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【 ORIGINAL ARTICLE 】

Endoscopic Ultrasound-guided Rendezvous Technique after Failed Endoscopic Retrograde Cholangiopancreatography: Which Approach Route Is the Best?

Nozomi Okuno[1], Kazuo Hara[1], Nobumasa Mizuno[1], Susumu Hijioka[1], Masahiro Tajika[2], Tsutomu Tanaka[2], Makoto Ishihara[2], Yutaka Hirayama[2], Sachiyo Onishi[2], Yasumasa Niwa[1,2] and Kenji Yamao[1]

Abstract:

Objective The endoscopic ultrasound-guided rendezvous technique (EUS-RV) is a salvage method for failed selective biliary cannulation. Three puncture routes have been reported, with many comparisons between the intra-hepatic and extra-hepatic biliary ducts. We used the trans-esophagus (TE) and trans-jejunum (TJ) routes. In the present study, the utility of EUS-RV for biliary access was evaluated, focusing on the approach routes.

Methods and Patients In 39 patients, 42 puncture routes were evaluated in detail. EUS-RV was performed between January 2010 and December 2014. The patients were prospectively enrolled, and their clinical data were retrospectively collected.

Results The patients' median age was 71 (range 29-84) years. The indications for endoscopic retrograde cholangiopancreatography (ERCP) were malignant biliary obstruction in 24 patients and benign biliary disease in 15. The technical success rate was 78.6% (33/42) and was similar among approach routes (p=0.377). The overall complication rate was 16.7% (7/42) and was similar among approach routes (p=0.489). However, mediastinal emphysema occurred in 2 TE route EUS-RV patients. No EUS-RV-related deaths occurred.

Conclusion EUS-RV proved reliable after failed ERCP. The selection of the appropriate route based on the patient's condition is crucial.

Key words: EUS-RV, EUS, ERCP

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Introduction

Endoscopic retrograde cholangiopancreatography (ERCP) is the standard technique for relief of biliary diseases. Therapeutic ERCP requires deep cannulation, and although the success rate of deep cannulation is high (97-98.5%) with advanced techniques such as wire-guided cannulation, precutting procedures, and guide wire placement in the pancreatic duct, it is still not perfect (1-3). Therefore, some patients require percutaneous transhepatic biliary drainage (PTBD) or surgical drainage. However, PTBD and surgical drainage are associated with considerable morbidity rates, patient discomfort, the need for repeated intervention, and occasional mortality (4-6).

The development of a linear array echoendoscope has enabled various endoscopic ultrasound-related diagnostic and therapeutic techniques to be performed, such as fine-needle aspiration (FNA) (7), pancreatic pseudocyst drainage (8), and celiac plexus neurolysis (9). In 2001, EUS-guided biliary drainage was reported for the first time (10). EUS-guided rendezvous technique (EUS-RV) were first reported in 2004 by Mallery (11). Recently, EUS-RV has been reported as an effective salvage technique after failed ERCP.

[1]Department of Gastroenterology, Aichi Cancer Center Hospital, Japan and [2]Department of Endoscopy, Aichi Cancer Center Hospital, Japan
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Correspondence to Dr. Kazuo Hara, khara@aichi-cc.jp

In the literature, three puncture routes have been reported: trans-gastric (TG), trans-duodenal short position (TDS), and trans-duodenal long position (TDL). We use the trans-esophagus (TE) and trans-jejunum (TJ) routes at our facility.

However, no report has evaluated puncture routes such as the TE or TJ route in detail. Therefore, we evaluated the utility of EUS-RV for biliary access with particular focus on the approach route.

Materials and Methods

Patients

A total of 1883 ERCPs were performed at our institution between January 2010 and December 2014, and 39 (42 procedures) of these patients underwent EUS-RV for biliary access after failed ERCP. Failed ERCP was defined as biliary cannulation that failed despite the use of advanced cannulation techniques by a skilled endoscopist, inaccessible papilla, or choledochojejunostomy and failure to pass the stricture. EUS-RV was performed on the same day as failed ERCP or a few days later, depending on the patient's condition. All patients provided their informed consent for the procedures, and the local institutional review board approved the study. The patients were prospectively enrolled, and the clinical data were retrospectively collected for these 42 cases. An intention-to-treat analysis was used to evaluate the technical success rate.

