Endoscopic Ultrasound–Guided Biliary Interventions

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KEYWORDS

• EUS • ERCP • Biliary drainage • Obstructive jaundice

KEY POINTS

- EUS-guided biliary drainage is an acceptable alternative at expert centers for patients with failed ERCP or altered surgical anatomy.
- EUS-BD allows biliary drainage into the stomach or duodenum depending on the procedure used
- Randomized studies have shown EUS-BD to have equivalent safety and efficacy to ERCP in patients with distal malignant biliary obstruction.
- A variety of EUS-BD procedures are described depending on the access and exit points of the stents.
- There is a learning curve, and these procedures should be attempted at expert pancreaticobiliary endoscopy centers.

INTRODUCTION

Endoscopic retrograde cholangiopancreatography (ERCP) is considered the gold standard for the management of biliary obstruction caused by bile duct stones or benign and malignant biliary strictures.[1–3] The success rate for ERCP has been quoted as more than 90%; however, this varies with expertise.[4] Should the ERCP fail, a repeat ERCP by a more experienced endoscopist at a high-volume center at an interval is suggested, provided there is no clinical emergency for biliary drainage, that is, cholangitis.[5] However, ERCP can be challenging even in expert hands because of the pathology encountered (gastric outlet obstruction, periampullary diverticulum, etc) or surgically altered anatomy (ie, Whipple, Roux en-Y gastric bypass, Billroth II surgery) and techniques such as double wire technique or precut sphincterotomy have been used in patients with difficult access.[6–8]

Alternative options for biliary drainage after the failure of ERCP include percutaneous transhepatic biliary drainage (PTBD), endoscopic ultrasound (EUS)-guided biliary drainage (EUS-BD), and surgical drainage[9–12] (**Table 1**). PTBD is widely available; however, complication rates have been estimated as high as 23%, including

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Table 1
Various procedures for biliary drainage

	PTBD	ERCP	EUS-BD
Access	Blind	Semiblind	Under vision
Difficult access	Rare	Relatively common	Rare
Access points	Liver	Papilla	Liver, duodenum
Stent placement	External/antegrade	Retrograde	Antegrade/Retrograde
Postsurgical anatomy Duodenal stenosis	Easy access	Difficult access	Easy access
Gall bladder	Easy access	Difficult access	Easy access

cholangitis, dislocation, or blocked catheters. PTBD is associated with higher morbidity, repeated procedures, and poor patient compliance.[13–15]

Wiersema and colleagues[16] described the first EUS-guided cholangiopancreatography in 1996 on patients who had failed ERCP. The world's first EUS-guided biliary drainage was published by Giovannini and colleagues[17] in 2001. Since then, several studies have been published proving its safety and efficacy.[18–21] EUS-BD is accepted as a safe and effective alternative for biliary drainage. The procedure is attractive as it can be performed via multiple routes, and access to papilla is not necessary. A variety of procedures are clubbed under EUS-BD, each with its own advantages.

INDICATIONS

EUS biliary interventions have been used for both benign and malignant indications, although most publications deal with malignant obstruction. The indications may broadly be classified depending on access to papilla.

Accessible Papilla

Failed ERCP (at an expert center), periampullary diverticulum, or neoplastic infiltration of the ampulla.

Inaccessible Papilla

Normal anatomy

Peptic duodenal strictures, malignant outlet obstructions, duodenal strictures from chronic pancreatitis.

Altered anatomy

Bariatric Roux-en Y gastric bypass surgery, Billroth II gastroenterostomy, Whipples surgery.

CONTRAINDICATIONS

Absolute contraindications would be tumor infiltration along the luminal surface and relative contraindications include massive ascites, coagulopathy, and lack of ductal dilatation.

TECHNIQUES

Currently, EUS-BD is used as a salvage technique for failed conventional ERCP, which could be due to anatomic constraints or the underlying pathology. The choice of EUS-BD depends on the indication for biliary drainage and operator preference.[22] There are 4 well-described techniques for performing EUS-BD: EUS-rendezvous (EUS-RV; Fig. 1), EUS-choledochoduodenostomy (EUS-CDS; Fig. 2), EUS-hepaticogastrostomy (EUS-HGS; Fig. 3), and EUS-antegrade (EUS-AG; Fig. 4). EUS-hepaticoduodenostomy (EUS-HDS) is not yet fully established. All the procedures essentially follow the same principles as described in the following sections other than the rendezvous procedure. With the advent of “Hot stent,” EUS-BD may be performed as a single-step procedure.

