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SYSTEMATIC REVIEWS

Endoscopic ultrasound-guided biliary intervention in patients with surgically altered anatomy

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Abstract

AIM: To evaluate the efficacy of endoscopic ultrasound guided biliary drainage (EUS-BD) in patients with surgically altered anatomies.

METHODS: We performed a search of the MEDLINE database for studies published between 2001 to July 2014 reporting on EUS-BD in patients with surgically altered anatomy using the terms "EUS drainage" and "altered anatomy". All relevant articles were accessed in full text. A manual search of the reference lists of relevant retrieved articles was also performed. Only full-text English papers were included. Data regarding age, gender, diagnosis, method of EUS-BD and intervention, type of altered anatomy, technical success, clinical success, and complications were extracted and collected. Anatomic alterations were categorized as: group 1, Billroth Ⅰ; group 2, Billroth Ⅱ; group 4, Roux-en-Y with gastric bypass; and group 3, all other types.

RESULTS: Twenty three articles identified in the literature search, three reports were from the same group with different numbers of cases. In total, 101 cases of EUS-BD in patients with altered anatomy were identified. Twenty-seven cases had no information and were excluded. Seventy four cases were included for analysis. Data of EUS-BD in patients categorized as group 1, 2 and 4 were limited with 2, 3 and 6 cases with EUS-BD done respectively. Thirty four cases with EUS-BD were reported in group 3. The pooled technical success, clinical success, and complication rates of all reports with available data were 89.18%, 91.07% and 17.5%, respectively. The results are similar to the reported outcomes of EUS-BD in general, however, with limited data of EUS-BD in patients with altered anatomy rendered it difficult to draw a firm conclusion.

CONCLUSION: EUS-BD may be an option for patients with altered anatomy after a failed endoscopic-retrograde-cholangiography in centers with expertise in EUS-BD procedures in a research setting.

Key words: Endoscopic ultrasound-guided anterograde approach; Endoscopic ultrasound-guided biliary drainage; Endoscopic ultrasound-guided choledochoduodenostomy; Endoscopic ultrasound-guided hepaticogastrostomy; Endoscopic ultrasound-rendezvous technique; Surgically altered anatomy; Overtube-assisted enteroscopy-endoscopic retrograde cholangiopancreatography

Core tip: Endoscopic retrograde cholangiopancreatography (ERCP) in patients with surgically altered anatomy is challenging, with a failure rate as high as 26%. Data of endoscopic ultrasound-guided biliary drainage (EUS-BD) in patients with altered anatomy from the literature show a similar efficacy to that of EUS-BD in general. EUS-BD may be selected as an alternative for patients with altered anatomy who failed overtube-assisted enteroscopy-ERCP in centers where the expertise in EUS-BD is available. However, the EUS-BD approach should be performed in a research setting based on the current stage of EUS-BD techniques.

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INTRODUCTION

Endoscopic retrograde cholangiopancreatography (ERCP) has been widely accepted as a standard procedure with a high success rate for the management of biliary disorders[1]. However, conventional ERCP in patients with surgically altered anatomy is technically difficult, and is accompanied by a relatively high rate of complications. In large case series, technical failures varied from 13% to 67%, and the rate of perforation was as high as 18%, with a mortality rate of 3%[2,3]. ERCP with overtube-assisted enteroscopy (OAE-ERCP), with a balloon or spiral overtube, achieved a success rate of approximately 74% and a 3.4% complication rate in patients with surgically altered anatomies[4]. Percutaneous transhepatic biliary drainage (PTBD) is a well-established technique that is usually selected as an alternative in patients with failed ERCP. However, despite the high clinical success rate, the PTBD approach is associated with 0.5%-15% morbidity and 0%-4.9% mortality rates[5].

Endoscopic ultrasound-guided biliary drainage (EUS-BD) was first reported in 2001 by Giovannini *et al*[6]. Subsequently, many groups reported the utilization of EUS-BD with various approaches as an alternative biliary drainage for failed ERCPs, with an average success rate varying from 77% to 94% and complication rate of 19%-27%[7]. This method may be an option for patients with altered anatomy for whom OAE-ERCP is difficult, as reflected by a high failure rate (26%)[4]. However, the role of EUS-BD in patients with altered anatomy and failed ERCP is not well defined, and the suitability of this as an alternative drainage procedure is unclear. This review analyzes the clinical efficacy, complications, clinical implication, and limitations of EUS-BD in patients with surgically altered anatomy from data available in the literature.

