Endoscopic Management of Acute Cholecystitis

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KEYWORDS

- Acute cholecystitis • EUS-guided gallbladder drainage
- Endoscopic transpapillary gallbladder drainage
- Percutaneous transhepatic gallbladder drainage

KEY POINTS

- Endoscopic management of acute cholecystitis in high surgical risk patients is recommended in tertiary hospitals whereby expertise, resources, and technical support are available.
- In patients who are not fit for surgery, percutaneous transhepatic gallbladder drainage (PTGBD), endoscopic transpapillary-gallbladder drainage (ET-GBD), and endoscopic ultrasound-guided gallbladder drainage (EUS-GBD) are effective and safe alternative procedures to cholecystectomy (CCY).
- EUS-GBD is preferred over PTGBD due to similar rates of technical success and reduced rates of reintervention and unplanned readmissions.
- Lumen-apposing metal stents (LAMS) are associated with reduced risks of AEs such as bile peritonitis and perforation as compared with plastic stents and these stents should be used for EUS-GBD.
- EUS-GBD is associated with a steeper learning curve and should be performed in high-volume endoscopy centers whereby expertise is available.

INTRODUCTION

Early laparoscopic cholecystectomy (CCY) is considered the standard treatment of patients with acute cholecystitis.[1,2] Nevertheless, for patients with high surgical risks, such as elderly patients and patients with multiple comorbidities, hemodynamic instability or intraabdominal malignancies, gallbladder drainage (GBD) with concomitant antibiotic treatment is recommended.[3] The GBD approaches for these nonsurgical candidates include percutaneous transhepatic gallbladder drainage (PTGBD) and endoscopic gallbladder drainage (EGBD). PTGBD is often recommended as the first

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alternative to surgical intervention in these patients.[4] PTGBD is technically less challenging and can be performed in most medical institutions with access to interventional radiology. Contraindications to PTGBD include severe ascites, untreated coagulopathy, or an anatomically inaccessible position. Adverse events (AEs) which include bile peritonitis, recurrent cholecystitis, bleeding, pneumothorax, catheter dislodgement, and inadvertent removal have been reported in up to 14% of patients undergoing PTGBD.[5] Additionally, PTGBD can cause physical discomfort to patients and adversely affect their quality of life. With the advancements in endoscopic techniques and accessories, endoscopic approaches for GBD including endoscopic transpapillary gallbladder drainage (ET-GBD) and endoscopic ultrasound (EUS)-guided gallbladder drainage (EUS-GBD) have gained popularity.[6] The Tokyo Guideline 2018 considers ET-GBD and EUS-GBD as effective alternative procedures to CCY in high-volume endoscopy centers whereby expertise is available.[4] The recently published European Society of Gastrointestinal Endoscopy (ESGE) therapeutic EUS guideline has also highlighted that when technically available, EUS-GBD should be preferred over PTGBD in view of lower rates of AEs and reintervention in EUS-GBD.[7] The aim of the present article is to review the current status of endoscopic approaches for GBD in patients with acute cholecystitis and to compare the efficacy, safety, and outcomes of these endoscopic approaches with PTGBD.

Endoscopic Transpapillary Gallbladder Drainage

The transpapillary approach for GBD via cystic duct cannulation during endoscopic retrograde cholangiopancreatography (ERCP) has been used for the treatment of acute cholecystitis for more than 20 years.[8] There are 2 methods of ET-GBD: endoscopic transpapillary naso-cholecystic drainage (endoscopic nasobiliary gallbladder drainage, ENGBD) and endoscopic transpapillary gallbladder stenting (ETGBS). The details of the procedures have been described previously.[3] In brief, a guidewire is advanced into the cystic duct and gallbladder after successful CBD cannulation. A 5-F or 8.5-F naso-cholecystic drainage tube (ENGBD) or a 6-Fr to 10-Fr double pigtail stent (ETGBS) is placed into the gallbladder to enable drainage and irrigation. However, cannulation of the gallbladder may be technically challenging due to the tortuosity of the cystic duct, obstruction by stones, or severe inflammation. Cholangioscopy can be used to facilitate cystic duct cannulation when necessary.[9]

