Single-operator EUS-guided cholangiopancreatography for difficult pancreaticobiliary access (with video)

Brian C. Brauer, MD, Yang K. Chen, MD, Norio Fukami, MD, Raj J. Shah, MD
Aurora, Colorado, USA

Background: When conventional ERCP methods fail because of periampullary or ductal obstruction, EUS-guided cholangiopancreatography (EUS-CP) may aid in pancreaticobiliary access.

Objective: To report our experience when using single-operator EUS-CP.

Setting: An academic tertiary-referral center.

Methods: Consecutive patients undergoing EUS-CP were prospectively identified. These patients had undergone failed attempt(s) at therapeutic ERCP. A data sheet was used to record indications, reasons for failed ERCP, EUS-CP visualization of the duct of interest, transpapillary or transenteric intervention, clinical follow-up, and complications.

Main Outcome Measurements: Technical success was decompression of the duct of interest. Clinical success was resolution of jaundice or a ≥50% reduction in pain or narcotics, as applicable.

Results: Between February 2003 and June 2007, EUS-CP was attempted in 20 patients (11 men, 9 women; mean [SD] age 58 ± 14.9 years). Indications included jaundice (n = 8), biliary stones (n = 3), chronic pancreatitis (n = 6), acute pancreatitis (n = 2), and papillary stenosis (n = 1). Reasons for failed ERCP included periampullary mass (n = 8), intradiverticular papillae (n = 4), and pancreatic duct (PD) stricture (n = 7) or stone (n = 1). Technical success was achieved in 18 of 20 patients (90%). Biliary decompression was obtained in 11 of 12 patients (92%) (7 transpapillary and 4 transenteric-transcholedochal). Pancreatic decompression was obtained in 7 of 8 patients (88%) (3 transpapillary, 4 transgastric). On follow-up, clinical improvement was noted in 15 of 20 patients (70%). For treatment of pain associated with chronic pancreatitis, pain scores decreased by a mean of 1.75 (P = .18). Complications (in 2 of 20 [10%]) included perforation (n = 1) and respiratory failure (n = 1).

Limitations: A single-center nonrandomized observational study with a small patient population.

Conclusions: At our academic referral center, single-operator EUS-CP provided decompression of obstructed ducts and may be performed after a failed attempt at conventional ERCP during the same endoscopic session. (Gastrointest Endosc 2009;70:471-9.)
PATIENTS AND METHODS

A prospective, consecutive group of patients at a single tertiary-referral center that had a failed attempt at conventional ERCP at our institution was offered EUS-CP as an alternative to other interventions to gain access to obstructed biliary ducts or pancreatic ducts (PD). All patients referred from outside centers for failed ERCP had repeated attempts at ERCP in our facility before proceeding to EUS-CP. Institutional review board approval was obtained to collect procedural data and for clinical follow-up. A data-collection sheet was used to record indications, reasons for failed ERCP, visualization of the duct of interest, antegrade or retrograde decompression of the duct, complications, and follow-up. All procedures, except for the index case, were performed by using a single-operator technique by experienced endoscopists who annually performed more than 400 ERCP and EUS procedures before their initial EUS-CP (R.S., Y.C., N.F., M.A.). All procedures were performed with registered nurse assistants trained in both EUS and ERCP. After obtaining informed consent, general anesthesia or intravenous sedation with fentanyl and midazolam, with or without diphenhydramine, was used in dedicated interventional endoscopy rooms equipped with both fluoroscopy and curvilinear-array EUS capability. Antibiotics were administered prophylactically. Early in the experience, EUS-CP was attempted on a separate day after failed ERCP, but more recently the two procedures have been performed on the same day to reduce repeated patient visits.