Techniques

Antibiotics were permitted in all cases before and after the intervention. EUS was performed using a linear array echoendoscope (GF-UGT240, GU-UGT260; Olympus Medical Systems, Tokyo, Japan) connected to an ultrasound device (EU-ME2; Olympus Medical Systems or SSD-α10; Aloka, Tokyo, Japan). Following the evaluation of the biliary system, either an extrahepatic biliary duct (EHBD) or an intrahepatic biliary duct (IHBD) was punctured with a 19- or 22-gauge needle under EUS guidance (Fig. 1). A 19-gauge needle is better, as it can accommodate a 0.025-inch guide wire. After puncturing the bile duct, contrast medium was injected into the bile duct to confirm the anatomy. A 0.025-inch angle tip guide wire (VisiGlide2; Olympus Medical Systems) was then advanced through the needle and manipulated antegrade into the small bowel via the native ampulla or surgical anastomosis. The guide wire tends to stick because the sharp edge of the needle penetrates the covering membrane and sometimes strips it off. To avoid this, the guide wire should not be pulled back, and a thin guide wire should be used. The needle and echoendoscope were then exchanged for a duodenoscope while keeping the guide wire in place. The catheter was then inserted through the papilla alongside the antegradely placed guide wire. If this attempt failed, the guide wire was grasped with a loop cutter (Olympus Medical Systems) (Fig. 2) and pulled out through the working channel of the duodenoscope, followed by over-the-wire biliary cannulation. After successful bile duct cannulation, different types of biliary intervention, such as biliary sphincterotomy or biliary stenting, were performed, depending on the patient's condition.

Data analyses

The main outcome measure of the study was technical success. The secondary outcome was complications. The severity of complications following endoscopic procedures was assessed according to the American Society for Gastrointestinal Endoscopy guidelines (12).

Results

Between January 2010 and December 2014, 1883 procedures included ERCP, and 39 patients (42 procedures) underwent EUS-RV after failed ERCP. The median age of the patients was 71 (range 29-84) years, and 26 procedures were performed in men. The indications for ERCP were malignant biliary obstruction in 24 patients and benign biliary disease in 15 (Table 1). The reasons for EUS-RV were surgically altered anatomy in 33.3% (14/39), failed passage through the stricture in 17.9% (7/39), failed cannulation in 17.9% (7/39), cancer infiltration in 12.8% (5/39), periampullary diverticulum in 7.7% (3/39), and other technical reasons in 7.7% (3/39) (Table 2).

A total of 35 rendezvous procedures were performed in the same session as the initial ERCP attempt, and 7 were performed at a subsequent session. The success rate of bile duct puncture and cholangiography was 97.6% (41/42). In only one case, there was no bile duct dilation, and therefore puncture could not be performed. Regarding the choice of approach route, the TG route was most commonly selected in both the non-altered and altered anatomy groups. The TE route was selected as the next-most common route in both anatomy groups. The TJ route was performed only in the altered anatomy group. EUS-RV was successful in 19 of 26 non-altered anatomy patients (73.1%) and 14 of 16 altered anatomy patients (87.5%). The technical success rates were similar between the two group (p=0.268). The overall success rate of EUS-RV was 78.6% (33/42) (Table 3). In comparing the technical success rate among the approach routes [TE 90.9% (10/11), TG 75.0% (12/16), TDL 57.1% (4/7), TDS 75.0% (3/4), TJ100% (4/4)], no significant differences were noted (p=0.377) (Table 4).

There were nine patients in whom EUS-RV failed, with reasons described as follows: kinking of the guide wire (n=4), failed passage through the stricture (n=3), no bile duct dilation (n=1), and others (n=1). In this study, there were no cases in which access to the papilla could not be achieved or the guide wire was lost.