Biliary Access

A therapeutic linear echoendoscope is used. The first step in biliary access is scope position, which is paramount to the success of the procedure. The scope position for CDS should be in the long/semilong loop in the duodenum looking toward the liver hilum, so as to ensure that the needle punctures in the axis of the bile duct. For HGS, the transgastric puncture is made after ascertaining the needle direction toward

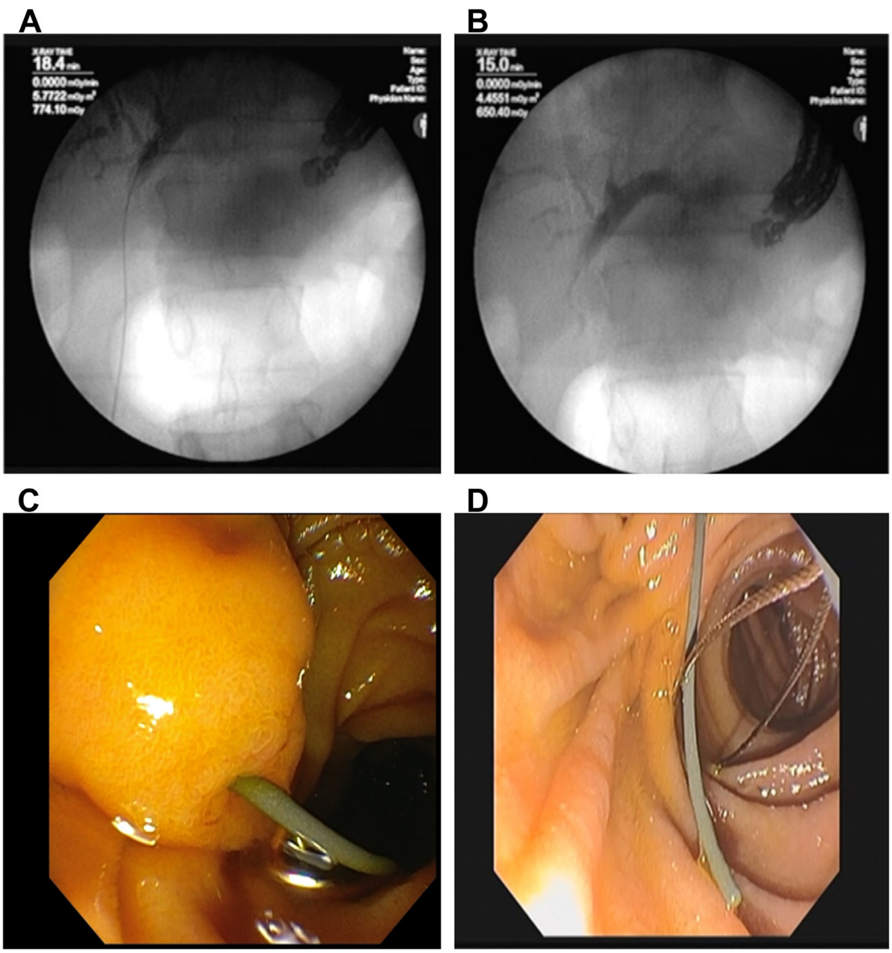

Fig. 1. EUS-Rendezvous procedure. (*A*) Transhepatic puncture with 19-gauge needle into the left duct. (*B*) Manipulation of the hydrophilic guidewire into the duodenum. (*C*) Guidewire seen extruding from the papilla with a side-viewing scope. (*D*) Guidewire retrieval with a snare.

