectively, and are ideal for the placement of a 10F stent, which is particularly useful when biliary drainage is attempted.

Puncture of the target duct is typically performed with either a 19- or 22-gauge needle (EUSN-19-T or EUS-1-CS; Cook Endoscopy). Despite being somewhat more difficult to use, the 19-gauge needle is preferred because it accommodates a 0.035-in. guidewire (Terumo; Microvasive), which provides more control than the 0.018-in. guidewire (Pathfinder; Microvasive Endoscopy, Boston Scientific Corp, Natick, MA).

Dilation of an enterocholedochal or pancreatic fistula can be accomplished with either a 4- or 6-mm wire-guided balloon catheter (MaxForce; Microvasive, Boston, MA) or a 6F or 7F bougie (SBDC-6 or -7; Wilson-Cook, Winston-Salem, NC).

EUS-guided Biliary Drainage

EUS-guided biliary drainage is typically attempted with either a transgastric-transhepatic (intrahepatic) or transenteric-transcholedochal (extrahepatic) approach. If the intrahepatic ducts are significantly dilated, the intrahepatic approach is preferred as this technique can provide antegrade stent placement across the ampulla without the need for a rendezvous procedure. Once the echoendoscope is adequately positioned, color doppler should be used to identify regional vasculature.

Intrahepatic Approach

The intrahepatic approach is performed with the echoendoscope positioned in the cardia or along the lesser curvature of the stomach to allow visualization of the dilated left intrahepatic biliary system. Once color doppler has excluded overlying vasculature, the EUS needle is advanced into the intrahepatic duct, bile is aspirated, and a small amount of contrast is injected to opacify the biliary tree, confirming position inside the bile duct (Fig. 1). A guidewire is then advanced antegrade through the EUS needle and into the bile duct (Fig. 2). With fluoroscopic and EUS guidance, the guidewire is manipulated beyond the biliary obstruction and across the ampulla into the duodenum. Once the guidewire has traversed the ampulla, the procedure can be completed in either an antegrade fashion or with a rendezvous technique.

For completing the procedure in antegrade fashion, a 6 or 7F bougie is utilized to dilate the tract (Fig. 3), followed by antegrade stent deployment across the stricture (Fig. 4).

If the rendezvous technique is chosen, the echoendoscope must be carefully removed while leaving the guidewire in place. A duodenoscope is inserted and advanced to the duodenum, with visualization of the ampulla and the wire exiting the ampullary orifice (Fig. 5). The wire is grasped with a snare and withdrawn through the accessory channel. Since access to the common bile duct has been achieved, the procedure can be completed using standard ERC with stent placement.

If the guidewire cannot be advanced into the duodenum, a transenteric fistula can be created by dilating the tract with a 4–6 mm wire-guided balloon catheter or a 6–7F bougie, followed by stent placement.

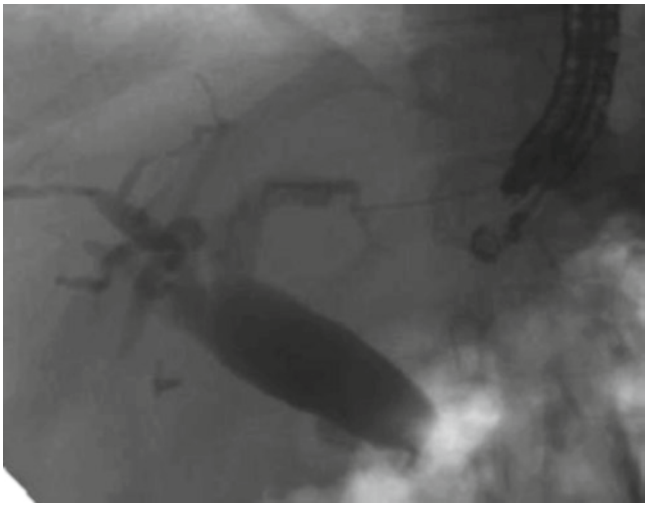

Fig. 1. Injection of contrast through the endoscopic ultrasound needle, demonstrating successful opacification of the intrahepatic duct.