Three patients in whom EUS-RV failed due to kinking of the guide wire were salvaged with immediate repeat EUS-RV, the success of which was attributed to changing the puncture route. In all cases, the first EUS-RV involved puncture of the extrahepatic bile duct from the stomach or

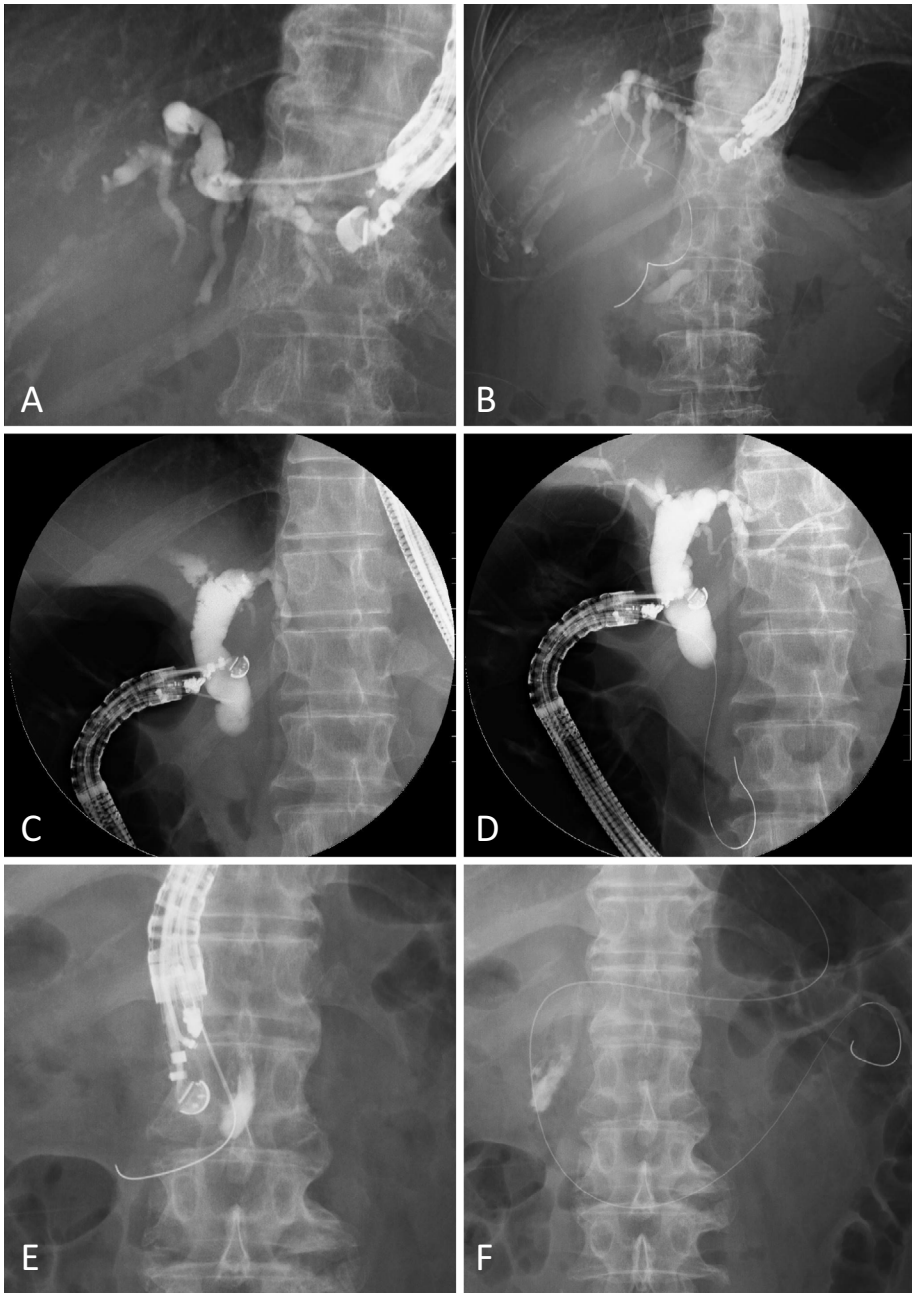

Figure 1. **EUS-Rendezvous technique. A, B: Trans-gastric route. The left intra-hepatic bile duct (B3) was punctured using the 19-G needle, and cholangiography was obtained (A). The guide wire was passed through the biliary stricture and papilla (B). The trans-esophagus and trans-jejunum routes are similar. C, D: Trans-duodenal long position. The extra-hepatic bile duct was punctured from the duodenum, and cholangiography was obtained (C). The guide wire passed through the papilla (D). E, F: Trans-duodenal short position. The extra-hepatic bile duct was punctured from the second portion of the duodenum, and the guide wire was passed through the papilla (E). The scope was exchanged for a duodenoscope while keeping the guide wire in place (F).**

duodenum, and the second EUS-RV involved puncture of the left intrahepatic bile duct from the stomach or esophagus. Changing the puncture route prevented guide wire kinking and allowed easy manipulation. Another patient underwent EUS-biliary drainage. The remaining five patients underwent PTBD (n=3) or ERCP (n=2) within 3 days (Table 5).