Outcomes

As shown in **Table 1**, the ET-GBD is associated with acceptable rates of technical success (70.6%–96.0%), clinical success (82.8%–100%), and AEs (0%–18%).[10–19] It is a technically challenging procedure and requires proficiency in the cannulation of the cystic duct. Cannulation of the gallbladder may not always be feasible especially if the cystic duct cannot be well-visualized on cholangiography or when there is tortuosity or stenosis of the cystic duct. A retrospective study investigated factors affecting the technical success of ET-GBD and revealed that cystic duct stones, CBD dilation, and unfavorable cystic duct direction can be considered predictors for increased rates of technical failure.[20] Ridtitid and colleagues reported a 22% increment in ET-GBD technical success rates with the use of cholangioscopy combined with fluoroscopy for difficult cystic duct cannulation.[9] Other studies have shown an improved technique success rate in high-volume endoscopy centers.[10,21] Kjaer and colleagues reported an enhanced success rate from 50% in the first 4 years of the study to 89% in the subsequent 5 years, demonstrating a relatively long learning curve for the procedure.[10]

Exploiting the natural biliary tree, ET-GBD reduced complications related to externalized drainage. A recent meta-analysis of ET-GBD reported a pooled overall AE

Table 1
Outcomes of endoscopic transpapillary gallbladder drainage

Author, Year	Research Type	Treatment Options	No. of Patients	Technical Success	Clinical Success	No. of Adverse Events	No. of Recurrence
Kjaer et al,[10] 2007	Retrospective	ENGBD/ETGBS	34	70.6%	87.5%	4	-
Mutignani et al.[11], 2009	Retrospective	ENGBD/ETGBS	35	82.9%	82.8%	6	2
Lee et al.[12], 2011	Prospective	ETGBS	29	79.3%	100.0%	Early 4 + Late 4	-
Yang et al.[13], 2015	Prospective	ENGBD	17	82.4%	85.7%	3	-
	Prospective	ETGBS	18	88.9%	93.8%	2	-
Widmer et al.[14], 2015	Prospective	ETGBS	128	91.0%	100.0%	7	-
Itoi et al.[15], 2015	Prospective	ENGBD	37	91.9%	94.1%	2	-
	Prospective	ETGBS	36	86.1%	90.3%	1	-
McCarthy et al.[16], 2015	Retrospective	ETGBS	29	75.9%	90.0%	2	-
Inoue et al.[17], 2016	Retrospective	ETGBS	35	82.9%	94.3%	3	0
Kim et al.[18], 2020	Retrospective	ENGBD/ETGBS	171	90.6%	90.1%	21	1
Storm et al.[19], 2021	Retrospective	ENGBD/ETGBS	51	96.0%	100.0%	3	3

rate of 8.83% (95% confidence interval (CI): 7.42–10.34).[22] The most common AEs were post-ERCP pancreatitis (1.98%), recurrent cholecystitis or biliary colic (1.48%), bleeding (1.03%), perforation (0.78%) of the cystic duct or gallbladder, and peritonitis/bile leakage (0.45%). The pooled rates of stent occlusion and migration were 0.39% and 0.13%, respectively.

Similar to PTGBD, ENGBD usually serves as a temporary measure for controlling acute cholecystitis until the patient is eligible for subsequent surgery or internal stent placement. Although it allows repeated gallbladder irrigation, performance of a cholecystogram, and bile sampling via the drainage tube, ENGBD is less favored by the patient and inadvertent drain dislodgement can occur. In contrast, ETGBS is better tolerated by patients and can be used for long-term drainage in high-risk patients or patients with limited life expectancy. However, in ETGBS, the stent cannot be irrigated and carries risks of occlusion or migration.[23,24] A randomized trial that compared ENGBD versus ETGBS in the management of acute cholecystitis demonstrated comparable safety and efficacy of these 2 methods.[15] As the stent can be removed when required, the major advantage of long-term placement of ETGBS over other alternatives is that it avoids permanent anatomic distortion. A few studies evaluated the long-term outcome of ETGBS. Hatanaka and colleagues reported a recurrence cholecystitis rate of 15.7% with a median follow-up time of 229 days, and the cumulative recurrent cholecystitis rates were 10.5% at 1 year and 18.7% at 2 years.[25] A multicenter prospective study by Lee and colleagues investigated the long-term clinical outcomes for patients after ET-GBD and revealed a median stent patency of 760 days.[12] Maekawa and colleagues reported long-term recurrent cholecystitis rate was approximately 3.3%, and 93.5% of the patients remained asymptomatic until death or the end of the study period (1 month to 5 years) without stent exchanges.[26] A recent multicenter retrospective cohort study by Maruta and colleagues showed a similar recurrent cholecystitis rate of 5.0% with a median follow-up time of 375 days.[27] These data demonstrated the long-term effectiveness of ETGBS in surgically unfit patients with acute cholecystitis. However, the optimal duration of stenting and whether routine stent replacement is required for improved long-term outcomes are still undefined.[28] Some studies have suggested that capillary action alongside the stent enables adequate drainage of the gallbladder even when the stent is occluded, eliminating the need for frequent stent exchange. Nevertheless, further prospective trials with a larger number of patients are warranted to determine the optimal time for stent removal or exchange.[17]