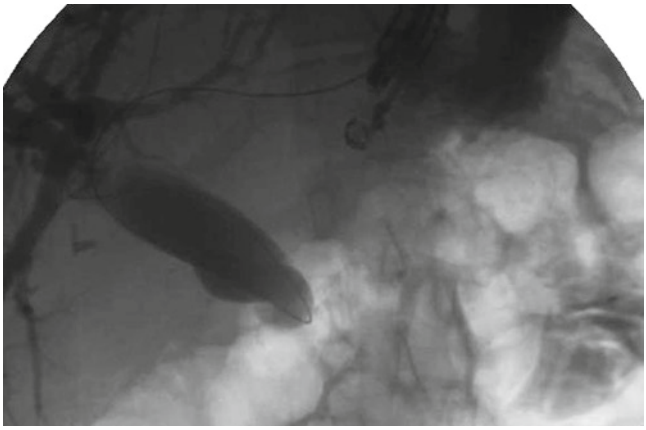

Fig. 2. A guidewire is advanced through the endoscopic ultrasound needle and into the biliary tree.

Extrahepatic Approach

To visualize the extrahepatic bile duct, the echoendoscope is typically positioned in the duodenum; it can also be positioned in the distal antrum, depending on the anatomy. After color doppler is used to identify adjacent vasculature, the EUS needle is then inserted into the bile

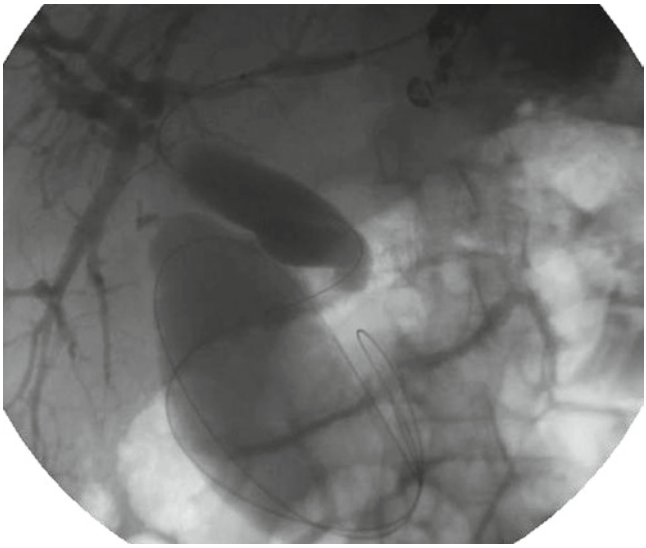

Fig. 3. Dilation of the tract between the stomach and the left intrahepatic duct in antegrade fashion.

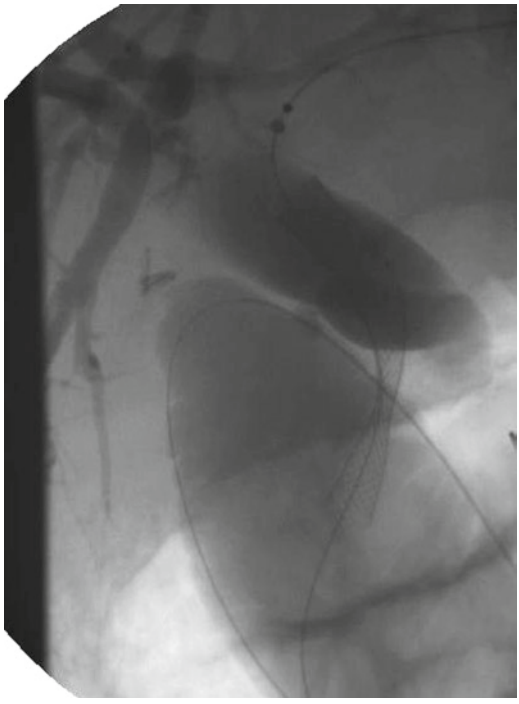

Fig. 4. Stent deployment into the left intrahepatic duct.