Complications

Complications were observed in 7 patients (16.7%, 7/42) in this study. The complication rate was 11.5% in non-altered anatomy patients (3/26) and 25.0% in altered anatomy patients (4/16), rates which were between the two groups (p=0.255) (Table 3). In comparing the complication rate among approach routes [TE 18.1% (2/11), TG 6.2% (1/

Figure 2. **Loop cutter (Olympus Medical Systems).**

Table 1. **Patient Characteristics.**

	N=39
Age, median[range]	71[29-84]
Males : Females	26:13
Indications for ERCP	
Malignant biliary obstruction, n	24
Pancreatic cancer	7
Gastric cancer	5
Bile duct cancer	3
Cholangiocellular carcinoma	3
Gallbladder cancer	2
Colorectal cancer	2
Hepatocellular carcinoma	1
Cancer of unknown primary	1
Benign biliary disease, n	15
Stone	9
Benign stricture	4
Stricture of choledochojejunostomy	2

16), TDL 14.3% (1/7), TDS 50.0% (2/4), TJ 25.0% (1/4)], no significant differences were noted (p=0.498) (Table 6).

Moderate mediastinal emphysema occurred in two patients who underwent TE route EUS-RV. In both cases, the 19-gauge needle was changed to an ERCP tapered catheter from the puncture route for guide wire manipulation. Mediastinal emphysema and pneumothorax were observed in one patient with anastomotic biliary stricture who underwent EUS-RV via the TE route (Fig. 3). Chest drainage was performed, and antibiotics were given for 5 days. On day 2, the pneumothorax improved, and the patient was discharged home on day 6. Another patient was treated conservatively. Moderate mediastinal emphysema occurred in only two cases through a device that was bigger than a 19-gauge needle. There were no complications in any other EUS-RV cases approached via the TE route. One case of moderate cholangitis occurred, requiring PTBD the next day. One case of mild pancreatitis, two cases of moderate peritonitis, and one case of retroperitoneal perforation occurred, and all cases were treated conservatively. There were no late complications and no EUS-RV-related deaths (Table 6).

Table 2. **Reasons for EUS-RV.**

	n(%)
Surgically altered anatomy	14(33.3)
TG+R-Y	4
DG+Billroth I	3
DG+Billroth II	2
PD+child	3
Others	2
Failed passing through the stricture	7(17.9)
Failed cannulation	7(17.9)
Cancer infiltration	5(12.8)
Peri-ampullary diverticulum	3(7.7)
Other technical reasons	3(7.7)

TG+R-Y: total gastrectomy+Roux-en-Y gastric bypass, DG: distal gastrectomy, PD: pancreatoduodenectomy

Discussion

Since the initial report on the use of EUS-RV after failed ERCP in 2004, several studies (13-22) have reported EUS-RV as an effective salvage technique for achieving biliary cannulation after failed ERCP. The EUS-RV techniques comprise three methods that are based on the approach route: TG, from the second portion of the duodenum in a short endoscopic position (TDS), and from the bulb of the duodenum in a long endoscopic position (TDL). No report has evaluated puncture routes such as the TE or TJ route in detail. In the current study, each EUS-RV technique was successful in all patients without significant morbidities. The previously published articles involving EUS-RV for biliary access after failed ERCP are reviewed in Table 7 (13-20). There were no significant differences in the rates of rendezvous success or complications among the approach routes.

TG route EUS-RV was first described in 2004 (21). With this route, the intrahepatic bile duct (IHBD) of B2 or B3 is punctured from the cardia or lesser curvature of the stomach. The major advantage of this route is that puncture is made through the liver parenchyma, resulting in a tendency toward less bile leakage than with the TD route. Another advantage of this route is that the scope position is easy to maintain during scope changes. Given these advantages, we often choose this route.