EUS-CP technique

EUS was performed by using a curvilinear array echoendoscope (GF-UC140 or GF-UCT140; Olympus America, Inc, Center Valley, Pa). Duct puncture by a transenteric-transcholedochal (extrahepatic) approach for biliary cases, or by the transgastric or transduodenal approach for pancreatic cases, was performed by using a 19-gauge or 22-gauge FNA needle (Echotip Ultra; Cook Endoscopy, Winston-Salem, NC) and a 0.035-inch (Jagwire, Hydra Jagwire; Boston Scientific, Marlborough, Mass) or 0.018-inch, 450-cm hydrophilic wire (Glidewire [Boston Scientific], Roadrunner [Cook Endoscopy]). With the assistance of fluoroscopy, every attempt was made to angle the echoendoscope’s tip in the direction of the downstream duct before extrahepatic needle puncture. Color-Doppler US was used to confirm the lack of vascular structures before EUS-guided puncture through the duodenal bulb or the second portion of the duodenum for biliary access (Fig. 1) and through the gastric body or duodenal bulb for PD access. Upon removal of the stylet, aspiration was performed to confirm the intraductal location of the needle tip, followed by contrast injection under fluoroscopic guidance to obtain a ductogram (Figs. 2 and 3A). Antegrade transpapillary guidewire placement was then attempted through the FNA needle. If transpapillary wire placement was achieved, then the echoendoscope was withdrawn, leaving the guidewire in place, which was then secured at the mouth. Rendezvous ERCP was carried out by grasping the transpapillary wire with a snare or a biopsy forceps and withdrawing it through the operating channel for retrograde introduction of a sphincterotome over the wire. The position of the wire at the mouth was retracted through the puncture site by firm and steady back tension until the wire was entirely within the duct for retrograde advancement. In cases in which antegrade transpapillary wire placement was not possible by using the extrahaepatic approach, the options included reintroduction of the duodenoscope for ERCP by using the EUS-guided cholangiogram or pancreatogram as a roadmap10 or EUS-guided antegrade transenteric stent placement as previously described (Fig. 3B).2,3 If transduodenal-transcholedochal stent placement was performed, then a choledochoduodenostomy tract was created by using a triple-lumen needle-knife sphincterotome over the wire with brief bursts of blended Endocut current (ERBE ICC 200 or ERBE VIO 300 D; ERBE USA, Atlanta, Ga).

Outcomes measurements

Technical success was defined as either antegrade or retrograde placement of a stent upstream from the level of obstruction for decompression or sphincterotomy, with or without stone extraction. Clinical success was resolution of jaundice or ≥50% reduction in pain or narcotics, as applicable. For treatment of pain associated with chronic pancreatitis, pain scores were recorded pre-attempted and post-attempted PD drainage and were compared by using the Wilcoxon signed-rank test.

RESULTS

Between February 2003 and June 2007, the 4 endoscopists performed 3100 ERCPs at the university hospital, and
EUS-CP was attempted in 20 patients (11 men, 9 women; mean [SD] age 58 ± 14.9 years) (Tables 1 and 2). A mean (SD) of 1.85 ± 0.8 failed ERCPs had been performed before EUS-CP. For biliary access, needle-knife pre-cut papillotomy was performed at our institution on 4 of 12 patients (33%) on the day of EUS-CP (n = 3) or during an ERCP attempt before EUS-CP (n = 1); it was not attempted because of altered periampullary anatomy in 8 patients. EUS-CP was performed at the time of initial failed ERCP at our institution on 10 patients (50%) and, on a subsequent day, on 10 patients (50%). Clinical diagnoses, indications, and reasons for failed ERCP are outlined in Table 1. Indications for procedures included obstructive jaundice (n = 8) (40%), chronic pancreatitis (n = 6: 5 for pain associated with chronic pancreatitis, 1 for treatment of a pancreatic fistula) (30%), choledocholithiasis (n = 3) (15%), acute pancreatitis (n = 2) (10%), and papillary stenosis (n = 1) (5%). Nineteen of the 20 patients (95%) had successful antegrade cholangiopancreatography.

EUS-guided cholangiography and decompression of the bile duct was technically successful in 11 of 12 patients (92%) with the extrahepatic approach. Details of successful biliary interventions and outcomes are listed in Table 1. Four of 11 patients (36%) had successful antegrade extrahepatic placement of a transpapillary wire for intervention. Seven of 11 patients (64%) underwent other techniques after EUS-guided cholangiography to achieve technical success: transenteric-transcholedochal stent placement (n = 4), a “fluoroscopic roadmap” to assist retrograde cannulation (n = 2), and the identification of an “everted papilla” on the rim of a diverticulum that permitted retrograde cannulation (n = 1).