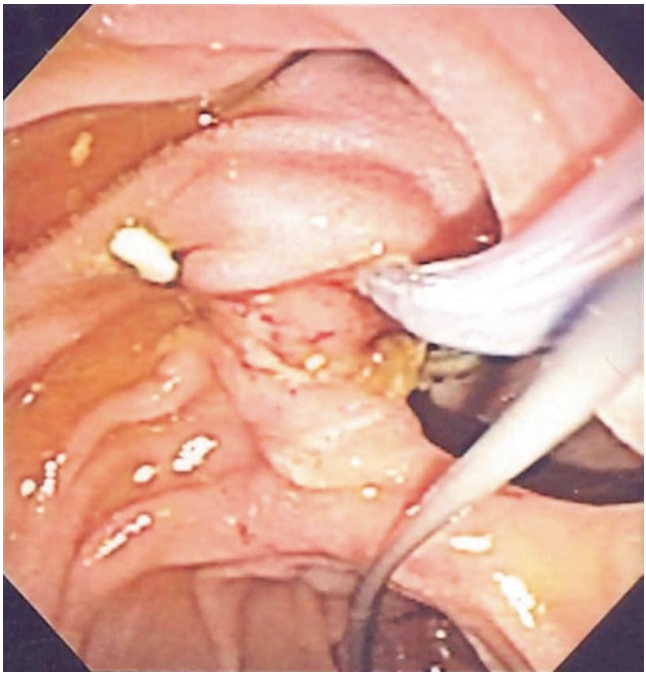

Fig. 5. Visualization of the wire exiting the ampullary orifice.

duct and the guidewire is advanced in an antegrade fashion across the ampulla and into the duodenum (Fig. 6). The remainder of the procedure is similar to that described above for the intrahepatic approach.

EUS-guided pancreatic drainage

By positioning the echoendoscope in the stomach, the main pancreatic duct is identified with EUS guidance and punctured with the EUS needle. A small amount of contrast material is injected and a pancreatogram is performed to confirm successful access to the pancreatic duct (Fig. 7). A guidewire is advanced through the needle and into the pancreatic duct, with subsequent antegrade advancement of the wire into the duodenum, if possible. If the guidewire cannot be advanced in an antegrade fashion, it should be advanced retrograde into the pancreatic duct. After ductal access has been achieved, a pancreatogastric fistula is enlarged with a 6F or 7F bougie followed by balloon dilation with a 4- or 6-mm MaxForce dilator (Fig. 8). Intraductal strictures should be dilated with either the bougie or balloon catheter. A 7F stent is then placed through the pancreatogastric fistula (Fig. 9).

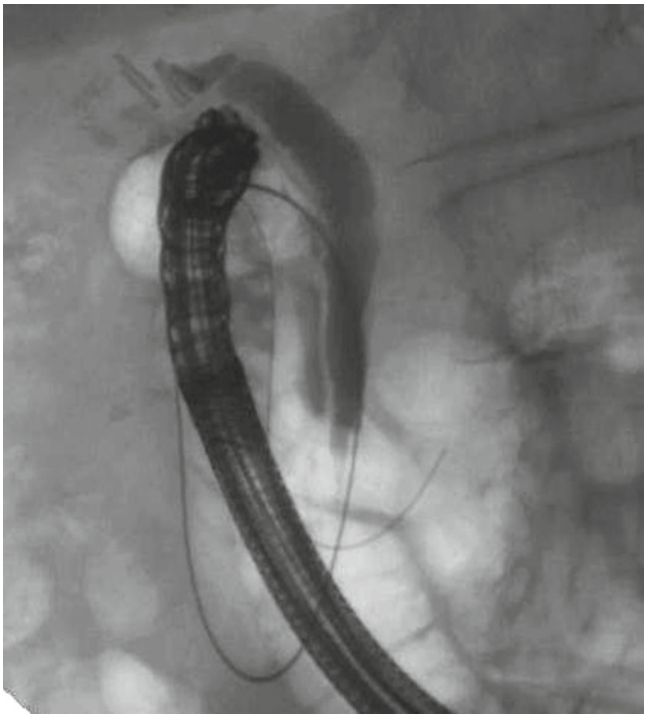

Fig. 6. Advancement of the guidewire into the extrahepatic bile duct, with advancement of the wire in an antegrade fashion.

LITERATURE REVIEW

EUS-Guided Biliary Drainage

Wiersema et al. described the use of EUS-guided cholangiography in ten patients in 1996 (24). In his series, biliary opacification guided repeat ERC with precut sphincterotomy in five of seven patients. In 2001, Giovannini et al. performed a choledochoduodenal fistula created under EUS guidance with a transbulbar stent placement (34). Two years later, Burmester et al. reported a series of four patients undergoing creation of an EUS enterobiliary fistula in three patients (35). EUS-guided drainage of obstructed biliary ducts via a rendezvous technique was performed in two patients by Mallery et al. (36). Kahaleh et al. reported a series of 23 patients undergoing EUS-guided ERC, with biliary decompression achieved in 21 patients (37). Most recently, our group has reported the largest study of EUS-guided ERC performed in 49 patients. The overall success rate was 84% (41/49), with an overall