In the present study, the success rate with the TG route was 75.0%, and the rate of complications was the lowest among the routes. B2 is easier for guide wire manipulation than B3. The TG route is known to be the safest route, therefore it is best to puncture B2 from the stomach. However, we sometimes may accidentally puncture the lower esophagus when attempting to puncture B2 from the stomach. With the TE route, it is easy to puncture B2; we therefore sometimes select the TE route for EUS-RV. However, two cases of mediastinal emphysema occurred among the patients who underwent TE route EUS-RV. We therefore avoid the TE route to prevent complications. In all cases in

Table 3. Outcomes of EUS-RV.

	Non-altered anatomy N=26	Altered anatomy N=16	Total	p value†
Diameter of bile duct, median[range], mm	5[2-16]	5[3-8]		
Procedure time, median[range], min	60[20-186]	63[20-122]		
Approach route, %(n/N)				
Esophagus (TE)	30.8(8/26)	18.8(3/16)	26.2(11/42)	
Gastric (TG)	34.6(9/26)	43.8(7/16)	38.1(16/42)	
Duodenal bulb (TDL)	26.9(7/26)	0(0/16)	16.7(7/42)	
Duodenum, second portion (TDS)	7.7(2/26)	12.5(2/16)	9.5(4/42)	
Jejunum (TJ)	0(0/26)	25.0(4/16)	9.5(4/42)	
The success rate of bile duct puncture and cholangiography, %(n/N)	96.2(25/26)	100.0(16/16)	97.6(41/42)	ns
Technical success rate, %(n/N)	73.1(19/26)	87.5(14/16)	78.6(33/42)	ns
Complication rate, %(n/N)	11.5(3/26)	25.0(4/16)	16.7(7/42)	ns

TE: transesophageal route, TG: transgastric route, TDL: transduodenal route long position, TDS: transduodenal route short position, TJ: transjejunum route, ns: not significant, N/A: not appricable

Table 4. Comparison of Clinical Backgrounds and Success Rate of Approach Route.

	Success rate, % (n/N)										p value†
	TE N=11		TG N=16		TDL N=7		TDS N=4		TJ N=4		
Clinical backgrounds											
Malignant/Benign	100.0 (8/8)	66.7 (2/3)	72.7 (8/11)	80.0 (4/5)	60.0 (3/5)	50.0 (1/2)	66.7 (2/3)	100.0 (1/1)	- (0/0)	100.0 (4/4)	
Non altered/Altered	87.5 (7/8)	100.0 (3/3)	66.6 (6/9)	100.0 (6/6)	57.1 (4/7)	- (0/0)	100.0 (2/2)	50.0 (1/2)	- (0/0)	100.0 (4/4)	
Ampulla/Anastomosis	90.0 (9/10)	100.0 (1/1)	69.2 (9/13)	100.0 (3/3)	57.1 (4/7)	- (0/0)	75.5 (3/4)	- (0/0)	100.0 (4/4)	- (0/0)	
Obstruction side EHBD/ IHBD	100.0 (7/7)	75.0 (3/4)	70.0 (7/10)	83.3 (5/6)	100.0 (2/2)	40.0 (2/5)	66.6 (2/3)	100.0 (1/1)	100.0 (4/4)	- (0/0)	
Over all technical success rate	90.9(10/11)		75.0(12/16)		57.1(4/7)		75.0(3/4)		100.0(4/4)		0.377

†Chi-square test.

TE: transesophageal route, TG: transgastric route, TDL: transduodenal route long position, TDS: transduodenal route short position, TJ: transjejunum route

which moderate mediastinal emphysema occurred, the device that was passed along the aspiration route was bigger than a 19-gauge needle. Puncturing the esophagus must be avoided; however, if it occurs inadvertently and is noted later, nothing should be passed through the device except a needle.

TD route EUS-RV comprises two approach routes: TDL and TDS. TDL is the standard for EUS-guided choledochoduodenostomy (EUS-CDS) and is suitable for advancing the guide wire toward the proximal side. However, it is sometimes difficult to advance the guide wire toward the papilla. TDS involves puncturing from the second portion of the duodenum, between the superior duodenal angle (SDA) and papilla. The major advantage of this route is the ease of directing the guide wire toward the papilla. The disadvantages are the difficulty in maintaining the scope position and the risk of bile leakage. Kim et al. (15) reported that TDS EUS-RV after failed ERCP was successful in 12 of 15 patients (80%). Iwashita et al. (20) reported that TDS EUS-RV was the most appropriate technique given its high success rate (100%). However, it also had the highest complication rate (Table 7).