The failed case was a patient with intradiverticular papillae and choledocholithiasis who did not undergo an attempt at extrahepatic puncture because of inadequate echoendoscope position. Percutaneous transhepatic cholecystostomy (PTC) was recommended but declined by the patient. The patient was asymptomatic at 10 months of follow-up. Two of the remaining 3 patients with intradiverticular papillae had successful retrograde biliary interventions that included biliary sphincterotomy for papillary stenosis and stone extraction, which resulted in complete clearance of the common bile duct (Fig. 2), and the third patient had transenteric-transcholedochal stent placement for decompression. The increased intraductal pressure after EUS-guided cholangiography in the patient with papillary stenosis resulted in a visible “bulge” from an everted papilla at the rim of the diverticulum (Fig. 4, Video 1, available online at www.giejournal.org), which subsequently permitted retrograde cannulation. In cases in which antegrade transpapillary wire was not technically possible, EUS-guided cholangiography permitted a “fluoroscopic roadmap” for retrograde cannulation in 2 patients. Overall, biliary interventions included the following: transpapillary biliary metal (n = 4) or plastic

Figure 1. EUS-image of transenteric-transcholedochal puncture of the bile duct by using an FNA needle.

Figure 2. A, EUS-guided cholangiogram in a patient with intradiverticular papilla, showing choledocholithiasis. B, The common bile duct was cleared after rendezvous ERCP and stone extraction.
pancreatography for planned decompression of the duct in all patients who had a technically successful procedure. A median 0.6 months (range 0.1-12.0 months) follow-up patients (92%), and clinical improvement was noted at iary indications, technical success was achieved in 11 of 12 traction was completed, along with stent removal. For bil-

![A](Image)

Figure 3. A, EUS-guided pancreatogram showing complete obstruction upstream of the ampulla; the wire is advanced antegrade into the PD. B, Successful transduodenal pancreatic stent (pancreaticobulbostomy).

(n = 1) stent placement, transenteric-transcholedochal plastic stent insertion (n = 4), sphincterotomy and stone extraction (n = 1), and sphincterotomy for papillary ste-

nosis (n = 1) (Table 1).

Procedure-related complications occurred in 2 patients. One patient with obstructive jaundice and periampullary tumor infiltration had transenteric-transcholedochal stent placement followed by pneumoperitoneum and peritonitis that resolved with conservative management. One patient whose procedure was performed with the patient under general anesthesia had an intradiverticular papilla and impacted choledocholithiasis that prohibited transpapillary wire placement. She underwent transenteric-transcholedochal stent placement in anticipation of a repeated attempt at transpapillary access at a later date. After the procedure, the patient developed respiratory and cardiac failure (B-type natriuretic peptide 721 pg/mL [normal <100 pg/mL]), secondary to fluid overload and despite the absence of fever, leukocytosis, elevated bilirubin, and pneumoperitoneum, we elected to refer her for percutaneous transhepatic drainage. The patient was sub-

sequently discharged, and rendezvous ERCP with interventional radiology for sphincterotomy and stone extraction was completed, along with stent removal. For bili-

dary indications, technical success was achieved in 11 of 12 patients (92%), and clinical improvement was noted at a median 0.6 months (range 0.1-12.0 months) follow-up in all patients who had a technically successful procedure.

Eight patients underwent successful EUS-guided pancreatography for planned decompression of the duct (Table 2). Indications included obstructing strictures or stones related to chronic pancreatitis (n = 5) (Fig. 4), pancreatic fistula (n = 1), and pancreatic ascites (n = 2). Technical success was achieved in 7 of 8 patients (88%) and included transpapillary stent placement above the level of obstruction (n = 3) (Fig. 3), pancreatogastro-
tomy (n = 3), and pancreaticobulbostomy (n = 1). One patient (no. 2, Table 2), with an obstructing stone and stricture, had antegrade wire placement across the minor papilla. Pancreatocscopy with electrohydraulic lithotripsy (EHL) via the minor papilla was performed during the same endoscopic session, and, after a second EHL ses-

sion, stone clearance was achieved. In the patient with technical failure, an extremely tortuous downstream duct in the head and the genu created a functional ob-

