

Long- and short-type double-balloon enteroscopy-assisted therapeutic ERCP for intact papilla in patients with a Roux-en-Y anastomosis

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Received: 10 August 2009 / Accepted: 12 November 2009 / Published online: 26 October 2010
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Abstract

Background There have been a few previous reports on attempted double-balloon endoscopy (DBE)-assisted endoscopic retrograde cholangiopancreatography (ERCP) in patients with Roux-en-Y anastomosis and an intact papilla. This study was designed to evaluate the usefulness of DBE-assisted ERCP in patients with Roux-en-Y anastomosis and an intact papilla of Vater.

Methods Thirteen DBE procedures were performed in nine patients who had undergone Roux-en-Y reconstruction combined with eight total gastrectomies and one partial gastrectomy. Both short-type and long-type DBE were used. Long-type DBE was replaced with a conventional forward-viewing upper endoscope after reaching the papilla. Technical success rate, measurement of procedure times, and adverse events were evaluated in the retrospective study.

Results In all cases, the scopes could reach the papilla. The mean time required to reach the papilla was 48 (range, 13–90) min. There was a statistically significant difference with the short and long scope (29.0 ± 19.2 min vs. 64.8 ± 24.7 min, respectively; $P = 0.044$). The success rate of bile duct cannulation, resulting in achieving therapeutic ERCP on the first session was 66.7% (6/9). The mean procedural time in the successful cases was 128

(range, 47–183) min. Finally, therapeutic ERCP was achieved in all nine cases. There was one adverse event in which retroperitoneal perforation during lithotripsy, but that was successfully treated by conservative therapy alone. **Conclusion** DBE-assisted ERCP seems to be a promising option to perform therapeutic ERCP for intact papilla in patients with a Roux-en-Y anastomosis.

Keywords Double-balloon enteroscopy · Endoscopic retrograde cholangiopancreatography · Endoscopic biliary stenting · Endoscopic stone removal

Abbreviations

DBE Double balloon enteroscopy
ERCP Endoscopic retrograde cholangiopancreatography
ES Endoscopic sphincterotomy
PTBD Percutaneous transhepatic biliary drainage

Roux-en-Y reconstruction is frequently performed for surgical reconstruction, especially when total or subtotal gastrectomy, gastric bypass surgery, pylorus-preserving pancreaticoduodenectomy, and biliary tract or liver surgery is performed [1]. In general, the presence of a Roux-en-Y anastomosis has been thought to preclude endoscopic access for diagnostic and therapeutic endoscopic retrograde cholangiopancreatography (ERCP) because the long length efferent and afferent limbs must be traversed to reach the major papilla. Furthermore, the acute angle of anastomosis of the afferent limb is frequently difficult to navigate. Even if the endoscope reaches a terminal portion of the afferent limb, selective duct cannulation or therapy via an intact papilla is considered to be difficult compared with accessing a biliopancreatoenteric anastomosis site.

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To date, ERCP in patients with Roux-en-Y anastomosis has been reported using not only a standard side-viewing duodenoscope but also using pediatric or adult colonoscopes. However, the ratio of reaching the end of afferent limb was not high. Recently, double-balloon endoscopy (DBE), which was first introduced by Yamamoto et al. [2], has been used not only for diagnostic and therapeutic endoscopy of the small bowel but also for ERCP-related procedures. However, there have been a few previous reports on attempted DBE-assisted ERCP in patients with Roux-en-Y anastomosis and an intact papilla. In the present study, we evaluated the usefulness of DBE-assisted ERCP in patients with Roux-en-Y anastomosis and an intact papilla.

Patients and methods

Thirteen DBE procedures were performed in nine patients (5 men and 4 women, 7 with bile duct stones, 1 with malignant biliary stricture due to lymph node metastasis of recurrent gastric cancer, and 1 with benign biliary stricture due to pancreatic abscess) with Roux-en-Y reconstruction combined with eight total gastrectomies and one partial gastrectomy for gastric cancer between June 2006 and January 2009 at Tokyo Medical University Hospital (Table 1). The mean age of these 9 patients was 67 (range, 57–77) years. The patients enrolled had not previously undergone any endoscopic procedures. The institutional review board approved this study. Written informed consent was obtained from all patients for DBE.