MATERIALS AND METHODS

A PubMed search of the MEDLINE database was conducted for articles published between 2001 and July 2014 using the terms "EUS drainage" and "altered anatomy". A manual search of the reference lists of relevant retrieved articles was also performed. Only full-text English papers were included. The computerized endoscopic data at our center were also searched for additional cases of EUS-BD in altered anatomy conducted after our published data[8]. Data regarding age, gender, diagnosis, method of EUS-BD and intervention, type of altered anatomy, technical success, clinical success, and complications were collected.

Classification of EUS-BD techniques

The three main techniques of EUS-guided procedures for biliary drainage that were included were: anterograde EUS-BD, transluminal drainage, and the rendezvous method[7,9,10]. Anterograde EUS-BD involves intervention *via* an anterograde route across the ampulla or anastomosis. Transluminal drainage encompasses transesophageal, transgastric (hepaticogastrostomy), transduodenal (choledochoduodenostomy, EUS-CDS), or transjejunal approaches. The rendezvous method involves EUS-guided placement of a guide-wire across the ampulla or anastomosis that is exchanged with a standard duodenoscope or enteroscope to perform the intervention.

Classification of surgically altered anatomy

Anatomic alterations were categorized as: group 1, Billroth Ⅰ; group 2, Billroth Ⅱ; group 3, Roux-en-Y with pancreaticoduodenectomy (with or without a modified Child procedure), pylorus-preserving pancreaticoduodenectomy, hepaticojejunostomy, choledochojejunostomy, and total or partial gastrectomy, distal gastrectomy without specific anastomosis mentioned, and hepatic and bile duct resection; and group 4, Roux-en-Y with gastric bypass (RY-GB).

Statistical analysis

The descriptive data of age was analyzed by using Minitab 15® and no other statistical analysis was done since this study was a descriptive review.

RESULTS

EUS-BD IN patients with surgically altered anatomy

Of the 23 articles identified in the literature search, three reports were from the same group with different numbers of cases[11-13]. As no details regarding individual cases were available from these three reports, the cases with the same type of surgically

Table 1 Demographics of endoscopic ultrasound-guided biliary drainage patients with altered anatomy[8,11,14,18-32] (*n* = 74)

Characteristic	Value
Age, yr (*n* = 36)	64.14 ± 15.08
Sex, female/male (*n* = 36)	22/14
Diagnosis (*n* = 38)	
Bile duct stone	14
Benign stricture	10
Malignant stricture	11
Gastric cancer	2
Occluded stent	1
Outcome of EUS-BD, *n* (%)	
Clinical success	51 (91.1)
Complications	7 (17.5)
Technical success	66 (89.2)
EUS-BD technique with technical success, *n*	
Anterograde	28
Hepaticogastrostomy	18
Hepaticojejunostomy	2
Hepaticoesophagostomy	1
Rendezvous	3
Unavailable	14

EUS-BD: Endoscopic ultrasound-guided biliary drainage.

altered anatomy and the same diagnosis were treated as one case. In total, 101 cases of EUS-BD in patients with altered anatomy were identified. Only one report was a case series[14], all other reports were case reports or reports of EUS-BD that included normal and altered anatomy patients. Twenty-seven cases had no information and were excluded[12,15-17], leaving 74 patients with altered anatomy who underwent EUS-BD[8,11,14,18-32]. Available demographic and procedural information of these cases is presented in Table 1. Of the 40 cases reporting complications, there were incidences of mild pancreatitis (*n* = 2), mild abdominal pain (*n* = 1), hematoma (*n* = 1), cholangitis (*n* = 1), minor bleeding (*n* = 1), and surgical repositioning of a stent in the peritoneum (*n* = 1), with no mortalities.