Endoscopic ultrasound-guided gallbladder drainage

EUS-GBD has opened new avenues in the treatment of acute cholecystitis. Baron and Topazian and colleagues initially reported EUS-GBD using a plastic stent in 2007 as a palliative treatment of acute cholecystitis in a patient with cholangiocarcinoma after failed ET-GBD.[29] With parallel development in novel endoscopic devices such as fully covered self-expandable metal stents (FCSEMS) and lumen-apposing metal stents (LAMS), substantial technical progress has been made to enable subsequent interventional procedures such as magnifying endoscopy, gallstone removal and polypectomy.[30]

Previous reports have described the procedures in detail (**Fig. 1**).[3] EUS-GBD can be achieved via a transgastric or transduodenal approach with the placement of transmural stents. Generally, the procedure is performed using a linear array echoendoscope. After clear visualization under EUS, the gallbladder is punctured from the duodenal bulb or gastric body with a 19-gauge needle. A guidewire is then placed into the gallbladder through the needle. Thereafter, a double pigtail plastic stent, FCSEMS, or a

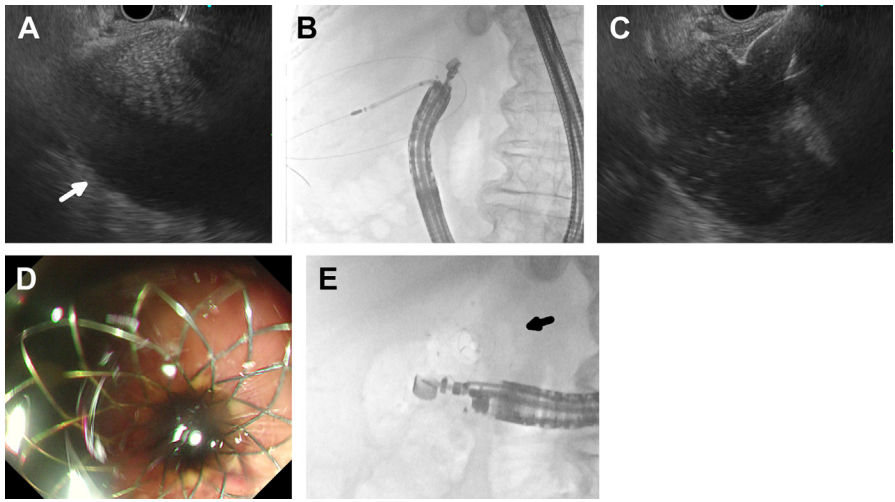

Fig. 1. (*A*) EUS noted a distended gallbladder as indicated by the white arrow. (*B*) Direct puncture with the cautery enhanced LAMS and insertion of a guidewire into the gallbladder. (*C*) Opening of the distal flange under EUS guidance. (*D*) Endoscopic view of the proximal flange. (*E*) X-ray image of a fully opened stent.

LAMS is inserted into the gallbladder for drainage and to allow subsequent interventional procedures if required.

Earlier EUS-GBD was performed with a double pigtail plastic stent with an acceptable technical success rate.[31] However, it was associated with a higher rate of advent events including pneumoperitoneum, bile peritonitis, stent occlusion, and migration. Subsequently, FCSEMS were used for EUS-GBD. These stents reduced the risk of bile leakage but were still not ideal for transmural drainage as the stents were too long, prone to migration. In light of these limitations, LAMSs were designed for transmural drainage of the gallbladder and pseudocysts.[32] With the anchoring function of the flanges and a shorter length, LAMS can generate adequate lumen-apposing force (LAF) to hold 2 organs in apposition and prevent stent migration.[33] The larger diameter of these LAMS also minimize the risk of stent obstruction and enable endoscopes to traverse the 2 organs for further interventional therapies including stone removal and polypectomy.