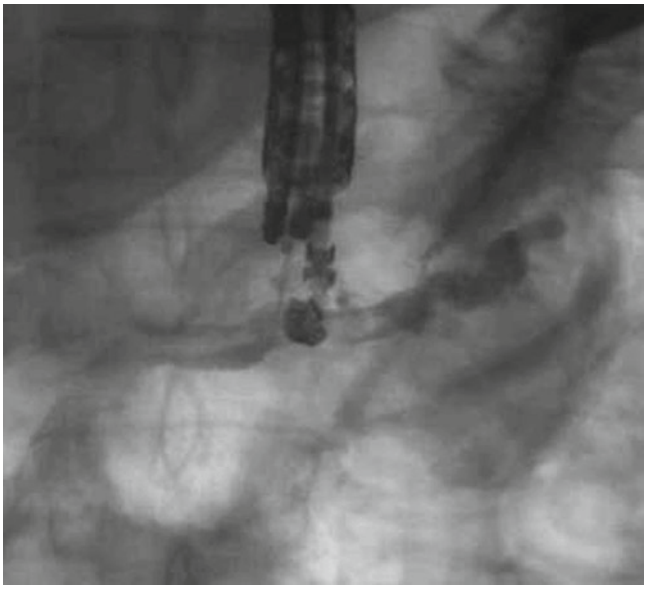

Fig. 7. Pancreatogram demonstrating successful access into the pancreatic duct.

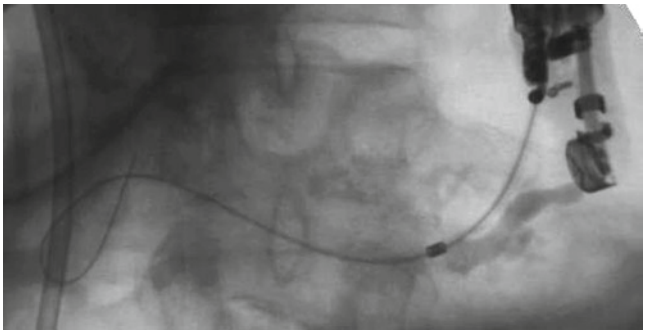

Fig. 8. Creation of pancreatogastric fistula followed by bougie dilation.

complication rate of 16%. Thirty-five patients underwent the intrahepatic approach, with a success rate of 83% (29/35). Fourteen patients underwent the extrahepatic approach (including 5 of whom had initially undergone the intrahepatic approach but were converted to the extrahepatic approach), with success in 12/14 patients, or 86% (38). Table 1 summarizes the published literature of EUS-guided biliary drainage to date.

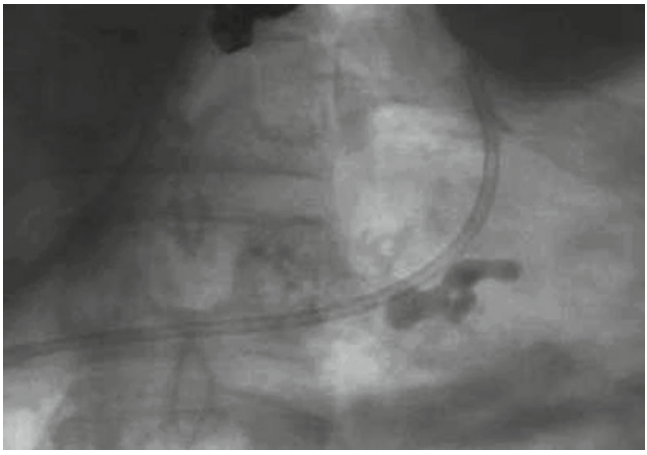

Fig. 9. Placement of a 7F stent through the pancreatogastric fistula.

The main complications associated with EUS-guided biliary drainage include pneumoperitoneum, postprocedure pain, and bleeding, most of which tend to be managed conservatively or self-resolving. The risk of bile leak and perforation leading to biliary peritonitis was found to be fairly small based on the reported case series. Of the 93 cases reported, there were 5 cases of pneumoperitoneum, 1 biliary leak, 1 case of biliary peritonitis, 1 case where the wire was passed outside of the bile duct lumen (35, 36, 38, 39). There was also one ileus, two cases of stent shortening, one early blockage, one death from complications of cirrhosis, three episodes of pain, one case of cholangitis, one aspiration pneumonia, and one case of self-resolving bleeding (38, 40–43). The overall complication rate in these 93 cases was 20% (19/93).