struction, and, despite successful antegrade transpapillary wire placement, retrograde stent insertion failed to traverse the tortuous segment. This patient was sub-

sequently referred for lateral pancreaticojejunostomy, which resulted in resolution of pain. No procedure-re-

lated complications occurred in the pancreatic group, but one patient with pancreatic ascites died 1 month af-

fter the procedure because of complications of ongoing pancreatitis and sepsis. Clinical improvement in patients with pancreatic indications was noted in 4 of 8 patients (50%) at a median 7.3 months (range 1.2-45.7 months) of follow-up: 2 with pancreatic fistulas, one with PD stric-

ture, and one with PD stones. In the 4 patients with chronic pancreatitis and pain with successful pancreatic stent placement, the mean (SD) pain scores improved from 6 ± 1.4 to 4.25 ± 3.3; P = .18 (Fig. 5).

**DISCUSSION**

We present a prospective and consecutive series of pa-


tients who had undergone single-operator EUS-CP. Overall, ductography during an attempt at EUS-CP was obtained in 19 of 20 patients (95%). The overall technical success was 18 of 20 (90%), which included 11 of 12 biliary and 7 of 8 pancreatic cases with transpapillary drainage (10/20 [50%]: 6 biliary, 4 pancreatic) or transenteric drainage (8/ 20 [40%]: 4 biliary, 4 pancreatic). Clinical improvement was noted in 15 of 20 patients (75%) at a median 4.3 months (range 0.1-45.7 months) of follow-up. The mean pain scores in patients with painful chronic pancreatitis decreased by 1.75 (P = .18), but this did not reach statistical significance. Complications occurred in 2 of 20 patients (10%). Both complications occurred in the biliary group.

We describe novel techniques for accomplishing biliary access when antegrade transpapillary wire placement fails. In 2 cases of periampullary tumor infiltration, a “fluoro-

scopic roadmap” was provided by EUS-guided cholangiography to facilitate identification of the ampullary anatomy to permit retrograde biliary access. Furthermore, after an-

tegrade cholangiography in the setting of intradiverticular papillae in another patient, repeated duodenoscopy of the
diverticulum revealed an “ampullary bulge” of a previously flat papilla that was not visible during the initial ERCP attempt. A fourth patient (biliary case no. 2) may have benefited from a repeated examination of the region of the major papilla, but this technique was not considered earlier in our experience.

Since its first description by Wiersema et al, EUS-CP has evolved into a primarily therapeutic technique. Major series for biliary and pancreatic EUS-CP are listed in Tables 3 and 4. The EUS-guided technique described by Mallery et al in 2004 required 2 endoscopists, and the antegrade placed transpapillary wire served as a guide for retrograde cannulation. Since then, there have been several case series of EUS-guided biliary drainage with a more conventional “rendezvous” technique, in which the transpapillary wire is grasped and withdrawn through the working channel of the duodenoscope, with subsequent retrograde introduction of ERCP devices.

Our single-operator, EUS-guided biliary decompression success and complication rate is similar to previously published series. The experience with this technique overall remains preliminary, with fewer than 50 cases reported in the literature. Technical success ranges from 75% to 91%, and complications, including perforation and bile leak, occur in up to 25%, most of which are managed conservatively. Kahaleh et al reported the largest biliary case series (n = 23) of patients who underwent either an intrahepatic or extrahepatic drainage attempt, with a technical success and complication rate of 91% and 17%, respectively, with no complications resulting in surgery; 78% underwent transpapillary stenting. The same center supplemented their initial series and presented preliminary data on 47 patients, and technical success declined to 81%, with a complication rate of 21%. The decline in the success rate may be explained by broader case selection as comfort with