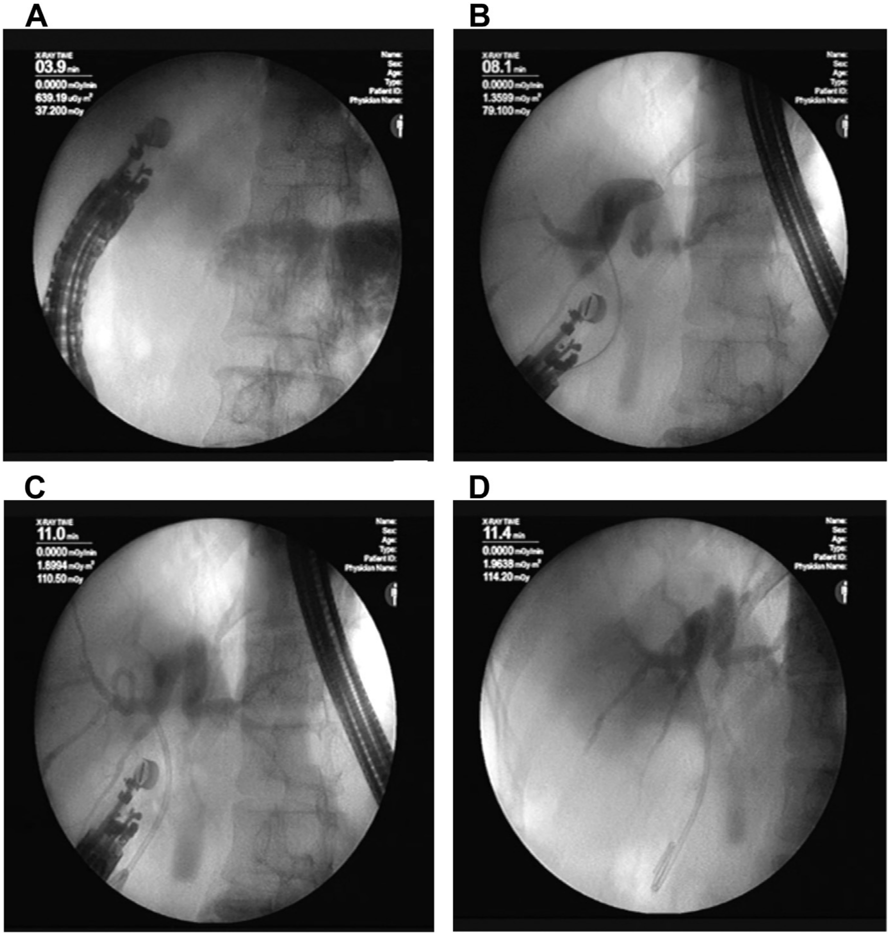

Fig. 2. EUS-Choledochoduodenostomy procedure. (*A*) Scope position for choledochoduodenostomy. (*B*) Needle puncture and guidewire manipulation in the bile duct. (*C*) Plastic stent placement with the aid of fluoroscopy. (*D*) Final choledochoduodenostomy stent placement.

segment B2/B3 biliary radicles. A 19-gauge needle is used in most cases, although 22 gauge may be used in patients with minimally dilated ducts.

Guidewire Manipulation into the Desired Duct

In cases of HGS and antegrade procedures, dilated left hepatic ducts are targeted as close to the hilum as possible to aid guidewire manipulation usually in segment B3. A 0.032″J tip Terumo (Radiofocus, Inc, USA) or 0.025″Visiglide 2 (Olympus, Tokyo, Japan) is preferred because of its flexible hydrophilic tip, which can negotiate bends and tight strictures. Guidewire manipulation could be challenging in the antegrade procedure as the wire has to be negotiated across the hilum down into the bile duct, and then across the papilla into the duodenum. Guidewire manipulation needs experience and patience, but can be successfully performed in most patients. Transluminal procedures like CDS and HGS do not require complex guidewire manipulations. Wire shearing may occur if the manipulation is done too fast.

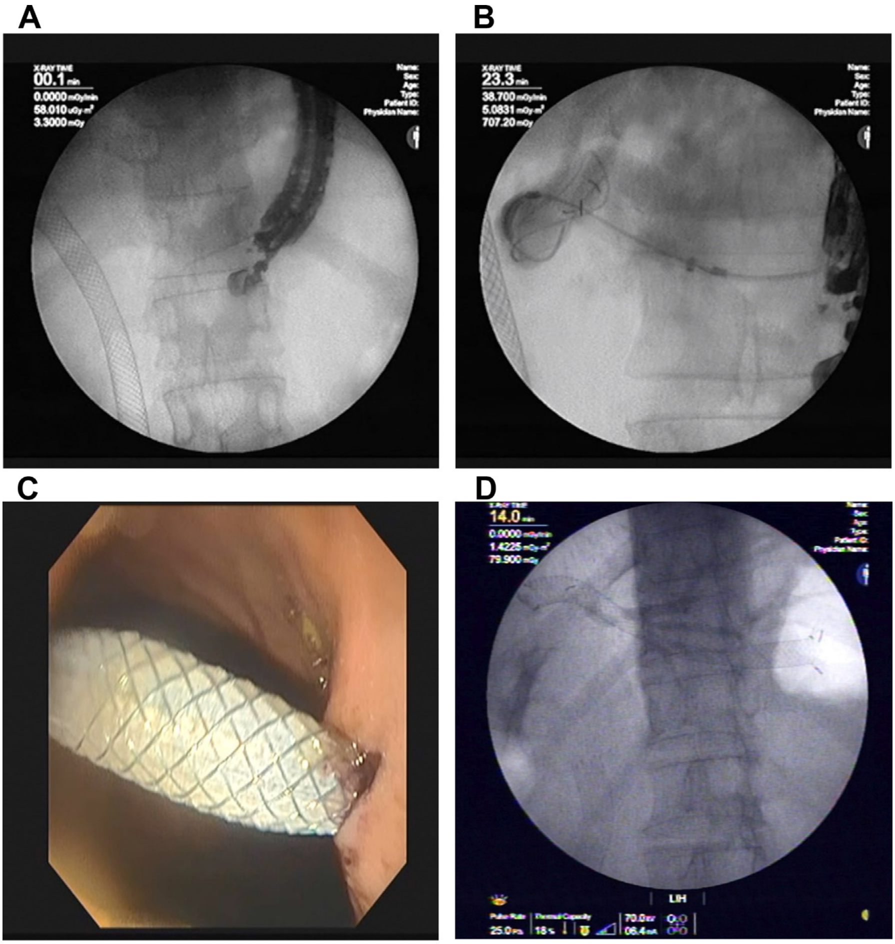

Fig. 3. EUS-Hepaticogastrostomy procedure. (*A*) Scope position for hepaticogastrostomy. (Note previously placed right-sided metal stent.) (*B*) Guidewire and cystotome manipulation within the left intrahepatic ducts. (*C*) EUS-Hepatico gastrostomy with Giobor stent placement in the stomach. (Note the long length in the stomach-covered portion.) (*D*) Hepaticogastrostomy Giobor stent placement as seen on fluoroscopy.