DBE procedures

All procedures were performed by a single endoscopist (TI). The procedure was performed under conscious sedation using a combination of flunitrazepam (mean dosage, 4 (range, 1–5) mg) and pethidine (50 mg). The patients were placed in semiprone or prone position.

In this study, until April 2007, we used a long-type DBE (working length 2,000 mm, EN-450T5, Fujinon Co. Ltd., Saitama, Japan). Later, a short-type DBE was used (working length 1,520 mm, EC-450B15, Fujinon). Detailed specifications of both therapeutic enteroscopes and the overtube are described in Table 2. When we used the long-type DBE, it was replaced during the procedure with a conventional forward-viewing upper endoscope (GIF-XQ 240, outer diameter 9 mm, working channel 2.8 mm, working length 1,030 mm, Olympus Medical Systems, Tokyo, Japan) because long accessories were not commercially available in Japan at that time. Specifically, the long-type DBE was removed through the indwelling

overtube with its balloon inflated after reaching the papilla. Then, an aperture, approximately 12 mm, was made in the overtube at a point 100 cm from its tip on the side opposite to the pressure line to enable the balloon to remain inflated for insertion of a forward viewing upper endoscope. Then, the upper endoscope was inserted through the overtube (Fig. 1). If the distance within the body to the tip of the overtube was more than 100 cm in length, we retracted it carefully using fluoroscopy to prevent tube dislocation until the total length of the overtube remaining within the body was less than approximately 100 cm; then the aperture was made.

ERCP procedures

A standard catheter (ERCP catheter, MTW Co. Ltd, Düsseldorf, Germany) and a tapered catheter (PR-110Q, Olympus Medical Systems) were used for initial cannulation. In cases requiring an endoscopic sphincterotomy (ES), a 0.025" guidewire was placed after deep cannulation into the bile duct; then a sphincterotome (KD-6Q, Olympus Medical Systems) was advanced into the bile duct alongside the guidewire. Before insertion of the sphincterotome, it was curved to direct the cutting wire to the 6 o'clock position on the papilla to allow it to be used as a push-type sphincterotome. ES was then performed. When selective cannulation was not possible, we performed precutting using a needle knife (PR-233Q or KD-10Q-1, Olympus Medical Systems). When deep cannulation could not be achieved despite attempting various techniques for approximately 60 min, the procedure was terminated.

When failed cannulation, we scheduled the percutaneous transhepatic (PTBD) rendezvous technique, followed by with the transpapillary approach as a salvage procedure in another session. A percutaneous transhepatic puncture was performed under transabdominal ultrasonographic guidance. The patients were initially placed in a supine position. After needle puncture into the intrahepatic bile duct, a 5-Fr sheath was inserted over the guidewire into the bile duct and a 0.035" guidewire was then advanced through the papilla. The patients were then placed in a semiprone position and the DBE was advanced to the papilla to perform ERCP. When the rendezvous technique was used, we placed a 6-Fr nasobiliary tube into the bile duct for 24 h to prevent bile-induced peritonitis after the procedure.

In cases with bile duct stones, we performed papillary balloon dilation (Hurricane or CRE Esophageal/Pyloric, Boston Scientific Japan, Tokyo, Japan) in combination with ES using a conventional sphincterotome or needle knife to enable a reliable approach to the bile duct. Basket catheter, retrieval balloon catheter, and/or mechanical lithotriptor