Recently, novel cautery-tipped stent delivery systems have been developed and enabled single-step EUS-guided gallbladder stenting.[34–36] Combining the functions of cystotomes, tract dilators, and stent delivery catheters, these devices decrease the need for a multistep procedure, instrument exchanges, and related AEs. Successful applications of these cautery-enhanced stents have been reported in the treatment of acute cholecystitis and peripancreatic fluid collection.[34]

Outcomes

As shown in **Table 2**, an increasing number of case series on EUS-GBD have been reported with high success rates and low AEs rates.[37–44] The technical success rate of EUS-GBD is 90% to 100%, the clinical success rate 86.4%–100%, and the procedure-related AE rate is 7.25%–12.80%. A retrospective international multicenter registry on EUS-GBD in 379 consecutive patients revealed technical and clinical success rates of 95.3% and 90.8% and 30-day AE and 30-day mortality rates of 15.3%

Table 2
Outcomes of endoscopic ultrasound-guided gallbladder drainage

Author, Year	Research Type	Number of Patients	Technical Success	Clinical Success	Number of Adverse Events	Number of Recurrence
Jang et al.[37], 2011	Prospective	15	100.0%	100.0%	2	0
Choi et al.[38], 2014	Retrospective	63	98.4%	98.4%	Early AE 3 Late AE 4	2
Walter et al.[39], 2015	Prospective	30	90.0%	86.7%	4	2
Dollhopf et al.[40], 2017	Retrospective	75	98.7%	95.9%	8	3
Ahmed et al.[41], 2018	Retrospective	13	100.0%	92.3%	1	1
Anderloni et al.[42], 2018	Retrospective	45	97.8%	86.4%	5	-
Oh et al.[43], 2019	Retrospective	83	99.3%	99.3%	6	2
Teoh et al.[44], 2019	Prospective (RCT)	39	97.4%	92.3%	30 d 5 1 year10	1

and 9.2%, respectively.[45] A recent meta-analysis reviewed a total of 558 patients from 17 EUS-GBD studies and the cumulative pooled technical success, clinical success and procedure-related AEs of 87.33% (95% CI: 84.42–89.77), 84.16% (95% CI: 80.30–87.38), and 11.00% (95% CI: 9.25–13.03), respectively.[46] Subgroup studies using only LAMS for EUS-GBD revealed superior outcomes; the technical success was 94.65% (95% CI: 91.54–96.67), clinical success was 92.06% (95% CI: 88.65–94.51), and AE rate was 11.71% (95% CI: 8.92–15.23). Data from these studies have shown definite benefits of EUS-GBD for the treatment of acute cholecystitis in surgically unfit patients.

Common AEs with EUS-GBD include pneumoperitoneum, bile leakage/peritonitis, bleeding, perforation, stent migration, and recurrent cholecystitis. A recent meta-analysis of EUS-GBD demonstrated pneumoperitoneum and bile leakage as the most common AEs in the procedure, which may potentially be caused by tract dilation and the placement of small diameter plastic stents. The use of self-expanding LAMS is, therefore, recommended to minimize tract dilation and reduce the risks of bile leakage and stent migration.[37,40] Another meta-analysis consisting of 8 studies with 393 patients evaluated AEs with LAMS in EUS-GBD.[47] The study reported an overall AE rate of 12.7% (95% CI: 8.4–18.7), an early AE risk of 6.5% (95% CI: 4.2–10), and a delayed AE risk of 8.3% (95% CI: 5.8–11.9). Common early AEs with LAMSs were bleeding (2.6%; 95% CI: 0.9-7.2), bile leakage (1.3%, 95% CI: 0.5-3.3), perforation (2.3%; 95% CI: 1.1-4.7) and stent migration (1.5%; 95% CI: 0.6-3.5), and common delayed AEs were stent occlusion (5.2%; 95% CI: 3-8.7), stent migration (3%; 95% 1.5-5.8), recurrent cholecystitis/cholangitis (4.6%; 95% CI: 2.6-9.5), and death (5%; 95% CI: 2.6-9.5), which were mainly attributed to patient comorbidities.