In the present study, only seven cases were treated via the TDL approach, and only four were treated via the TDS approach. We experienced kinking of a guide wire in each group. With the TDL approach, we were unable to shift the guide wire toward the papilla, and when we pulled the guide wire back into the needle, kinking occurred. With the TDS approach, the distance between the puncture site and the papilla was short, preventing us from pushing the guide wire. Therefore, when we pulled the guide wire back into the needle, kinking occurred. Both approaches required changing the approach route from the TD to the TG route due to an inability to advance the guide wire toward the papilla. The

Table 5. Summary of Failed EUS-RV.

Patient No	Age	Sex	Diagnosis	Reason for failed EUS-RV	Salvage
1	79	F	Gallbladder cancer	Kinking of a guide wire	Repeat EUS-RV
2	84	F	Gallbladder cancer	Kinking of a guide wire	Repeat EUS-RV
3	78	M	Pancreatic cancer	Kinking of a guide wire	Repeat EUS-RV
4	64	M	Colon cancer	Kinking of a guide wire	Repeat ERCP
5	47	M	Stricture of choledochojejunostomy	Failed passing through the stricture	PTBD
6	74	M	Cholangiocellular carcinoma	Failed passing through the stricture	PTBD
7	56	M	Colon cancer	Failed passing through the stricture	EUS-HDS
8	29	M	Cancer of unknown primary	No bile duct dilation	PTBD
9	74	F	Colon cancer	Others	Repeat ERCP

EUS-RV: endoscopic ultrasound-guided rendezvous technique, PTBD: percutaneous transhepatic biliary drainage, ERCP: endoscopic retrograde cholangiopancreatography, EUS-HDS: endoscopic ultrasound-guided hepatico jejunostomy

Table 6. Comparison of Complications of Approach Route.

	Approach route					p value†
	TE N=11	TG N=16	TDL N=7	TDS N=4	TJ N=4	
Early complications, n (grade*)	Mediastinal emphysema, 2(moderate)	Retroperitoneal perforation, 1(moderate)	Cholangitis, 1(moderate)	Peritonitis, 1(moderate) Pancreatitis, 1(mild)	Peritonitis, 1(moderate)	
Late complications, n (grade*)	0	0	0	0	0	
Over all complication rate, %(n/N)	18.1(2/11)	6.2(1/16)	14.3(1/7)	50.0(2/4)	25.0(1/4)	0.489

TE: transesophageal route, TG: transgastric route, TDL: transduodenal route long position, TDS: transduodenal route short position, TJ: transjejunum route

Early adverse events : within 14 days, Late adverse events : after 14 days.

*Severity grading system in ref (12).

†Chi-square test.

guide wire tends to stick because the sharp edge of the needle penetrates the covering membrane and sometimes strips it off. To avoid this, the guide wire should not be pulled back. If the angle of the needle and bile duct is not ideal and guide wire manipulation is difficult, changing the approach route may be effective, as seen in the present cases.

Four cases were treated via the TJ route in the present study. All four were altered anatomy cases, and the surgical procedure was total gastrectomy with Rouex-en-Y gastric bypass. The TJ route is similar to the TG route, so the scope position is easy to maintain during the procedure. The success rate was 100% in the TJ cases. However, we must take care to avoid trans-esophagus puncture as the TJ route involves puncturing the intrahepatic bile duct.

Other alternatives to biliary access after failed ERCP are PTBD, percutaneous rendezvous, and surgery. PTBD has been reported to have a high success rates of 87-100%. However, it is limited by external catheter placement and inherent morbidities and has a relatively high complication rate of 10-39% (23, 24). In cases of hepatic hilar stricture, multiple external catheters are sometimes necessary. Therefore, the patient's quality of life is markedly decreased. We therefore believe that EUS-RV is useful in cases of hepatic hilar stricture.

Percutaneous rendezvous is another salvage method in patients with failed ERCP, with reported clinical success and complication rates of 81-94.3% and 4.9-7.0%, respectively (25-27). The major disadvantage of this procedure is the requirement for both endoscopic and percutaneous interventions, which cannot always be performed simultaneously after failed ERCP cannulation if an interventional radiologist is not present. In contrast, EUS-RV can be performed in the same session as the failed ERCP if the procedure is anticipated and proper informed consent is obtained before the procedure. A randomized, controlled trial is required to compare the EUS-RV and percutaneous rendezvous techniques after failed ERCP.