<table>
<thead>
<tr>
<th>Patient no.</th>
<th>Age (y)</th>
<th>Sex</th>
<th>Diagnosis</th>
<th>Retrograde access successful after EUS?</th>
<th>Intervention</th>
<th>Outcome</th>
<th>Complication</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>55</td>
<td>F</td>
<td>Pancreatic CA</td>
<td>Yes</td>
<td>SEMS, 10 × 60 mm</td>
<td>Jaundice resolved after further interventions</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>80</td>
<td>F</td>
<td>Choledocholithiasis</td>
<td>Not attempted</td>
<td>Choledochoduodenostomy, PTC and subsequent stone removal during rendezvous ERCP and sphincterotomy</td>
<td>Cardiac and respiratory failure from fluid overload</td>
<td>None</td>
</tr>
<tr>
<td>3</td>
<td>62</td>
<td>F</td>
<td>Papillary stenosis</td>
<td>Yes</td>
<td>Sphincterotomy, temporary transpapillary stent</td>
<td>Resolution of symptoms</td>
<td>None</td>
</tr>
<tr>
<td>4</td>
<td>72</td>
<td>M</td>
<td>Choledocholithiasis</td>
<td>n/a</td>
<td>None</td>
<td>No further intervention, symptoms resolved</td>
<td>None</td>
</tr>
<tr>
<td>5</td>
<td>93</td>
<td>M</td>
<td>Choledocholithiasis</td>
<td>Yes</td>
<td>Stone removal plus 8.5F × 7-cm single-pigtail stent</td>
<td>Pain resolved</td>
<td>None</td>
</tr>
<tr>
<td>6</td>
<td>49</td>
<td>M</td>
<td>Pancreatic CA</td>
<td>Yes</td>
<td>Stent, 10F × 5 cm</td>
<td>Resolution of jaundice</td>
<td>None</td>
</tr>
<tr>
<td>7</td>
<td>56</td>
<td>M</td>
<td>Pancreatic CA</td>
<td>Yes</td>
<td>SEMS, 10 mm × 60 cm; duodenal SEMS</td>
<td>Resolution of jaundice</td>
<td>None</td>
</tr>
<tr>
<td>8</td>
<td>42</td>
<td>M</td>
<td>Gastric CA</td>
<td>Not attempted</td>
<td>Choledochoduodenostomy, Resolution of jaundice</td>
<td>Pneumoperitoneum</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>61</td>
<td>M</td>
<td>Pancreatic CA</td>
<td>Not attempted</td>
<td>Choledochoduodenostomy, Jaundice improved</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>63</td>
<td>M</td>
<td>Pancreatic CA</td>
<td>Yes</td>
<td>SEMS, 10 × 60 mm</td>
<td>Resolution of jaundice</td>
<td>None</td>
</tr>
<tr>
<td>11</td>
<td>55</td>
<td>F</td>
<td>Pancreatic CA</td>
<td>Yes</td>
<td>SEMS, 10 × 80 mm</td>
<td>Resolution of jaundice</td>
<td>None</td>
</tr>
<tr>
<td>12</td>
<td>72</td>
<td>F</td>
<td>Pancreatic CA</td>
<td>Yes</td>
<td>SEMS, 10 × 80 mm</td>
<td>Resolution of jaundice</td>
<td>None</td>
</tr>
</tbody>
</table>

CA, Cancer; F, female; M, male; SEMS, self-expanding metallic stent; PTC, percutaneous transhepatic cholangiography.
the technique grows. Although intrahepatic and extrahepatic puncture have both been described for biliary access, if a failed drainage attempt occurs, then a lower risk of biliary peritonitis may exist when using the intrahepatic approach.3,4

Most reported series used a separate endoscopist for the EUS and ERCP portion of the procedure. Our series represents a single institution’s initial experience of the technique by 4 endoscopists trained and experienced in both ERCP and EUS, whereas most prior publications...
included the experience of only one or two endoscopists at select centers. All procedures were performed in a dedicated advanced endoscopy room with fluoroscopy and EUS capability, and with nurses trained in both procedures. Furthermore, the ability to interchange ERCP and EUS has permitted expansion of our therapeutic capabilities for decompression during an initial referral for failed ERCP at another institution and can reduce the number of required procedures. The advantage of EUS-guided intervention of the biliary tract over PTC is the ability to perform the decompression during a single procedure time and to provide immediate internalization of drainage.