Table 1 Outcome of double balloon-assisted ERCP

Patient sex	Age (years)	Type of surgery	Indication for ERCP	Length of scope	Exchange of scope	Session	Type of invention	Reaching papilla time at first session (min)	Procedural time at first session (min)	1st ERCP success	2nd procedure	Complications
1	61/F	TG with R-Y	CBD stone	Long type ^a	EGD	1	Precutting	90	162	Yes	–	No
2	65/F	TG with R-Y	CBD stone	Long type ^a	EGD	1	ES	26	47	Yes	–	Perforation ^b
3	57/M	TG with R-Y	Jaundice due to LN mets ^c	Long type ^a	EGD	1	ES,SEMS	80	114	Yes	–	No
4	77/M	TG with R-Y	Jaundice, Pancreatic abscess	Long type ^a	EGD	2	Precutting + ES, EBS, ENPD, EPS	70	182	Yes	–	No
5	71/F	TG with R-Y	CBD stone	Long type	EGD	2	Precutting, PPBD (18 mm) ^d	58	126	No	PTBD rendezvous	No
6	69/M	TG with R-Y	CBD stone	Short type	No	1	Precutting, EPBD (10 mm)	15	183	Yes	–	No
7	74/M	TG with R-Y	CBD stone	Short type	No	2	ES	13	78	No	PTBD rendezvous	No
8	66/M	TG with R-Y	CBD stone	Short type	No	1	Es. EPBD (15 mm)	34	80	Yes	–	No
9	65/F	TG with R-Y	CBD stone	Short type	No	2	Precutting, EPBD (8 mm)	54	124	No	PTBD rendezvous	No

TG total gastrectomy, PG partial gastrectomy, R-Y Roux-en-Y, CBD common bile duct, ES endoscopic sphincterotomy, EPBD endoscopic papillary balloon dilation (maximum balloon diameter), SEMS self-expandable metallic stent, ENPD endoscopic transpapillary nasopancreatic cyst drainage, PTBD percutaneous transhepatic biliary drainage, EBS endoscopic biliary stenting, EPS endoscopic pancreatic duct stenting

^a Double-balloon enteroscopy was replaced with conventional gastroduodenoscopy through the indwelling sliding tube

^b During lithotripsy and improvement by conservative therapy

^c Lymph node (LN) metastasis derived from gastric cancer

^d PPBD percutaneous transhepatic papillary balloon dilation (maximum balloon diameter)

Table 2 Specifications of two-types double-balloon endoscopes

Therapeutic enteroscope	EN-450T5	EC-450BI5
Direction of view	Forward-viewing	Forward-viewing
Angle of view	140°	140°
Outer diameter (mm)		
Distal end	9.4	9.4
Insertion end	9.3	9.3
Bending section		
Up/down	180°/160°	180°/160°
Right/left	160°/160°	160°/160°
Working length (mm)	2000	1520
Total length (mm)	2300	1820
Working channel diameter (mm)	2.8	2.8
Overtube	TS-13140	TS-13101
Outer diameter (mm)	13.2	13.2
Inner diameter (mm)	10.8	10.8
Working length (mm)	1350	950
Total length (mm)	1450	1050
Tube material	Polyurethane	Polyurethane
Balloon material	Latex	Latex



Fig. 1 Aperture approximately 12 mm was made in the overtube at a point 100 cm from its tip on the side opposite to the pressure line, to enable the balloon to remain inflated, for possible insertion of a conventional forward-viewing upper endoscope

(BML-V232QR-30, Olympus) were used for removal of stones.

Statistical analysis

Statistical analysis was performed by the chi-square test or Fisher's exact test for noncontinuous variables and the Student *t* test for continuous variables. $P < 0.05$ was

regarded as indicating a statistically significant difference. Statistical analyses were performed with StatMate III (ATMS Co Ltd, Tokyo, Japan).

Results

Table 1 summarizes the results of DBE procedures. In nine patients, five long-type scopes and four short-type scopes were used for the DBE technique. The mean procedural time at first session was 121.8 (range, 47–182) min. In all cases, the papilla was reached. The mean time required to reach the papilla was 48.9 (range, 13–90) min. There was a statistically significant difference in the mean time to reach the papilla between the short and long enteroscopes (29 ± 19.2 min vs. 64.8 ± 24.7 min, respectively; $P = 0.044$). In all five cases in which a long-type scope was used, the major papilla could be seen on reinsertion of a conventional forward-viewing upper endoscope.