EUS-Guided Pancreatic Drainage

In 1996, Wiersema (24) and Gress et al. (44) each reported one case of EUS-guided pancreatography. One approach to achieving pancreatic drainage involves the creation of a pancreaticoenteric fistula followed by rendezvous (36, 45, 46). Another technique requires the creation of a pancreaticogastric fistula as the main method for duct drainage (47, 48). The rendezvous technique was described by Mallery and colleagues, in whose series successful drainage was reported in only 25% (1 of 4) of patients (36) (Table 1). In one case, the pancreatic duct could not be punctured, and in two of the cases, the wire could not be advanced

Table 1
Published series of IEUCP

Author	*Year*	*No. of patients*	*Technique*	*Complications*	*Rate of success*[a]
Biliary drainage					
Burmester et al. (35)	2003	4	Intrahepatic (1), extrahepatic (2)	Bile leak (1)	75% (3 of 4)
Mallery et al. (36)	2004	2	Extrahepatic (2)	Wire passed out of biliary lumen (1)	100% (2 of 2)
Puspok et al. (40)	2005	6	Extrahepatic (6)	None	83% (5 of 6)
Bories et al. (41)	2007	11	Intrahepatic (11)	Ileus (1), stent shortening (2), early blockage (1)	91% (10 of 11)
Will et al. (42)	2007	8	Intrahepatic (7), extrahepatic (1)	Slight pain (2), cholangitis (1)	88% (7 of 8)
Tarantino et al. (43)	2008	8	Extrahepatic (8)	Death from cirrhosis (1)	100% (8 of 8)
Yamao et al. (39)	2008	5	Extrahepatic (5)	Pneumoperitoneum (1)	100% (5 of 5)
Maranki et al. (38)	2009	49	Intrahepatic (35), extrahepatic (14)	Biliary peritonitis (1), pain (1), pneumoperitoneum (4), aspiration pneumonia (1), self-resolving bleeding (1)	84% (41 of 49)

(continued)

Table 1
(continued)

Author	*Year*	*No. of patients*	*Technique*	*Complications*	*Rate of success*[a]
Pancreatic drainage					
Francois et al. (47)	2002	4	Pancreaticogastrostomy (4)	Stent dislocation (1)	100% (4 of 4)
Kahaleh et al. (48)	2003	2	Pancreaticogastrostomy (2)	Hematemesis due to stent adjacent to vessel (1)	100% (2 of 2)
Mallery et al. (36)	2004	4	Rendezvous (4)	Transient fever (1)	25% (1 of 4)
Papachristou et al. (49)	2007	2	Rendezvous (2)	None	100% (2 of 2)
Kahaleh et al. (51)	2007	13	Pancreaticogastrostomy (10)	Bleeding (1), contained perforation (1)	77% (10 of 13)
Tessier et al. (52)	2007	36	Pancreaticogastrostomy (26), pancreaticobulbostomy (7)	Hematoma (1), pancreatitis (1)	92% (33of 36)
Will et al. (53)	2007	12	Pancreaticogastrostomy (5), rendezvous (4)	Pain (4), bleeding (1), perforation (1), pseudocyst (1)	75% (9 of 12)

[a]Success as defined by adequate drainage of the applicable duct

through the stricture. More recently, Papachristou et al. reported two cases of successful pancreatic drainage with the rendezvous technique in patients with nondilated pancreatic ducts (49). When the pancreatic duct cannot be decompressed from the second portion of the duodenum, creation of a pancreaticogastric fistula is the preferred method to achieve duct drainage (50). In a study at our institution, 13 patients with chronic pancreatitis and intractable pain were included; 7 of these patients had prior surgical diversions (51). Successful creation of a pancreaticogastric fistula was achieved in 10 (77%) patients, followed by stent placement. In two cases, the needle could not be oriented to allow the advancement of the guidewire for access, thus no endoprosthesis was placed. Complications of the procedures included one case of bleeding requiring hemoclip placement and one case of contained perforation that resolved spontaneously. Tessier and colleagues reported the largest retrospective series to date of 36 patients who underwent either pancreaticogastrostomy or pancreaticobulbostomy. Success was achieved in 92% of cases (33 of 36) and complications, including hematoma and severe pancreatitis, occurred in two patients (52). In 2007, Will and colleagues reported 12 patients through 14 interventions who underwent EUS-guided pancreatic duct drainage (53). Pancreatography was successful in all patients, and drainage of the pancreatic duct was achieved in nine patients. The transgastric approach, with creation of a pancreaticogastric fistula, was utilized in five patients, whereas four patients underwent the rendezvous technique with subsequent ERCP. The complication rate was 43%, with postprocedural pain occurring in four patients, bleeding in one patient, and perforation in one patient.