Tract Dilatation

After access has been secured with the guidewire in place, a 6-mm CRE biliary balloon or a 6-French cystotome is used to dilate the desired tract. Precut papillotomy or knife has been used, but has been shown to increase adverse events, as the cautery is not coaxial.

Stent Placement

Once the tract is dilated, a plastic or metal stent is inserted under endoscopy and fluoroscopy guidance. Our choice of stents is indicated in the chart (Table 2). There should be good coordination between the endoscopist and the gastrointestinal assistant, as the guidewire will need to be held tightly when the stent is traversing a tight stricture or an angulated duct.

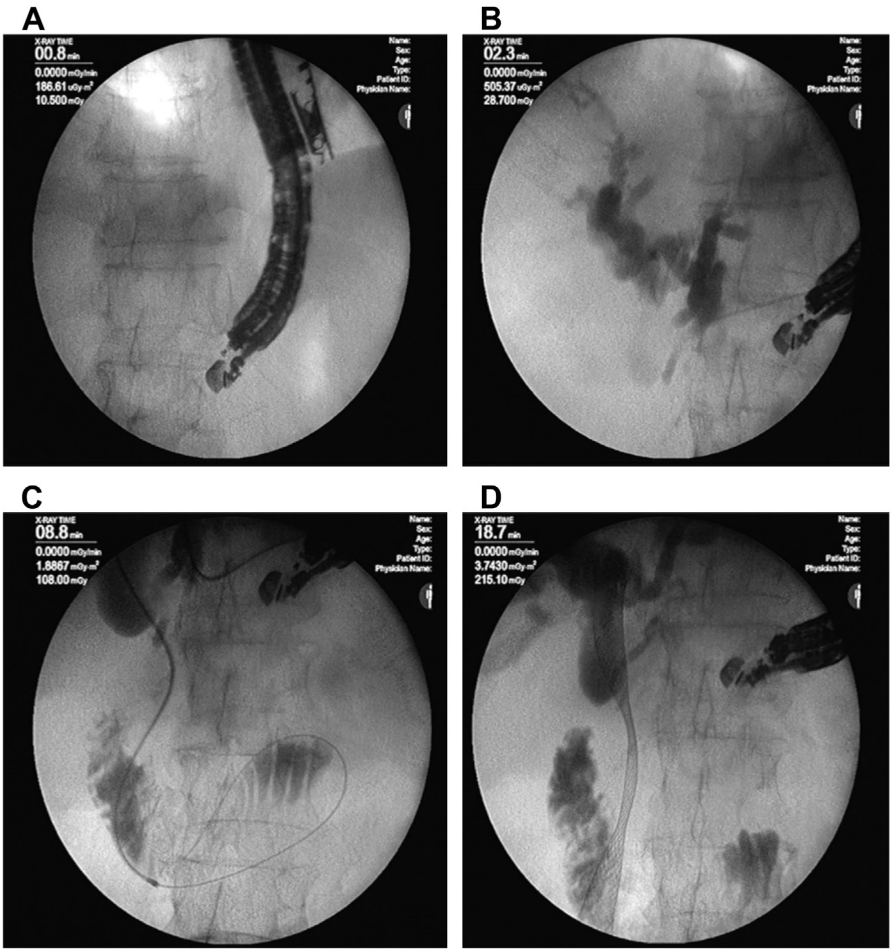

Fig. 4. EUS-Antegrade stenting procedure. (*A*) Scope position for antegrade puncture of intrahepatic ducts. (*B*) Antegrade puncture of the left ducts with contrast injection. (*C*) Antegrade wire manipulation into the duodenum and cystotome dilatation. (Note the contrast in the duodenal and jejunal loops to confirm the wire placement.) (*D*) Antegrade metal stent placement.

The hot stents have an inbuilt cautery device and the procedure of puncturing, dilatation, and stent placement is performed in a single step. This is usually easy when the bile duct is significantly dilated, but may be challenging in the minimally dilated bile duct, and a guidewire placement is advised in such situation to prevent injury to the opposite bile duct wall.

The rendezvous procedure can be attempted via the transgastric or transduodenal route. The position of the echoendoscope and direction of needle puncture are crucial to the success of the procedure. After needle puncture (transhepatic or transduodenal), a soft tip 0.032″ wire (Terumo or Visiglide 2) is passed and manipulated across the papilla into the duodenum (see **Fig. 1**). The echoendoscope is then withdrawn, leaving the guidewire in place under fluoroscopy control. A duodenoscope is inserted by the side of the guidewire, and cannulation is attempted either by the side of the wire

Table 2
Suggested stent choice for EUS-guided procedures

	Stent Type				
Procedure	**Plastic**	**Uncovered Metal**	**Covered Metal**	**LAMS**	**Tubular**
Rendezvous	✓	✓	✓	×	×
Transluminal CDS (CBD<15 mm)	?	×	✓	?	×
Transluminal CDS(CBD>15 mm)	?	×	✓	✓	×
Transluminal HGS	✓	×	?	×	✓
Antegrade	×	✓	×	×	×

coming out of the papilla (see Fig. 1) or if this does not succeed, the wire is pulled through the biopsy channel with the aid of a cannula through the duodenoscope, with the help of a snare (see Fig. 1) or a rat tooth forceps. ERCP is then completed in the usual way.