EUS-BD in altered anatomy subtypes

The classification of altered anatomy types is listed in Table 2. In group 1, one case of EUS-BD with common bile duct (CBD) stones was reported[25], and EUS-BD was performed in one patient with distal CBD stricture at our center. Both had successful clinical outcomes. There were three cases with EUS-BD in group 2: two cases with malignant stricture and one case with a CBD stone, in whom the EUS-BD failed[11,32].

Within group 3, Roux-en-Y was performed with hepaticojejunostomy (*n* = 10), choledochojejunostomy (*n* = 1), total gastrectomy (*n* = 5), subtotal gastrectomy (*n* = 2), Whipple's operation (*n* = 6), distal gastrectomy (*n* = 2), pylorus-preserving pancreaticoduodenectomy (*n* = 5), pancreaticoduodenectomy with a modified Child procedure (*n* = 2), and hepatic and bile duct resection (*n* = 1)[8,11,14,18-32]. The diagnoses in group 3 included bile duct stones (*n* = 9), benign stricture (*n* = 9), malignant stricture (*n* = 9), occluded metallic stents placed by percutaneous route (*n* = 1), or were unspecified (*n* = 6). The success rates were in the range reported for EUS-BD in general. However, the missing data in a large proportion of patients in this group rendered it difficult to draw a firm conclusion.

Table 2 Results of endoscopic ultrasound-guided biliary drainage in altered anatomy subgroups

Group	Subtype	No. of cases	Technical success	Clinical success	Complications
1	Billroth Ⅰ	2	2	2	0
2	Billroth Ⅱ	3	2	2	0
3	Roux-en-Y	34	33 (97.0%)	23 (92.0%)	5
4	Roux-en-Y gastric bypass	6	6	5	1

Twenty-seven cases with unspecified type and no details available were excluded.

Six cases within group 4 received EUS-BD with RY-GB[33]. These patients all had CBD stones, and stone clearance was achieved with EUS-BD in five of these, with a failure in one with a hematoma.

In 27 cases that were excluded from analysis due to insufficient information[12,15-17], the overall technical success rate (including patients with altered anatomy) varied from 67.2% to 94.0%, the clinical success rate varied from 63.2% to 97.0%, and the complication rate varied from 12.0% to 23.2%.

DISCUSSION

EUS-BD vs PTBD

PTBD is a traditional alternative for patients with a failed ERCP, though it is associated with a risk of complication and significant morbidity[5]. One of the major drawbacks of PTBD is external bile loss, which leads to a decreased total bile pool. Theoretically, maintenance of enterohepatic bile circulation is important for host defense function. Kamiya *et al*[33] reported that bile replacement by oral intake of the externally diverted bile helped restore gut barrier function in patients with bile duct obstruction, but internal drainage is still more physiologic than external drainage. Moreover, the burden to the patients or family members caring for the catheter is considerable, and individuals who bathe twice daily may be disturbed by the inability to do so, thus decreasing their quality of life. In one retrospective study that compared 22 EUS-BD patients with 51 PTBD patients, the procedures showed a similar clinical success, but EUS-BD was associated with fewer adverse events and was less costly in the long term[34]. However, PTBD in their study had a 100% success rate, which was significantly higher than the 86.4% with EUS-BD. Another retrospective study compared 25 cases with EUS-BD with 26 cases with PTBD, and showed that EUS-BD was superior to PTBD in terms of success and complication rates[35]. In contrast, a prospective study showed a similar efficacy between EUS-BD performed

in 13 patients and PTBD in 12 patients[36]. Taken together, these data suggest that EUS-BD is a suitable alternative in patients with failed ERCP, and it may be an option in the centers where EUS-BD is available.

Role of EUS-BD in altered anatomy patients

The available data suggest that EUS-BD is as effective in patients with altered anatomy as in general patients. EUS-BD is still in a state of development, with proper procedural techniques under refinement. Furthermore, EUS-BD for patients with altered anatomy and failed ERCP should be assessed in a research setting to properly define its role. A standardized treatment algorithm for selection of EUS-BD techniques based on the clinical context may improve the outcome[26].