On the other hand, there is so far no consensus on when LAMS should be removed or replaced. Recent studies from Jang and colleagues and Saumoy and colleagues demonstrated that the presence of a LAMS did not interfere with subsequent CCY if required.[48,49] However, for patients with limited life expectancy and those that are too frail to undergo CCY or another endoscopic procedure for stent removal, LAMS may be left indefinitely after EUS-GBD. A multicenter, prospective, long-term study of EUS-GBD with LAMS reported the absence of stent-related AEs during a mean follow-up time of 364 days.[39] Similar results have also been observed in other studies using SEMS, LAMS, or cautery enhanced LAMS with long term stenting up to 3 years.[50] Although preliminary data suggested that LAMS might be considered for permanent placement in selected patients, more research should be carried out to improve stent patency and to avoid potential stent-induced AEs in the long term.

In addition, although high technical and clinical success were reported in the literature, most of these procedures have been performed in tertiary hospitals by endoscopists proficient in interventional EUS and ERCP. Some studies have suggested EUS-GBD is associated with a steep learning curve even when adopted by experienced endoscopists in high-volume centers.[45,51] Tyberg and colleagues and Teoh and colleagues concluded that the number of cases required to gain competency with EUS-GBD was 19 cases and 25 cases, respectively. Further effort is required to establish a standardized training program and accreditation system for more endoscopists to develop the required skills if EUS-GBD is to become the standard GBD procedure.

Interventions after endoscopic ultrasound-guided gallbladder drainage with lumen-apposing metal stents

EUS-GBD with LAMS has made subsequent advanced endoscopic assessment and interventions to the gallbladder and cystic duct possible. Exploiting the large diameter

of the LAMS, endoscopes and different accessories can be directly advanced into the gallbladder for further treatment after EUS-GBD, such as stone removal, magnifying endoscopy, and polypectomy (Fig. 2).[30,52] Chan S et al. reported that stone clearance was achieved in 88% of patients after EUS-GBD.[30] Spontaneous passage of gallstones via the fistula was observed in 56% of these patients, and the remaining gallstones can be retrieved with water irrigation, basket, and laser lithotripsy.

In another report, a polypoid lesion in the gallbladder was assessed using magnified endoscopy. Irregular glands with a corkscrew microvascular pattern were observed, highly suggestive of a malignant lesion.[53] Biopsy confirmed adenocarcinoma of the gallbladder. Gallbladder polypectomy has also been described in a few studies using LAMS as a portal.[30,54] However, further studies with long-term follow-up are needed to investigate the clinical outcomes of these advanced interventional procedures.

COMPARATIVE STUDIES

Comparison of Endoscopic Transpapillary-Gallbladder Drainage and Endoscopic Ultrasound-Guided Gallbladder Drainage

The two endoscopic modalities for GBD have been compared in surgically unfit patients with acute cholecystitis in a few recent studies. A retrospective study consisting of 172 consecutive patients revealed significantly higher rates of technical (99.3% vs 86.6%, $P < 0.01$) and clinical success (99.3% vs 86%, $P < 0.01$) with EUS-GBD compared with ET-GBD (Table 3).[43] The AE rate (7.1% vs 19.3%, $P = 0.02$) and combined cholecystitis and cholangitis recurrence rate (3.2% vs 12.4% vs, $P = 0.04$) were also lower for EUS-GBD. A meta-analysis including 5 retrospective studies with 857 high-surgical risk patients noted a similar finding. Significantly higher rates of technical ($P < 0.01$) and clinical ($P < 0.01$) success were observed in the EUS-GBD group than in the ET-GBD group.[55] With similar rates of overall AEs, EUS-GBD is preferred over ET-GBD due to a lower rate of recurrent cholecystitis ($P < 0.01$). In view of the superior technical efficacy and clinical outcome of EUS-GBD, it may be favored over ET-GBD in nonsurgical patients with acute cholecystitis. The ESGE Guideline also recommends EUS-GBD over ET-GBD when both techniques are available.[7] However, most of the studies comparing EUS-GBD versus ET-GBD were conducted in a retrospective cohort, and well-designed prospective studies are needed to verify the current results.