TECHNICAL TIPS AND TRICKS

Scope position is the key to various EUS-guided procedures (see Figs. 1A, 2A, 3A, and 4A). A sharp needle with flexible and echo visible tip is preferred to target the duct. Although soft guide wires are a great boon to negotiate tight strictures, they can shear within the 19-gauge needle due to repeated to and fro movements within the biliary tract. This must be avoided as this will lead to a sheared wire within the duct and difficult subsequent fluoroscopic visualization. After the initial intended cannulation, it is imperative to change the wire to a kink-resistant stiff wire as this will aid tract dilatation and most importantly stent placement. Optimal saline flush of accessories is required as the wires are hydrophilic.

Coaxial instruments should only be used to safely dilate the tract. Cystotome seems to outscore balloon dilatation and precut knife in safety and gives a clean cut. Needle knives/papillotomy should be avoided because of lack of control and bleeding. The choice of stent and its placement must be deployed under utmost care with radiological and endoscopic guidance to prevent malpositioning of stents and subsequent complications. Care must be taken to visualize the proximal, middle, and distal markers before final deployment, and often the stent can be partially deployed within the scope to prevent inward migration. Lumen apposing stents offer good anchorage, low migration rates. With antegrade procedures, it is important to identify the papilla on fluoroscopy with contrast injection as the stent placement is purely fluoroscopy guided. The key in the rendezvous procedure is to get the wire past the papilla hence. If the duct is dilated beyond 15 mm, then wire manipulation can become tricky and care must be taken to puncture the bile duct near the ampulla with the needle facing in the downward fashion.

APPROACH AND CHOICE OF STENTS

Several algorithms are available regarding the choice of EUS-BD procedure. There is no significant difference in the success rate and adverse event rate of the various EUS-BD procedures in expert hands. In general, transpapillary approaches (rendezvous or antegrade stenting) are used first probably due to the comfort level of deploying a stent through the papilla and familiarity with the accessories in using conventional ERCP specific stents. Transluminal approaches are used if transpapillary procedures fail; however, as accessories evolve and experience of EUS-BD increases, this may change with time. A learning curve effect was also suggested by the cumulative experience of 101 salvage EUS procedures carried out at a single center after failed ERCP.[23] In another study by Vila and colleagues,[24] endoscopists with more than 500 EUS procedures had higher success rates than endoscopists who had performed fewer than 500 EUS procedures.

In a recent study, patients were divided based on cross-sectional imaging. If intrahepatic biliary radicals were dilated on imaging, an antegrade procedure was the first choice. If intrahepatic biliary radicals were not dilated, rendezvous procedure was the first choice. Transluminal procedures were used in the event of failure of transpapillary procedures (hepaticogastrostomy for dilated radicals, and choledochoduodenostomy for nondilated radicals).[25]

EUS-SPECIFIC STENTS

Traditional ERCP stents do not serve the purpose of EUS-guided transluminal stenting in all cases due to the length of the stent, no anchoring mechanism, and the chance of migration.

As the experience with interventional EUS increased, the specific requirements from stents became clear. The most important distinction was the need for a covered stent, full or partial, as EUS-guided stents need to traverse across organs like stomach, liver, jejunum, duodenum, bile duct, or gallbladder. In the absence of a covered stent, the probability of leaks between organs is high. The extent of covered portion was different in different organs. For example, hepaticogastrostomy needs long tubular stents with a distal uncovered portion in the intrahepatic ducts to prevent side branch obstruction, and fully covered portion between the liver capsule and stomach to prevent bile leak.[26,27]

The second issue was the stent length. Stents used in ERCP are usually 4 cm or longer. Such a long stent is not needed for many indications with EUS like choledochoduodenostomy, gastroenterostomy, or pancreatic fluid collection drainage. A short stent length like 1 to 2 cm is usually sufficient to bring the 2 walls close together.[26] A longer stent has a propensity to migration, as well as separation of the 2 anastomosed walls leading to bleeding and complications. The third issue was migration. As these stents do not traverse through any stricture or tumor, they can migrate easily. Thus antimigration mechanisms in the form of wide flanges or other anchoring mechanisms were needed. In a study by Umeda and colleagues,[28] newly designed plastic stent has been used for EUS-guided hepaticogastrostomy.

Several stents have been designed specific to EUS therapies, which have been summarized in **Tables 3** and **4**.