IEUCP has several advantages over percutaneous drainage, including the ability to visualize overlying vascular structures in real-time using color doppler while attempting needle puncture of the biliary or pancreatic ducts, potentially decreasing vascular injury. IEUCP provides the ability to achieve drainage without the need for an external drain, which can be a source of infection and discomfort. While the reported complication rate for EUS-guided pancreatic drainage is somewhat high, the complication rate for EUS-guided biliary drainage is more favorable, making it an attractive alternative to PTC.

SUMMARY

IEUCP should be considered as an alternative to PTC or surgery in patients with obstructive jaundice or pancreatic strictures who have failed conventional ERCP. Since the procedure is technically challenging, it should be performed by trained interventional endoscopists and at

a tertiary care center, with experienced pancreatobiliary surgeons and interventional radiologists available in the event of complications. In the presence of dilated intrahepatic ducts, the preferred method for biliary drainage is the intrahepatic approach with antegrade stent placement, avoiding the need for a rendezvous procedure. In the pancreatic duct, the antegrade approach is recommended for pancreatic drainage. IEUCP is a technique that is increasingly utilized in tertiary care centers and is evolving as a feasible alternative technique to PTC or surgery.

REFERENCES

1. Fogel EL, Sherman S, Devereaux BM, Lehman GA. Therapeutic biliary endoscopy. Endoscopy. 2001;33:31–8.
2. Schofl R. Diagnostic endoscopic retrograde cholangiopancreatography. Endoscopy. 2001;33:147–57.
3. Carr-Locke DL. Overview of the role of ERCP in the management of diseases of the biliary tract and the pancreas. Gastrointest Endosc. 2002;56:S157–60.
4. Dumonceau JM, Deviere J, Le Moine O, Delhaye M, Vandermeeren A, Baize M, et al. Endoscopic pancreatic drainage in chronic pancreatitis associated with ductal stones: long-term results. Gastrointest Endosc. 1996;43:547–55.
5. Ponchon T, Bory RM, Hedelius F, Roubein LD, Paliard P, Napoleon B, et al. Endoscopic stenting for pain relief in chronic pancreatitis: results of a standardized protocol. Gastrointest Endosc. 1995;42:452–6.
6. Cremer M, Deviere J, Delhaye M, Baize M, Vandermeeren A. Stenting in severe chronic pancreatitis: results of medium-term follow-up in seventy-six patients. Endoscopy. 1991;23:171–6.
7. Howard TJ, Moore SA, Saxena R, Matthews DE, Schmidt CM, Wiebke EA. Pancreatic duct strictures are a common cause of recurrent pancreatitis after successful management of pancreatic necrosis. Surgery. 2004;136:909–16.
8. Huibregtse K. Endoscopic retrograde cholangiopancreatography, endoscopic sphincterotomy and endoscopic biliary and pancreatic drainage. In: Yamada T, editor. Textbook of gastroenterology. Philadelphia: J.B. Lippincott, 1995. p. 2590–617.
9. Fink AS, Perez de Ayala V, Chapman M, Cotton PB. Radiologic pitfalls in endoscopic retrograde pancreatography. Pancreas. 1986;1:180–7.
10. Martin DF. Combined percutaneous and endoscopic procedures for bile duct obstruction. Gut. 1994;35:1011–2.
11. Lobo DN, Balfour TW, Iftikhar SY. Periampullary diverticula: consequences of failed ERCP. Ann R Coll Surg Engl. 1998;80:326–31.
12. Wright BE, Cass OW, Freeman ML. ERCP in patients with long-limb Roux-en-Y gastrojejunostomy and intact papilla. Gastrointest Endosc. 2002;56:225–32.
13. Kumar S, Sherman S, Hawes RH, Lehman GA. Success and yield of second attempt ERCP. Gastrointest Endosc. 1995;41:445–7.
14. Choudari CP, Sherman S, Fogel EL, Phillips S, Kochell A, Flueckiger J, et al. Success of ERCP at a referral center after a previously unsuccessful attempt. Gastrointest Endosc. 2000;52:478–83.