Comparison of Endoscopic Transpapillary-Gallbladder Drainage and Percutaneous Transhepatic Gallbladder Drainage

Several studies compared the efficacy and outcomes of ET-GBD with PTGBD for the treatment of acute cholecystitis. An international multicenter comparative study involving 1764 patients suggested similar clinical success rates within 3 days

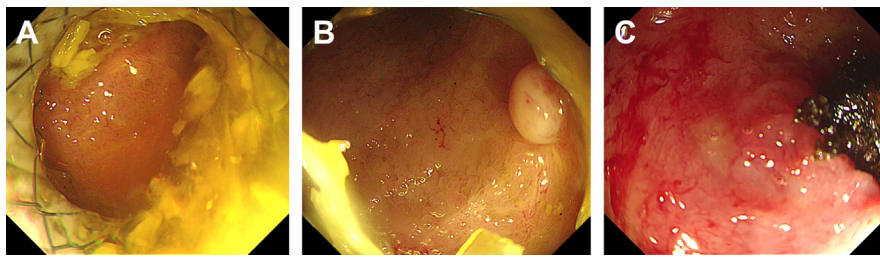

Fig. 2. (*A*) Endoscopic view of cholecystoscopy. (*B*) Inflammatory polyp noted in the gallbladder. (*C*) Gallstone noted in the cystic duct opening.

Table 3
Summary of results from comparative studies in gallbladder drainage

Study, Year	Research Type	Type of GBD	No. of Patients	Technical Success	Clinical Success	Adverse Effects	Notes
Teoh et al.[44], 2020	Randomized control trial	EUS-GBD	39	97.4%	92.3%	1 y: 25.6% 30 d: 12.8%	EUS-GBD significantly reduced 1-y AEs, 30 d AEs, re-interventions, unplanned readmissions, and recurrent cholecystitis
		PTGBD	40	100.0%	92.5%	1 y: 77.5% 30 d: 47.5%	
Jang et al.[48], 2012	Randomized control trial	EUS-GBD	30	97.0%	100.0%	7.0%	EUS-GBD significantly reduced postprocedure pain score
		PTGBD	29	97.0%	96.0%	3.0%	
Choi et al.[66], 2016	Retrospective	EUS-GBD	14	85.7%	100.0%	28.5%	EUS-GBD significantly reduced postprocedure cost and length of hospital stay
		PTGBD	19	91.7%	86.4%	21.1%	
Irani et al.[67], 2016	Retrospective	EUS-GBD	45	98.0%	96.0%	11.0%	EUS-GBD significantly reduced the length of hospital stay and postprocedure pain
		PTGBD	45	100.0%	91.0%	32.0%	
Tyberg et al.[60], 2018	Retrospective	EUS-GBD	42	95.0%	95.0%	11.0%	EUS-GBD was associated with a significantly decreased rate of re-interventions
		PTGBD	113	99.0%	86.0%	32.0%	
Iino et al.[58], 2018	Retrospective	ET-GBD	43	77.0%	-	9.3%	ET-GBD resulted in a significantly lower technique success rate but a shorter length of hospitalization
		PTGBD	32	100.0%	-	6.0%	
Itoi et al.[56], 2017	Retrospective	ET-GBD	333	-	7 d: 89.2%	8.2%	ET-GBD significantly increased the clinical success within 3 d
		PTGBD	333	-	7 d: 85.7%	5.6%	
Oh et al.[43], 2018	Retrospective	EUS-GBD	76	99.3%	99.3%	7.1%	EUS-GBD was associated with significantly higher rates of clinical success and technical success; and lower rates of AEs and recurrent cholecystitis or cholangitis
		ET-GBD	96	86.6%	86.0%	19.3%	

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Table 3
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Study, Year	Research Type	Type of GBD	No. of Patients	Technical Success	Clinical Success	Adverse Effects	Notes
Higa et al.[68], 2019	Retrospective	EUS-GBD ET-GBD	40 38	97.5% 84.2%	95.0% 86.0%	17.9% 9.4%	EUS-GBD resulted in significantly higher technical and clinical success, and less-frequent recurrent cholecystitis
Siddiqui et al.[62], 2019	Retrospective	EUS-GBD ET-GBD PTGBD	102 124 146	94.0% 88.0% 98.0%	90.0% 80.0% 97.0%	2.0% 5.0% 20.0%	ET-GBD was associated with significantly lower technical and clinical success compared with PTGBD and EUS-GBD. EUS-GBD with LAMS had significantly lower AEs, length of hospital stays, and unplanned admissions compared with PTGBD.