ADVERSE EVENT AND MANAGEMENT

alOutcomes and complications in EUS-BD have been well documented in sever large studies as summarized in **Table 5**.[21,23–25,29–40] EUS-BD has a similar profile of adverse events to ERCP. In a meta-analysis, an overall pooled rate of adverse events was 17.9%, the commonest being biliary leak and infection.[41] The pooled rate of biliary leaks was 4%, and the pooled rate of infection and stent migration was 3.8%.[42]

Bleeding

This is the most common adverse event, 10% to 15% of cases[43–45] largely prevented by checking the coagulation parameters before the procedure and puncturing with Doppler control. Bleeding is more with needle knives rather than coaxial instruments

Table 3
Comparative data of LAMS stents

Stent Type	Flange Diameter (mm)	Length (mm)	Catheter Diameter (French)	Lumen Apposing Force (Newton)	Studied Applications
AXIOS	6–20	8,10	10.8	2.29	GJ, CDS, PFC, GG, GBD
SPAXUS	8–16	20	10	1.76	PFC, GBD, GJ
NAGI	10–16	10,20,30	9,10	1.08	PFC, GBD
AIXSTENT	10–15	30	10	NA	PFC
PLUMBER	12–16	10,20,30	10.2	NA	PFC

like cystotome or balloon dilators. Bleeding is managed with usual endoscopic methods such as metallic clips, injection of epinephrine solution (1:10,000), and use of coagulation devices, balloon compression, and hemostatic spray powder. SEMS or LAMS can stop bleeding in the great majority of cases by sheer mechanical compression.

Perforation, Peritonitis

If identified, early intervention is necessary either with clip closure or placement of a new LAMS in the same place, provided the trajectory and site is identified. Even if closure is not possible generally conservative treatment with intravenous (IV) antibiotics, IV fluids, and NBM status heals most perforations.[29,46] Rarely in the presence of peritonitis, surgical intervention may be required.

Malpositioned Stent

Usually, rat tooth forceps are good enough to remove or reposition the stents. Malpositioned stents into the peritoneum usually need surgical intervention.

Cholangitis

Cholangitis reportedly occurs in 1.9% to 31.0% of patients undergoing EUS-guided drainage[45,47] and usually indicates partial drainage. An imaging study should be done to look for residual biliary system dilation. IV antibiotics should be administered. In some patients, particularly those with hilar obstruction, additional drainage may be needed.

Table 4
Comparative data of hybrid stents

Stent Type	Stent Diameter (mm)	Stent Covered Length (mm)	Stent Length (cm)	Catheter Diameter (French)	Studied Applications	Stent Type
Giobor	8,10	40,50	8,10	8.5	HGS	Giobor
Hanaro	10	30	8,10	8.5	HGS	Hanaro
Deus delivery premounted stent	6	35–85	5,10	7	HGS, CDS	Deus delivery premounted stent

Table 5
Outcome of EUS-BD in studies with greater than 50 patients

Study	No. Patients	Technical Success	Complications
Dhir et al[21]	104	97 (93.3%)	9 (8.6%)
Poincloux et al[23]	101	99 (98.0%)	12 (11.9%)
Vila et al[24]	106	73 (68.9%)	29 (27.3%)
Tyberg et al[25]	52	50 (96.2%)	5 (9.6%)
Park et al[29]	57	55 (96.5%)	22 (38.6%)
Khashab et al[30]	121	112 (92.6%)	20 (17.8%)
Dhir et al[31]	58	57 (98.3%)	2 (3.4%)
Kawakubo et al[32]	64	61 (95.3%)	12 (18.7%)
Gupta et al[33]	240	207 (86.2%)	81 (33.7%)
Cho et al[34]	54	54 (100%)	9 (16.7%)
Shah et al[35]	66	50 (75.7%)	6 (9.1%)
Kunda et al[36]	57	56 (98.2%)	4 (7.0%)
Khashab et al[37]	96	92 (95.8%)	10 (10.4%)
Minaga et al[38]	54	46 (85.1%)	10 (5.4%)
Will et al[39]	94	80 (85.1%)	15 (15.9%)
Paik et al[40]	64	60 (93.8%)	4 (6.3%)
Total	1520	1432 (87.2%)	266 (16.7%)

Bile Leak

Incidence of bile leaks in various studies have been shown in Table 6,[21,23–25,32–35,37–39,48] which often tend to cause self-limiting abdominal pain and provided there are no signs of peritonitis or sepsis can be managed conservatively with analgesics, IV antibiotics, and fluids. Choosing the right stent size and type is

Table 6
Incidence of bile leak in EUS-BD procedures

Author	Number of Patients	Bile Leak
Dhir et al[21]	104	3
Poincloux et al[23]	101	5
Vila et al[24]	125	6
Tyberg et al[25]	52	0
Kawakubo et al[32]	64	5
Gupta et al[33]	234	27
Shah et al[35]	88	1
Khashab et al[37]	96	3
Minaga et al[38]	54	1
Will et al[39]	94	0
Dhir et al[48]	68	4
Total	1115	55 (4.9%)

important to prevent bile leaks (see Table 2). Patients with significant bile leaks may need surgical intervention.

STENT OBSTRUCTION

The mean stent patency of EUS-BD is equivalent to that of ERCP, and has been summarized in Table 7.[34,37,49,50] Stents found blocked during follow-up may need additional therapy in the form of a plastic stent through the blocked stent or a fresh metal stent.