Our two complications were in patients with transenteric-transcholedochal stent placement. One patient with postprocedure pneumoperitoneum and peritonitis was treated with conservative management and ultimately had resolution of jaundice. A potential explanation is that a tangential transduodenal approach, along with brief bursts of cautery to create the biliary-enteric fistula for device advancement, may result in a wider defect than would be “sealed” by a transduodenal stent, leading to biliary leak. A second patient (biliary case no. 2), who was elderly, underwent transenteric-transcholedochal stent placement. After a prolonged procedure with general anesthesia, she had cardiorespiratory decline in the absence of signs of a biliary leak. We elected to refer the patient for PTC, and she subsequently underwent successful conventional rendezvous ERCP for stone extraction.

In our preliminary experience with EUS-guided pancreatic decompression, technical success was achieved in 7 of 8 patients (88%) without complications. Clinical improvement was achieved in 4 of 8 patients (50%) at a median 7.3 months of follow-up. Mean pain scores in patients with chronic pancreatitis who had successful transenteric pancreatic stent placement decreased by 1.75 ($P = .18$), and the lack of statistical significance can likely be accounted for by the small number of patients. One patient with pancreas divisum underwent successful EUS-guided antegrade placement of a transpapillary wire across the minor papilla. This was followed by minor papillotomy, pancreatoscopy, and EHL of pancreaticolithiasis during the same session. After complete clearance of the duct on a subsequent ERCP, she had complete resolution of symptoms. One patient had recurrence of her abdominal pain after stent removal 3 months after initial stent placement and was referred for lateral pancreaticojejunostomy. The initial stent was upsized after 4 weeks, and, because of concerns on pancreatography of “stent-associated” changes and the appearance of a decrease in ductal diameter on a subsequent follow-up pancreatogram, it was decided to attempt a stent-free trial. In select cases after prolonged stenting, the pancreaticogastrostomy fistula may remain patent after

---

**TABLE 3. Major pancreatic series**

<table>
<thead>
<tr>
<th>Year</th>
<th>Study</th>
<th>N</th>
<th>Technique</th>
<th>Successful stent insertion</th>
<th>Major complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>Francois et al</td>
<td>4</td>
<td>Transgastric</td>
<td>4/4 (100%)</td>
<td>None</td>
</tr>
<tr>
<td>2004</td>
<td>Mallery et al</td>
<td>4</td>
<td>Transgastric</td>
<td>1/4 (25%); successful pancreatography 3/4 (75%)</td>
<td>None</td>
</tr>
<tr>
<td>2007</td>
<td>Tessier et al</td>
<td>36</td>
<td>29 Transgastric, 7 transduodenal</td>
<td>33/36 (92%)</td>
<td>1 Pseudocyst, 1 hematoma</td>
</tr>
<tr>
<td>2007</td>
<td>Kahaleh et al</td>
<td>13</td>
<td>Transgastric</td>
<td>10/13 (77%)</td>
<td>1 Bleeding, 1 contained perforation</td>
</tr>
<tr>
<td>2007</td>
<td>Will et al</td>
<td>12</td>
<td>Transgastric</td>
<td>9/12 (75%)</td>
<td>1 Bleeding, 1 perforation</td>
</tr>
</tbody>
</table>

Figure 5. Box plots, showing pain scores for 4 patients with chronic pancreatitis who underwent PD stent placement for the treatment of pain.
stent removal, but this management strategy was not used in this young patient. Given the data to suggest longer-term durability in select patients undergoing surgical decompression, EUS-guided pancreatic intervention may be reserved for suboptimal surgical candidates, those who desire a less-invasive alternative, as in our patient, or to permit rendezvous ERCP. If antegrade guidewire placement fails after EUS-guided pancreatography, we recommend that decompression of the duct by aspiration of contrast or transgastric stenting be temporarily performed to reduce the risk of a PD leak.