The overall success rate of EUS-RV is 80.3%, with a complication rate of 11.6% (Table 7). While EUS-RV is indeed a reasonable salvage method after failed ERCP, evidence remains insufficient to determine which approach route is the best. At present, the selection of the approach

Table 7. EUS-RV for Biliary Access in the Reported Cases.

Reference	Years	Number of cases	Puncture site		Puncture success(%)	Rendezvous success(%)		Total rendezvous success(%)	Complication (n)	Complication rate(%)		Total complication rate(%)
13	2008	12	TDL	12	100	TDL	58	58	Pneumoperitoneum 1, Respiratory failure 1	TDL	13	13
14	2009	49	TG	35	100	TG	69	84	Bleeding 1, Pneumoperitoneum 1	TG	14	16
			TDS	14		TDS	57		Pneumonia 1, Peritonitis 1, Abdominal pain 1, Pneumoperitoneum 1	TDS	21	
15	2010	15	TDS	15	100	TDS	80	80	Pancreatitis 1, sepsis 1	TDS	13	13
16	2011	50	TG	50	97	TG	75	75	Pancreatitis 2, Hematoma 1, Bile leak 1, Infection 1, Perforation 1	TG	12	12
17	2012	40	TG	8	100	TG	44	73	Pancreatitis 2, Abdominal pain 1, Pneumoperitoneum 1, Sepsis 1	-	-	13
			TDL	16		TD	81					
			TDS	13								
			TJ	3		TJ						
18	2012	58	TDL	58	98	TDL	98	98	Bile leakage 2	TDL	3	3
19	2013	14	TG	5	100	TG	100	100		TG	0	14
			TDL	4		TDL	100		Biliary peritonitis 1	TDL	25	
			TDS	5		TDS	100		Pancreatits 1	TDS	20	
20	2015	20	TG	4	95	TG	75	80	Hematoma 1, Pancreatitis 1	TG	50	15
			TDL	5		TDL	60			TDL	0	
			TDS	10		TDS	100		Pancreatitis 1	TDS	10	
Present study	-	42	TE	11	98	TE	91	79	Mediastinal emphysema 2	TE	18.1	16.7
			TG	16		TG	75		Retroperitoneal perforation 1	TG	6.2	
			TDL	7		TDL	57		Cholangitis 1	TDL	16.7	
			TDS	4		TDS	75		Peritonitis 1, Pancreatitis 1	TDS	50.0	
			TJ	4		TJ	100		Peritonitis 1	TJ	25.0	
Total		259	TE	11		TE	90.9	80.3	2	TE	18.1	11.6
			TG	110		TG	73.6		11	TG	10.0	
			TDL	86		TDL	87.2		6	TDL	7.0	
			TDS	48		TDS	79.1		10	TDS	20.8	
			TJ	4		TJ	100.0		1	TJ	25.1	

TE: transesophageal route, TG: transgastric route, TDL: transduodenal route long position, TDS: transduodenal route short position, TJ: transjejunum route