OUTCOMES

Comparative studies between EUS-BD and other techniques are primarily available for distal malignant obstruction.

In a recent systemic review and meta-analysis of EUS-BD versus ERCP, 9 studies involving 634 patients were included. There were no significant differences between the technical and clinical success of EUS-BD and ERCP-BD. EUS-BD was associated with significantly less reintervention versus ERCP-BD and regarding adverse events, the rates were similar for EUS-BD and ERCP-BD. There were no significant differences in the types of adverse events (stent occlusion, stent migration, stent dysfunction, and duration of stent patency) between the 2 techniques. EUS-BD was associated with lower reintervention rates compared with ERCP-BD, with comparable safety and efficacy outcomes[51]

EUS-BD versus PTBD

There is level 1 evidence for EUS-BD in the distal biliary malignant block. A recent systematic review and meta-analysis by Sharaiha and colleagues[41] included 9 studies comparing the efficacy and safety of EUS-BD and PTBD: 3 randomized controlled trials (RCTs) and 6 retrospective studies. EUS-BD and PTBD showed equivalent technical success. However, EUS-BD was associated with better clinical success, fewer postprocedure adverse events, and lower reintervention rates as shown in Table 8.[12,50,52–54] No significant differences were observed for the duration of hospital stay between EUS-BD and PTBD, but EUS-BD was more cost-effective. In another systemic review and meta-analysis, 20 independent cohort studies and 3 RCTs with a total of 1437 patients were included, which showed a calculated pooled rate of reintervention was 6.5%.[42] In another RCT, EUS-BD had similar outcomes and adverse events to ERCP for primary biliary decompression.[55]

EUS-BD versus ERCP

In a recent systemic review and meta-analysis, 9 studies (3 RCTs and 6 retrospective analyses) involving 634 patients were included. There were no significant differences

Table 7
Average stent patency of EUS-specific stents

Author	Stent Patency in Days
Cho et al[34]	166 - HGS 329 - CDS
Khashab et al[37]	>365
Nakai et al[49]	255
Lee et al[50]	228

Table 8
Studies comparing EUS-BD versus PTBD

Author	Study Type	Study	Success	*P* Value	AE	*P* Value
Giovannini et al[12]	RCT	EUS[20] PTBD[21]	19 (95%) 17 (80.9%)	NS	11 18	
Lee et al[50]	RCT	EUS (32) PTBD (34)	32 (100%) 31 (91.1%)	NS	3 (8.8%) 10 (31.2%)	.022
Ginestet et al[52]	Retrospective	EUS[50] PTBD[45]	49 (98.2%) 41 (89.3%)	<.0001	(2.12%) (22.7%)	0.003
Huang et al[53]	Prospective	EUS[36] PTBD[30]	29 (94.4%) 26 (86.6%)	>0.05	(5.5%) (23.3%)	
Artifon et al[54]	RCT	EUS 13 PTBD 12	13 (100%) 12 (100%)	NS	2 3	

between EUS-BD and ERCP-BD in the technical and clinical success. There were no significant differences in the types of adverse events (stent occlusion, stent migration, stent dysfunction, and duration of stent patency) between the 2 techniques. EUS-BD was associated with lower reintervention rates compared with ERCP-BD, with comparable safety and efficacy outcomes..[51] Adverse events rates were similar for EUS-BD and ERCP-BD in various studies shown in **Table 9**.[21,32,40,55,56]

EUS-HGS and CDS

In a systemic review and meta-analysis published recently, 13 studies were included. This showed that EUS-CDS and EUS-HGS have comparable technical and clinical success rates, adverse events, and overall survival. However, EUS-CDS has less reintervention and stent obstruction.[57] In another systemic review, a total of 10 studies with 434 patients were included with similar outcomes. This showed that the technical success for CDS and HGS was 94.1% and 93.7%, respectively, and clinical success was 88.5% in CDS and 84.5% in HGS. There was no difference for adverse events[47]

In an international multicenter trial, both EUS-CDS and EUS-HG were effective and safe techniques for the treatment of distal biliary obstruction after failed ERCP. CDS was associated with shorter hospital stay, improved stent patency, and fewer procedure and stent-related complications.[30]

Table 9
Studies comparing EUS-BD versus ERCP

Author	Study Type	Study	Success	*P* Value	AE	*P* Value
Dhir et al[21]	Retrospective	EUS (104) ERCP (104)	93.3% 94.2%	NS	8.6 8.6	NS
Kawakubo et al[32]	Retrospective	EUS[26] ERCP[56]	96.2% 98.2%	NS	26.9 35.7	NS
Paik et al[40]	RCT	EUS[64] ERCP[61]	93.8% 90.2%	NS	6.3 19.7	*P* = 0.03
Bang et al[55]	RCT	EUS[33] ERP[34]	90.9% 94.1%	NS	21.2 14.7	NS
Park et al[56]	RCT	EUS[15] ERCP[15]	93% 100%	NS	- -	NA