In patients with a Billroth Ⅰ operation, the straight anatomy of the stomach and duodenum cause the tip of a standard duodenoscope to come too close to the papilla, making it difficult to position the ERCP catheter along the axis of the bile duct, leading to a failed procedure in some patients[37]. In patients with Billroth Ⅱ anatomy, OAE-ERCP has an endoscopic success rate of 96% and a successful ERCP rate of 90%[4]. ERCP is the most difficult in patients with RY-GB, and OAE-ERCP has an endoscopic success rate of only 80% and successful ERCP rate of only 70%[4]. In post RY-GB patients with failed OAE-ERCP, laparoscopy-assisted ERCP may be an alternative, as the results in four publications[38-41] demonstrated a high success rate of 90%-100%. However, these studies were limited by the number of patients, longer procedure time, the need for a laparoscopic doctor, and a much higher cost of treatment. The data supporting the role of EUS-BD in groups 1, 2 and 4 were very limited, and need further evaluation.

EUS-BD may be a suitable alternative in patients with failed OAE-ERCP with altered anatomy classified as group 3. In patients with benign stricture, the accepted treatment includes extended multiple plastic stents or metallic stent placement[42-44]. Short-term outcome of EUS-BD for a small number of these patients was promising, though no long-term data is available[8,11,14,18,21,27,31]. Anterograde balloon dilation has been reported in very few cases, with a successful short-term outcome[8,14,21], and transgastric placement of multiple plastic stents across the anastomotic stricture was feasible in select patients. One patient in our report had a good long-term result after three years[8]. Because of the repeated nature of the procedures in this group for the assessment of stricture patency or insertion of an additional stent, EUS-BD with anterograde or rendezvous techniques may be initially selected as a bridging procedure in the patients with endoscopic access of the papilla or biliary anastomotic site, but failed ERCP cannulation. At present, EUS-BD in patients with benign stricture and failed OAE-ERPC access to the papilla or biliary anastomosis is challenging. In patients with malignant strictures, the same approach is applicable, but transluminal drainage is preferred, as repeated procedures may be easier using a standard endoscope. In patients with bile duct stones associated with altered anatomy and OAE-ERCP access to the papilla or biliary anastomosis with failed ERCP cannulation, EUS-BD with anterograde or rendezvous procedures may be preferred for stone removal[4,45]. EUS-BD with anterograde stone removal using balloon dilation with the stones pushed across the ampulla or anastomosis was reported in 11 patients with one failure[8,14,22], and may be an option in select patients with failed OAE-ERCP access to the papilla or biliary anastomosis. Placement of a transgastric nasobiliary drainage tube or a plastic stent to maintain access for subsequent repeated procedures was also an option[8,14]. The details of the procedure should be customized based on clinical setting.

EUS-BD as an initial modality

OAE-ERCP is increasingly used in patients with altered anatomy with more supporting data compared with EUS-BD[4,8,11,14,18-32,45], though no comparative studies are available. In patients with benign strictures, standard ERCP (for patients with Billroth Ⅰ or Ⅱ anatomy, Whipple's operation,) or OAE-ERCP is more suitable because of the likelihood for repeated procedures for additional stent placement or stent exchange. In patients with malignant strictures, EUS-BD may be an alternative to PTBD in centers with appropriate expertise when OAE-ERCP is not available, however, this should be done in a research setting. For patients with bile duct stones, OAE-ERCP may be suitable as the options for treatment of the stones are more readily available, and EUS-BD should be reserved for patients in whom this procedure fails.

Limitations of EUS-BD

As it is difficult to pass the linear EUS endoscope into the afferent limb[46], EUS-CDS is not the appropriate option for patients with altered anatomies. The EUS-BD drainage access is limited to the left biliary system, and requires the presence of a dilated ductal system. Manipulation of the guide-wire to cross a stricture or papilla may be difficult, and the guide-wire can be sheared[47,48]. As only limited data for anterograde EUS-BD were available[48], the success rate may be lower with a lower complication rate compared with other techniques[7]. EUS-hepaticogastrostomy is limited by the lack of adherence between the stomach and the liver, which may increase the risk of stent dislocation and lead to bile leak. The risk of bleeding from the liver may also increase[48]. The main limitation of the rendezvous method is the requirement of an endoscopically accessible papilla or anastomosis, which is always troublesome in cases of surgically altered anatomy. In addition, the rendezvous procedure requires exchanging the echoendoscope for a duodenoscope, during which guide-wire access can be lost[48].