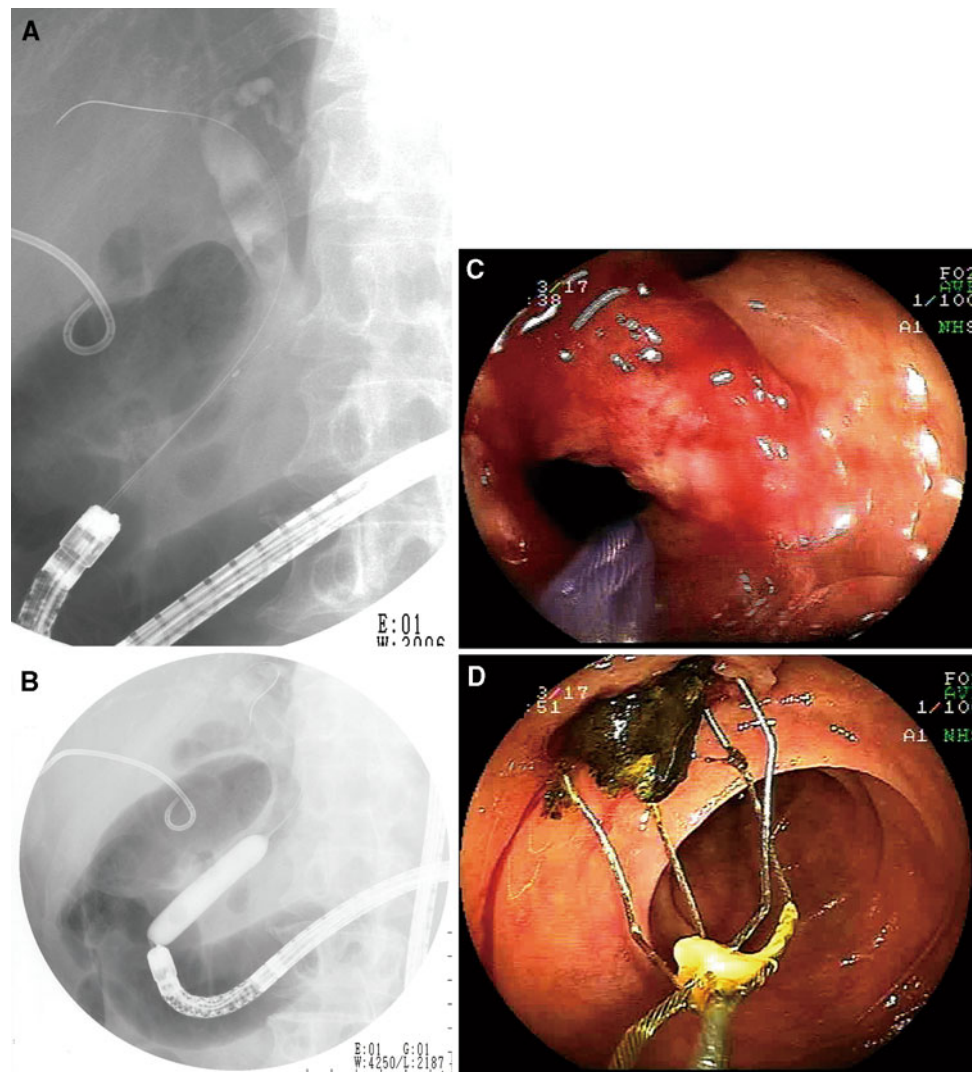
The success rate of bile duct cannulation, resulting in achieving therapeutic ERCP on the first session was 66.7% (6/9). The mean procedural time of the successful group at the first session was 128 (range, 47–183) min. Precutting was used for bile duct cannulation on the first session in five cases (56%). In three of these cases, bile duct cannulation was successful. In the remaining two cases, in which catheters could not be advanced into the bile duct, the PTBD rendezvous technique was used to enable therapeutic ERCP on the second session. Therapeutic ERCP was achieved in all nine cases.