(62.5% and 69.8%, $P = 0.085$) and 7 days (87.6% and 89.2%, $P = 0.579$) and no significant difference in AE rates (4.8% and 8.2%, $P = 0.083$) between PTGBD and ET-GBD, respectively.[56] Contrast to the previous report, studies by Iino and colleagues and Kaura and colleagues demonstrated that ET-GBD was associated with a suboptimal technical success rate (77%–91% vs 100%; $P < 0.001$) compared with PTGBD.[57,58]

However, the long-term outcome was superior in the ET-GBD group versus PTGBD group; Inoue and colleagues revealed a significantly reduced rate of recurrent cholecystitis (0% vs 17.2%, $P = 0.043$) and reduced overall biliary event rates (9.1% vs 24.1%, albeit not statistically significant, $P = 0.207$) in the ET-GBD group.[17] Surgical outcomes post–ET-GBD versus PTGBD were also investigated and suggested comparable rates of conversion to open CCY and postoperative complications.[57,59] One recently published randomized controlled trial enrolled 22 high-surgical risk patients with acute cholecystitis who received CCY 2 to 3 months after ET-GBD or PTGBD drainage[59]; and showed significantly reduced abdominal pain ($P < 0.001$), less postoperative hemorrhage and abdominal drainage tube placement ($P = 0.03$), and better gallbladder pathologic grades ($P = 0.004$) in the ET-GBD group compared with PTGBD group.

Comparison of Endoscopic Ultrasound-Guided Gallbladder Drainage and Percutaneous Transhepatic Gallbladder Drainage

Several studies have compared EUS-GBD with PTGBD in nonsurgical candidates and have suggested that EUS-GBD may be associated with comparable technical success rates but improved clinical outcomes and fewer AEs than PTGBD.[6,48,60] An international randomized multicenter controlled superiority trial (DRAC 1) with 80 consecutive high-risk patients with acute calculous cholecystitis reported similar technical (97.4% vs 100%, $P = 0.494$) and clinical success rates (92.3% vs 92.5%, $P = 1.0$), 30-day mortality (7.7% vs 10%, $P = 0.68$) and hospital stays (8 vs 9 days; $P = 0.18$) in EUS-GBD and PTGBD.[44] The study also demonstrated that EUS-GBD was associated with significantly reduced 30-day AEs (12.8% vs 47.5%, $P = 0.010$) and 1-year AEs (25.6% vs 77.5%, $P = 0.001$), 30-day reinterventions (2.6% vs 30%, $P = 0.001$), unplanned readmissions (15.4% vs 50%, $P = 0.002$) and recurrent cholecystitis (2.6% vs 20%, $P = 0.029$). Similar results were reported in a recent meta-analysis including 5 comparative studies with a total of 495 patients with acute cholecystitis.[61] Comparable rates in technical and clinical success (odds ratio (OR): 0.43; $P = 0.21$) between the 2 modalities were demonstrated, while postprocedure AEs (OR: 0.43, $P = 0.05$), days of hospital stay (– 2.53; $P = 0.005$), reinterventions (OR: 0.16, $P < 0.001$) and readmissions (OR: 0.16, $P = 0.003$) were significantly lower for EUS-GBD than for PTGBD.

In addition, EUS-GBD might be considered an alternative modality to PTGBD as a bridging therapy to CCY, even though the technical challenges for closing the gastric/duodenal fistula in EUS-GBD have to be taken into consideration. A prospective randomized controlled trial reported that the conversion rate from laparoscopic to open CCY was comparable between patients post–EUS-GBD and PTGBD (9% vs 12%, $P = 0.99$).[48] A multicenter international retrospective study also reported similar open conversion rates and AEs between the 2 GBD modalities and demonstrated that interval CCY after EUD-GBD is safe and feasible.[49]

Overall, although larger comparative studies are warranted, EUS-GBD and PTGBD showed comparable technical and clinical success rates in the results of the above literature. In view of the lower rates of AEs and reduced readmission and reintervention rates, EUS-GBD should be favored over PTGBD when technically available.[7]

Comparison of Endoscopic Transpapillary-Gallbladder Drainage, Endoscopic Ultrasound-Guided Gallbladder Drainage, and Percutaneous Transhepatic Gallbladder Drainage