The majority of the data concerning EUS-BD is reported by experts, and may not translate to clinical practice. For example, in a national study in Spain involving community endoscopists, EUS-BD had a lower success rate (67.2%) and a complication rate of 23.2%[15]. Moreover, there is no well-designed EUS-training system and training using swine models, or computer-based simulators are expensive and not accessible by all trainees[47]. This may hinder the establishment of skills in therapeutic EUS.

FUTURE DEVELOPMENTS

Most of EUS-BDs were performed with conventional fine-needle aspiration needles. The new 19-gauge blunt tip (Echo-HD; Cook Medical, Bloomington, IN, United States) may reduce catching at the needle tip during to-and-fro manipulation of a guide-wire that may reduce shearing. Needle-knife dilation was reported to increase the risk of complications in EUS-BD[49]. The tip of the needle knife may not align with the axis of the guide-wire, thus a 6 Fr catheter with diathermic ring (Endoflex, Voerde, Germany) was used in some centers[47]. A prototype compression coil and twin-headed needle may simplify the EUS-BD procedure, and shows promise for use in EUS-CDS in a study in canines[50]. The development of a forward-viewing echoendoscope allows simultaneous visualization of the endoscopic and EUS operating fields, while the perpendicular access and lack of angulation at the exit of the working channel allow for easy introduction of a 19-gauge needle and passing of the stent without indentation[51]. Although the forward-viewing echoendoscope showed a high success rate for EUS-CDS in a prospective case series[52], further studies are needed to confirm its advantage in EUS-BD. Multiple exchanges over the wire during EUS-BD may increase the risk of leakage, increase the procedure time, and increase the chance to lose guide-wire access[47]. Non-exchange systems have been evaluated in experimental animal studies[53,54], and may minimize the aforementioned drawbacks of the current EUS-BD technique when the devices are available in the future.

CONCLUSION

EUS-guided biliary intervention is technically feasible and the available data indicate a high success rate in patients with surgically altered anatomies. Although the complication rate may be higher than for OAE-ERCP in patients with altered anatomy (17.5% *vs* 3.4%[4]), EUS-BD may be a rescue option in patients for whom OAE-ERCP has failed when conducted within centers with appropriate expertise and in a research setting. A standardized algorithm for using different EUS-BD techniques, refinement of these methods, and the development of new devices may improve the efficacy of EUS-BD and minimize the complication rate. The role of forward-viewing echoendoscope and comparison with the current standard EUS endoscope remain to be assessed.

COMMENTS

Background

Surgically altered anatomy is a consequence of an operation for treatment of a specific disease. This precludes a normal access to the bile duct opening by a standard duodenoscope in many cases and an over-tube assisted endoscopy (OAE) is usually needed to access the bile duct. However, OAE has a failure rate as high as 26%. Endoscopic ultrasound guided biliary drainage (EUS-BD), a recently developed technique, showed a high success rate. The efficacy of EUS-BD in altered anatomy is not well defined.

Research frontiers

To the best of our knowledge, no review of EUS-BD in surgically altered anatomy has been previously published. The objective of this study was to review systematically the efficacy of EUS-BD in altered anatomy.

Innovations and breakthroughs

EUS-BD in the setting of surgically altered anatomy has an efficacy similar to EUS-BD in general, nonetheless, the available data were limited and further studies to evaluate the role of EUS-BD in altered anatomy are needed.

Applications

EUS-BD may be an option for patient with surgically altered anatomy with a failed OAE therapeutic intervention but this should be done in centers with the expertise in EUS-BD in a research setting.

Terminology

EUS-BD is a technique using an endoscope with ultrasound technology to visualize a bile duct. A needle puncture of the bile duct was done under ultrasound guidance then intervention was done using various kinds of endoscopic accessories. OAE is a technique of endoscopy that utilizing an over-tube with a balloon at the tip or an over-tube with a spiral configuration to facilitate the insertion of an enteroscope.

Peer-review

This study was well investigated and will give us important information especially in clinical gastroenterology.

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