15. Ferrucci Jr JT, Mueller PR, Harbin WP. Percutaneous transhepatic biliary drainage: technique, results, and applications. Radiology. 1980;135:1–13.
16. Harbin WP, Mueller PR, Ferrucci Jr JT. Transhepatic cholangiography: complicatons and use patterns of the fine-needle technique: a multi-institutional survey. Radiology. 1980;135:15–22.
17. Calvo MM, Bujanda L, Heras I, Cabriada JL, Bernal A, Orive V, et al. The rendezvous technique for the treatment of choledocholithiasis. Gastrointest Endosc. 2001;54:511–3.
18. Smith AC, Dowsett JF, Russell RC, Hatfield AR, Cotton PB. Randomised trial of endoscopic stenting versus surgical bypass in malignant low bileduct obstruction. Lancet. 1994;344:1655–60.
19. Lameris JS, Stoker J, Nijs HG, Zonderland HM, Terpstra OT, van Blankenstein M, et al. Malignant biliary obstruction: percutaneous use of self-expandable stents. Radiology. 1991;179:703–7.
20. Beissert M, Wittenberg G, Sandstede J, Beer M, Tschammler A, Burghardt W, et al. Metallic stents and plastic endoprostheses in percutaneous treatment of biliary obstruction. Z Gastroenterol. 2002;40:503–10.
21. Kama NA, Coskun T, Yuksek YN, Yazgan A. Factors affecting post-operative mortality in malignant biliary tract obstruction. Hepatogastroenterology. 1999;46:103–7.
22. Wiersema MJ, Vilmann P, Giovannini M, Chang KJ, Wiersema LM. Endosonography-guided fine-needle aspiration biopsy: diagnostic accuracy and complication assessment. Gastroenterology. 1997;112:1087–95.
23. Grimm H, Binmoeller KF, Soehendra N. Endosonography-guided drainage of a pancreatic pseudocyst. Gastrointest Endosc. 1992;38:170–1.
24. Wiersema MJ. Endosonography-guided cystoduodenostomy with a therapeutic ultrasound endoscope. Gastrointest Endosc. 1996;44:614–7.
25. Kahaleh M, Shami VM, Conaway MR, Tokar J, Rockoff T, De La Rue SA, et al. Endoscopic ultrasound drainage of pancreatic pseudocyst: a prospective comparison with conventional endoscopic drainage. Endoscopy. 2006;38:355–9.
26. Wiersema MJ, Wiersema LM. Endosonography-guided celiac plexus neurolysis. Gastrointest Endosc. 1996;44:656–62.
27. Abedi M, Zfass AM. Endoscopic ultrasound-guided (neurolytic) celiac plexus block. J Clin Gastroenterol. 2001;32:390–3.
28. Gress F, Schmitt C, Sherman S, Ciaccia D, Ikenberry S, Lehman G. Endoscopic ultrasound-guided celiac plexus block for managing abdominal pain associated with chronic pancreatitis: a prospective single center experience. Am J Gastroenterol. 2001;96:409–16.
29. Collins D, Penman I, Mishra G, Draganov P. EUS-guided celiac block and neurolysis. Endoscopy. 2006;38:935–9.
30. Michaels AJ, Draganov PV. Endoscopic ultrasonography guided celiac plexus neurolysis and celiac plexus block in the management of pain due to pancreatic cancer and chronic pancreatitis. World J Gastroenterol. 2007;13:3575–80.
31. Schmulewitz N, Hawes R. EUS-guided celiac plexus neurolysis – technique and indication. Endoscopy. 2003;35:S49–53.
32. Levy MJ, Wiersema MJ. EUS-guided celiac plexus neurolysis and celiac plexus block. Gastrointest Endosc. 2003;57:923–30.