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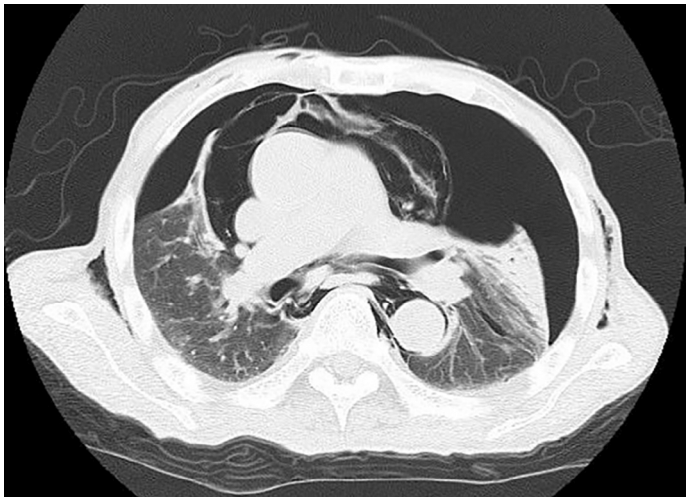
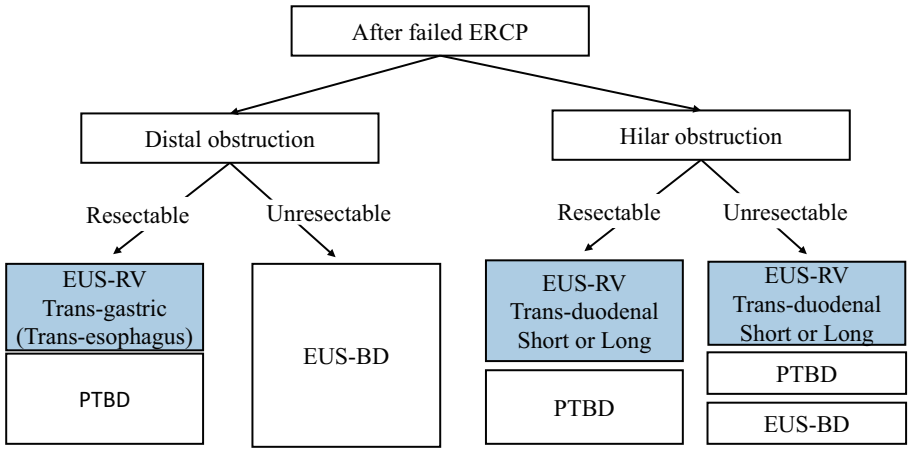


Figure 3. Computed tomography revealed mediastinal emphysema and pneumothorax.



ERCP: Endoscopic retrograde cholangiopancreatography, EUS-RV: Endoscopic ultrasound-guided rendezvous technique
PTBD: Percutaneous transhepatic biliary drainage, EUS-BD: Endoscopic ultrasound-guided biliary drainage

Figure 4. Proposed treatment procedure using endoscopic ultrasound-guided biliary drainage after failed ERCP.

route differs among facilities. Taking the results of previous studies on EUS-RV into account, we have proposed a treatment algorithm using EUS-RV after failed ERCP, shown in Fig. 4. We believe that repeating ERCP on a different day is a reasonable alternative if immediate biliary therapy is not required in benign biliary disease. If EUS-RV is selected, we feel that the TD route is better for benign biliary diseases, such as stone removal.

The indications for EUS-guided biliary drainage should be limited to cases of unresectable malignant biliary obstruction (28). In patients with distal malignant biliary obstruction, such as those with pancreatic head cancer after failed ERCP, if the lesion is resectable and endoscopic access to the papilla is possible, we select EUS-RV. TDS might be difficult, as the scope position might be lost from D2 when the scope is pulled to puncture the EHBD above the obstruction. With TDL, it can be difficult to advance the guide wire toward the papilla. In the present study, the success rate of TE EUS-RV was high. However, this route carries a risk of mediastinal emphysema. As such, in distal malignant biliary obstruction cases, TG EUS-RV is preferable because of the low risk of biliary leakage.

In patients with hilar biliary obstruction, the TG or TE approach might be difficult, as the guide wire must pass through the stricture. Therefore, in hilar malignant biliary obstruction cases, TDS or TDL EUS-RV is preferable. In cases requiring multiple drainage, EUS-RV can be performed in the same session and can be used for multiple stenting at once. The selection of an approach route that maximizes the success rate is the most important factor for reducing the rate of complications associated with bile leakage, since proper biliary drainage can reduce bile leakage and treat bile peritonitis.

Our study has limitations because it was a retrospective, single-center study. A multicenter, randomized trial is essential to prove the superiority of this method.

Conclusion

EUS-RV provides safe and reliable transpapillary bile duct access after failed ERCP. EUS-RV may have an advantage in that it can be performed in the same session as ERCP as a one-step procedure without having to delay definitive therapy and without the pain and inconvenience of an external catheter. We believe that TG EUS-RV is preferable to other routes because of the low risk of complications and should therefore be performed when technically and anatomically possible. If a B2 puncture due to a TE approach is noted later, nothing should be passed through the device except for a needle in order to prevent complications. Further technological advances and the availability of dedicated tools are likely to improve the outcomes of EUS-RV. Large multicenter, randomized trials are needed to establish the therapeutic safety profiles of EUS-RV before this technique can be accepted as a standard alternative.

The authors state that they have no Conflict of Interest (COI).

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