EUS-Rendezvous

This procedure can be cumbersome but in cases where ERCP fails with an accessible ampulla in a potentially benign condition then it is an invaluable technique. There have been studies evaluating the technique itself,[58] rendezvous with short hydrophilic guidewire,[59] extrahepatic versus transhepatic route[60] and comparing it with precut papillotomy[31] suggestive of good outcomes. In a recent meta-analysis, 12 studies reporting a total of 342 patients were included. The pooled rates of technical success, clinical success, and overall adverse events were 86.1%, 80.8%, and 14%, respectively.[61]

EUS-BD with LAMS

LAMS stents have been a major advance in EUS-guided procedures. The main advantage is that their deployment is a single-step process that significantly shortens procedural time with lower adverse events. A recent meta-analysis examined 7 studies including 284 patients who underwent EUS-BD using LAMS after a failed ERCP. The pooled rates of technical success, clinical success, and postprocedure adverse events were 95.7%, 95.9%, and 5.2%, respectively.[62]

EUS-BD in Malignant Hilar Block

Malignant hilar block (MHO) is a challenging problem needing drainage of various segments of the liver to achieve clinical success. ERCP has been the standard of care with percutaneous biliary drainage as the rescue option. Recently, EUS-BD has been shown to be an alternative for MHO.

In one of the largest series of 30 patients by Minaga and colleagues, 40% had type IV block, 43.3% had type III block, and 16.6% had type II block.[63] Technical success was 96.6% and clinical success in those with technical success was 75.9%. In this series, 28 patients underwent EUS-HGS and 2 patients underwent EUS-HDS. Bismuth type IV block was the only factor associated with the clinical ineffectiveness of EUS-BD on multivariate analysis. Systemic review and meta-analysis is lacking. **Table 10** summarizes recent studies.[63–68]

EUS-Guided Stone Extraction

EUS-guided AG stone extraction is an alternative to enteroscopy-assisted ERCP in patients with altered anatomy. In EUS-AG stone extraction, biliary access is achieved

Table 10
EUS-guided biliary drainage in patients with malignant hilar block

Author	Patient Number	Technical Success	Clinical Success	Adverse Events	Reintervention Days
Minaga et al[63]	30	29/30 (96.6%)	22/29 (75.95)	3 - Early (10%) 7 - Late (23.3%)	NA
Bories et al[64]	11	10/11(90.9%)	10/11(90.9%)	3 (27.2%)	NA
Ogura et al[65]	11	11/11 (100%)	11/11 (100%)	0	NA
Ogura et al[66]	10	10/10 (100%)	9/10 (90%)	0	NA
Moryoussef et al[67]	18	17/18 (94.4%)	14/18 (72.2%)	3 (16.7%)	NA
Kongkam et al[68]	36	CERES 16/19 (84%)	CERES 15/18 (78.9%)	5/19 (26.3%)	92 d

Abbreviation: CERES, combined EUS and ERCP.

through the puncture of the left intrahepatic bile duct, followed by guidewire advancement through the ampulla into the duodenum. Then, balloon dilatation of the ampulla is performed, and stones are extracted with a balloon catheter. A plastic stent is placed in antegrade fashion through the ampulla. Intrahepatic duct dilatation is minimal in these cases and duct puncture, guidewire manipulation can be challenging. Large stones may not be amenable to extraction through the papilla, in which case a mechanical lithotripter, electrohydrolithotripsy, or spy cholangioscope may be needed in staged sessions. In these cases, a fistula is formed with either an HGS or CDS metal stent. In a recent study, the overall technical success of the creation of the hepatoenteric tract by EUS was 91.9% with modest adverse events were observed in 8.1%.[69] In a prospective study of 103 patients, the technical success was 96%, clinical success 100%, reintervention rates were 18%, and adverse events of 25%.[70]

Training in EUS-Guided Interventions

There are several studies involving training in EUS-guided biopsy but interventional EUS training is lacking because of the inadequate training facilities, low volumes even in tertiary centers, and no formal training program. However, with the training models like the "Mumbai EUS," "hybrid model (Mumbai Endoscopic Ultrasound II)" and the "EUS Magic Box" trainees can achieve competence in various interventional EUS procedures.[71–73] During the COVID-19 epidemic, virtual training courses have been trialed with good success.[74]

SUMMARY

EUS-BD has evolved as a safe viable technique for patients with failed ERCP and seems to have lower adverse events and similar technical and clinical success compared to PTBD. However, techniques and accessories need to be refined to tailor specifically to EUS-guided interventions.

CLINICS CARE POINTS

- Establishing a good echoendoscope position and maintaining it throughout the procedure is critical to the success of procedure
- Learning guidewire manipulation helps in procedures especially antegrade and rendezvous procedures
- A balloon dilator or a coaxial cautery dilator is preferred for track dilation
- It is advisable to deploy the final part of the stent within the echoendoscope for better control of the final stent position
- Early recognition of postprocedure adverse events and a backup interventional radiology or surgical team is essential for better outcomes

DISCLOSURE

The authors have nothing to disclose.

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