Three-way comparative studies were performed retrospectively to evaluate the clinical outcomes and efficacy of the 3 modalities.[62] An international multicenter study consisting of 372 high-risk surgical patients with acute cholecystitis compared EUS-GBD using LAMS, ET-GBD, and PTGBD. PTGBD and EUS-GBD had significantly higher technical (98% vs 94% vs 88%; $P = 0.004$) and clinical (97% vs 90% vs 80%; $P < 0.001$) success rates than ET-GBD. While significantly higher AEs (20% vs 2% vs 5%; $P = 0.01$) and additional surgical intervention (49% vs 4% vs 11%; $P < 0.0001$) were observed in the PTGBD group. The lowest overall AEs, hospital stay, and unplanned admissions were observed in the EUS-GBD group. Another network meta-analysis (10 studies, 1267 patients) comparing the 3 treatment options of GBD also reported similar outcomes.[63] In the network ranking estimate, PTGBD and EUS-GBD had higher rates of technical and clinical success compared with ET-GBD. While EUS-GBD had the lowest rate of recurrent cholecystitis and PTGBD had the highest reintervention and unplanned readmission.

Recently, a cost-effectiveness analysis in a hypothetical cohort of surgically unfit patients with acute cholecystitis illustrated that, compared with PTGBD, ET-GBD was associated with reduced cost and improved effectiveness and EUS-GBD was associated with higher expenses but improved effectiveness.[64] The study suggests that endoscopic approaches for GBD may be favored over PTGBD from an economical perspective.

Comparison of Endoscopic Ultrasound-Guided Gallbladder Drainage and Laparoscopic Cholecystectomy

One retrospective study compared the outcomes of EUS-GBD with laparoscopic CCY for acute cholecystitis in 60 patients.[65] A comparable technical (100% vs 100%) and clinical success (93.3% vs 100%, $P = 1$), mortality (6.7% vs 0%, $P = 0.492$), recurrent biliary events (10% vs 10%, $P = 0.784$), reintervention (13.3% vs 10%, $P = 1$) and 1-year unplanned readmission rate (10% vs 10%, $P = 0.784$) were reported. Although future prospective studies with a larger sample size is warranted, the results suggest that EUS-GBD may potentially be an alternative to laparoscopic CCY in a selected group of patients who may be suitable for definitive surgery.

SUMMARY

Endoscopic management of acute cholecystitis in high surgical risk patients is recommended in tertiary hospitals whereby expertise, resources, and technical support are available. The optimal treatment modality (PTGBD, ET-GBD, or EUS-GBD) should be individualized based on patient conditions and the techniques available in the facility. There are accumulating evidence that suggests that EUS-GBD should be favored over PTGBD or ET-GBD when the expertise is available due to the higher technical efficacy, lower rates of AEs, and reintervention in EUS-GBD. However, further prospective studies and long-term follow-up are necessary to clarify the optimal patient selection for each technique and to guide stent management after EUS-GBD/ET-GBD. Future research is also required to address the optimal stent, the duration of stenting, and the need for gallstone removal after stent placement for transmural GBD. Studies are also required to further elucidate the role of EUS-GBD as an alternative treatment to laparoscopic CCY for patients who might be fit for surgery. Finally, the endoscopic procedures for GBD need to be standardized and training programs are required to introduce the techniques effectively and safely to the wider endoscopic society.

CLINICS CARE POINTS

- In patients who are not fit for surgery, PTGBD, ET-GBD, and EUS-GBD are effective and safe alternative procedures to cholecystectomy (CCY).
- ET-GBD and EUS-GBD showed similar conversion rates from CCY to open surgery compared with PTGBD and can be considered as bridging therapies to CCY instead of PTGBD.
- EUS-GBD is preferred over PTGBD due to similar rates of technical success and reduced rates of reintervention and unplanned readmission.
- LAMS is associated with reduced risks of AEs such as bile peritonitis and perforation compared with plastic stents after EUS-GBD.
- EUS-GBD is associated with a steeper learning curve and should be performed in high-volume endoscopy centers whereby expertise is available.

DISCLOSURE

A.Y.B. Teoh is a consultant for Boston Scientific, Cook, Taewoong and Microtech Medical Corporations. R. Sharaiha is a consultant for Boston Scientific, Cook, Lumendi. Other co-authors do not have any conflicts of interest to disclose.

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