Tessier et al described a multi-institution series of 36 patients who underwent EUS-guided pancreaticogastrostomy or pancreaticobulbostomy with technical success achieved in 92%, along with a 14% complication rate. Twelve cases had surgically altered anatomy. Improvement was noted in 69% of patients during a median follow-up of 14.5 months; however, stent malfunction occurred in 55% of patients, which remains a limitation. In a smaller single-institution series, Kahaleh et al attempted EUS-guided pancreaticogastrostomy in 13 patients, with success in 10 (77%) and a 15% overall complication rate. Improvement in mean pain scores and mean diameter of the PD was reported at a mean follow-up of 14 months. In another, smaller series, 12 patients underwent attempted EUS-guided pancreatography, with successful drainage achieved in 69% but an exceptionally high 43% overall complication rate. In summary, in the hands of operators experienced in both ERCP and EUS, EUS-CP is a promising adjunct to therapeutic ERCP and provides ductal decompression in the majority of patients. In our preliminary experience, we achieved diagnostic EUS-CP in 95% of the patients and technical success for decompression in 80%, with a 10% complication rate in the biliary group and no complications in the pancreatic group. Two patients were referred for PTC, but the initial EUS-guided therapy did not adversely impact their clinical outcome. In the absence of successful antegrade advancement of a transpapillary wire, the “fluoroscopy roadmap” and/or “ampullary bulge” identified after antegrade cholangiography can be useful in facilitating retrograde cannulation. For biliary decompression, single-operator EUS-guided intervention is a promising alternative to PTC, with the advantage of immediate internal drainage, which eliminated the need for coordination with another endoscopist or radiologist, and potential completion of the procedure in a single endoscopic session. Depending on the payer, a single-operator approach may result in an incremental reduction in reimbursement for a second procedure when compared with 2 endoscopists who code for separate procedures. However, these financial considerations would need to be compared with a second endoscopist’s availability and the overall efficiency of the endoscopy unit. Given the technical complexity of these procedures and the comorbidities of many of the patients, we recommend that these procedures be performed with anesthesia support, mostly with the patient under general anesthesia. Complications may be minimized in the future as experience grows and EUS accessories are modified to facilitate pancreaticobiliary intervention. In the case of failed ERCP, referral to a tertiary-referral center with expertise in pancreaticobiliary endoscopy for a second attempt at ERCP, and preplanned EUS-guided access, if necessary, is recommended to reduce unnecessary PTC or surgical drainage.

REFERENCES


<table>
<thead>
<tr>
<th>Year</th>
<th>Study</th>
<th>N</th>
<th>Site of needle puncture</th>
<th>Successful drainage</th>
<th>Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>Wiersema et al1</td>
<td>10</td>
<td>Extrahepatic</td>
<td>Opacification-guided therapy 7/10</td>
<td>1 Pancreatitis</td>
</tr>
<tr>
<td>2003</td>
<td>Burmester et al</td>
<td>4</td>
<td>2 Extrahepatic, 2 Intrahepatic</td>
<td>3/4 (75%)</td>
<td>1 Bile leak</td>
</tr>
<tr>
<td>2004</td>
<td>Mallery et al</td>
<td>2</td>
<td>Extrahepatic</td>
<td>2/2 (100%)</td>
<td>None</td>
</tr>
<tr>
<td>2005</td>
<td>Puspok et al 14</td>
<td>6</td>
<td>5 Extrahepatic, 1 intrahepatic</td>
<td>5/6 (83%)</td>
<td>None</td>
</tr>
<tr>
<td>2005</td>
<td>Kahaleh et al 4</td>
<td>6</td>
<td>Intrahepatic</td>
<td>5/6 (83%)</td>
<td>None</td>
</tr>
<tr>
<td>2006</td>
<td>Kahaleh et al 3</td>
<td>23</td>
<td>10 Extrahepatic, 13 intrahepatic</td>
<td>21/23 (91%)</td>
<td>4 (1 bile leak, 2 pneumoperitoneum, 1 bleeding)</td>
</tr>
<tr>
<td>2007</td>
<td>Will et al 15</td>
<td>8</td>
<td>Intrahepatic</td>
<td>7/8 (88%)</td>
<td>1 Cholangitis</td>
</tr>
</tbody>
</table>

Received July 1, 2008. Accepted December 20, 2008.
Current affiliations: Division of Gastroenterology and Hepatology, Department of Medicine, University of Colorado Denver, Aurora, Colorado, USA.
Reprint requests: Raj J. Shah, MD, Division of Gastroenterology and Hepatology, Department of Medicine, University of Colorado Health Science Center, 1635 N Ursula St, PO Box 6510, MS F735, AIP 2.031, Aurora, CO 80045.
If you would like to chat with an author of this article, you may contact him at Raj.Shah@uchsc.edu.