33. Wiersema MJ, Sandusky D, Carr R, Wiersema LM, Erdel WC, Frederick PK. Endosonography-guided cholangiopancreatography. Gastrointest Endosc. 1996;43:102–6.
34. Giovannini M, Moutardier V, Pesenti C, Bories E, Lelong B, Delpero JR. Endoscopic ultrasound-guided bilioduodenal anastomosis: a new technique for biliary drainage. Endoscopy. 2001;33:898–900.
35. Burmester E, Niehaus J, Leineweber T, Huetteroth T. EUS-cholangio-drainage of the bile duct: report of 4 cases. Gastrointest Endosc. 2003;57:246–51.
36. Mallery S, Matlock J, Freeman ML. EUS-guided rendezvous drainage of obstructed biliary and pancreatic ducts: report of 6 cases. Gastrointest Endosc. 2004;59:100–7.
37. Kahaleh M, Hernandez AJ, Tokar J, Adams RB, Shami VM, Yeaton P. Interventional EUS-guided cholangiography: evaluation of a technique in evolution. Gastrointest Endosc. 2006;64:52–9.
38. Maranki J, Hernandez A, Arlan B, Jaffan AA, Angle JF, Shami VM, et al. Interventional EUS-guided cholangiography (IEUC): long term experience of an emerging alternative to percutaneous transhepatic cholangiography (PTC) with video. Endoscopy. 2009;41:532–8.
39. Yamao K, Bhatia V, Mizuno N, Sawaki A, Ishikawa H, Tajika M, et al. EUS-guided choledochoduodenostomy for palliative biliary drainage in patients with malignant biliary obstruction: results of long-term follow-up. Endoscopy. 2008;40:340–2.
40. Puspok A, Lomoschitz F, Dejaco C, Hejna M, Sautner T, Gangl A. Endoscopic ultrasound guided therapy of benign and malignant biliary obstruction: a case series. Am J Gastroenterol. 2005;100:1743–7.
41. Bories E, Pesenti C, Caillol F, Lopes C, Giovannini M. Transgastric endoscopic ultrasonography-guided biliary drainage: results of a pilot study. Endoscopy. 2007;39:287–91.
42. Will U, Thieme A, Fueldner F, Gerlach R, Wanzar I, Meyer F. Treatment of biliary obstruction in selected patients by endoscopic ultrasonography (EUS)-guided transluminal biliary drainage. Endoscopy. 2007;39:292–5.
43. Tarantino I, Barresi L, Repici A, Traina M. EUS-guided biliary drainage: a case series. Endoscopy. 2008;40:336–9.
44. Gress F, Ikenberry S, Sherman S, Lehman G. Endoscopic ultrasound-directed pancreatography. Gastrointest Endosc. 1996;44:736–9.
45. Will U, Meyer F, Manger T, Wanzar I. Endoscopic ultrasound-assisted rendezvous maneuver to achieve pancreatic duct drainage in obstructive chronic pancreatitis. Endoscopy. 2005;37:171–3.
46. Bataille L, Deprez P. A new application for therapeutic EUS: main pancreatic duct drainage with a "pancreatic rendezvous technique". Gastrointest Endosc. 2002;55: 740–3.
47. Francois E, Kahaleh M, Giovannini M, Matos C, Deviere J. EUS-guided pancreaticogastrostomy. Gastrointest Endosc. 2002;56:128–33.
48. Kahaleh M, Yoshida C, Yeaton P. EUS antegrade pancreatography with gastropancreatic duct stent placement: review of two cases. Gastrointest Endosc. 2003;58:919–23.

49. Papachristou GI, Gleeson FC, Petersen BT, Levy MJ. Pancreatic endoscopic ultrasound-assisted rendezvous procedure to facilitate drainage of nondilated pancreatic ducts. Endoscopy. 2007;39 Suppl 1:E324–5.
50. Shami VM, Kahaleh M. Endoscopic ultrasonography (EUS)-guided access and therapy of pancreatico-biliary disorders: EUS-guided cholangio and pancreatic drainage. Gastrointest Endosc Clin N Am. 2007;17:581–93.
51. Kahaleh M, Hernandez AJ, Tokar J, Adams RB, Shami VM, Yeaton P. EUS-guided pancreaticogastrostomy: analysis of its efficacy to drain inaccessible pancreatic ducts. Gastrointest Endosc. 2007;65:224–30.
52. Tessier G, Bories E, Arvanitakis M, Hittelet A, Pesenti C, Le Moine O, et al. EUS-guided pancreatogastrostomy and pancreatobulbostomy for the treatment of pain in patients with pancreatic ductal dilatation inaccessible for transpapillary endoscopic therapy. Gastrointest Endosc. 2007;65:233–41.
53. Will U, Fueldner F, Thieme AK, Goldmann B, Gerlach R, Wanzar I, et al. Transgastric pancreatography and EUS-guided drainage of the pancreatic duct. J Hepatobiliary Pancreat Surg. 2007;14:377–82.