In four of seven cases with bile duct stones, papillary balloon dilation was performed in addition to ES or precutting (Fig. 2). In one case (case 5), because transpapillary retrograde balloon dilation was difficult, antegrade balloon dilation via the PTBD route was performed. Complete stone clearance was achieved and confirmed by cholangiography using a retrieval balloon catheter or direct cholangioscopy.

An uncovered self-expandable metallic stent (SEMS) (Zilva, 10-mm diameter, 6-cm long, Wilson-Cook Medical Inc., Winston-Salem, NC) was successfully placed across the biliary stricture after ES in a patient with lymph node metastasis (case 3) (Fig. 3). In a patient with obstructive jaundice and pancreatic abscess (case 4), ERCP showed pancreatic duct stenosis and a pancreatic cyst. We eventually succeeded in placing a 5-Fr biliary stent in the bile duct and a 5-Fr pigtail-type nasocystic drainage tube in the pancreatic cyst.

There was one adverse event (case 2) in which a retroperitoneal perforation occurred during lithotripsy after endoscopic sphincterotomy. The patient was managed nonoperatively.

Fig. 2 **A** Cholangiogram shows two bile duct stones. **B** X-ray film shows papillary dilation using a large balloon catheter. **C** Basket catheter was inserted in the large biliary orifice. **D** Bile duct stone was removed without crushing



Discussion

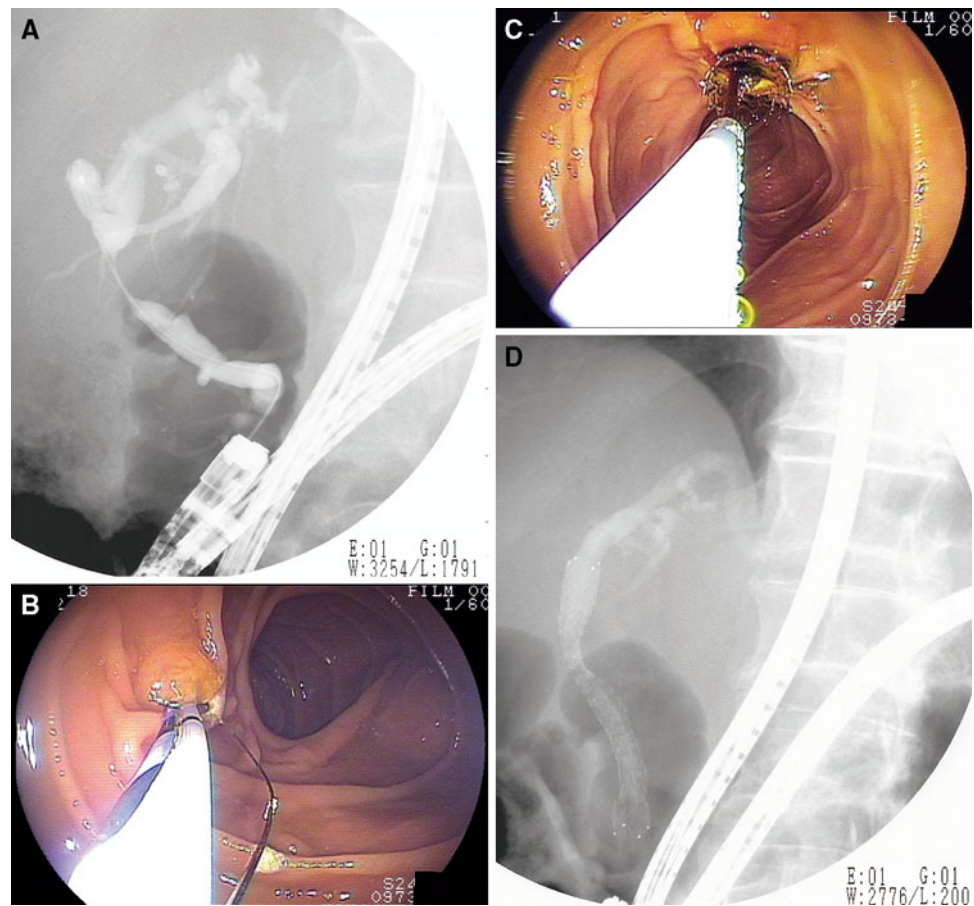
There have been a few previous reports on attempted ERCP in patients with Roux-en-Y anastomosis and an intact papilla [3–9]. Wright et al. [6] revealed that once the major papilla was accessed with a duodenoscope (67%: 10/15), therapeutic ERCP was feasible in all cases (100%), although previous data described that only 8 (57%) of 14 attempts to cannulate an intact papilla via a Roux-en-Y anastomosis could be successful [4, 5, 7–9].

However, recently developed DBE systems have made it possible to reach the papilla or biliopancreatoenteric anastomosis site with certainty even in patients with Roux-en-Y surgical anastomoses [10–23] (Table 3). In particular, sharp angulation of the Roux limb in any given case may make it difficult to negotiate the passage of the scope to the papilla even for skilled endoscopists. Then, the longer and thinner DBE may be more effective than a

standard adult or pediatric colonoscope in navigating to the papilla or anastomotic site. Interestingly, Baron reported the option of using the DBE to place a percutaneous endoscopic gastrostomy tube in the resected stomach through which a duodenoscope can be passed [24].

In the present study, we could advance the DBE to the papilla in all cases. There was a statistically significant difference in the mean time to reach the papilla for the short and long scopes. We think there are two reasons for this: (1) the short-type DBE may have better maneuverability than the long-type DBE; (2) when we used the long-type DBE, it took some additional time because the DBE had to be replaced by a conventional forward-viewing upper endoscope; (3) the endoscopist (TI) was able to improve his technique through the initial five long-type DBE cases. In relation to this, one report on DBE has described that there was a significant learning curve, because there was a significant decline in overall procedure

Fig. 3 **A** Cholangiogram shows a biliary stricture. **B** Endoscopic sphincterotomy was performed. **C** Uncovered metallic stent was placed. **D** X-ray shows correct positioning of the metallic stent



time and fluoroscopic time after the initial ten DBE cases, although these included not only biliopancreatic cases but also a large number of diseases of the small intestine [11]. With regard to intubation time, Aabakken et al. reported that the mean intubation time to reach the end of the Roux limb was 40 (range, 5–120) minutes [15], and these data are similar to ours (48.9 min). Although short-type DBE could reach the papilla in the present study, we should evaluate whether short-type DBE is enough for reaching the papilla in patients with long limb after Roux-en-Y gastric bypass for morbid obesity in the near future.

In cases of anastomosis, if there is an intact papilla, there are several hurdles for successful DBE-assisted ERCP: (1) absence of a side-viewing endoscope or an instrument elevator mechanism, making selective duct cannulation more difficult than standard ERCP; (2) the maneuverability of DBE is poor, particularly due to torsion of the shaft of the scope, loop formation, and bending of the tip of the scope, which render the introduction of accessories through the working channel difficult or impossible. Although complete elimination of loop formation would simplify the subsequent procedure because of possible better transmission of the rotating force of the scope or advancing the accessory in 1:1 force transmission

[21], loop elimination often is anatomically impossible due to adhesion, or forced elimination can cause perforation. (3) Types of accessories are limited, in particular those usable with the long DBE. Specially designed longer accessories have recently become commercially available or can be made to order in some countries but not Japan. However, the variety of devices available is insufficient for routine clinical work. In terms of accessories, this problem may be solved by using a short DBE or replacing a DBE with a conventional forward-viewing upper endoscope in almost all cases, because more conventional accessories can be used with these shorter scopes. (4) Narrow working channels also limit DBE-assisted therapeutic ERCP. DBE must be developed with a large working channel, and a large overtube (maximum 14 mm in diameter) through which duodenoscope exchange could be performed [12].

Interestingly, we found that a method closely resembling our approach to replacing the DBE with a 110-cm long conventional forward-viewing upper endoscope by incision of the fixed overtube had been reported by Fährdrich et al. [22]. Care has to be taken that the pressure line for the balloon remains intact to prevent spontaneous deflation of the balloon. Nevertheless, there is still risk in pulling the balloon back to the oral side because strong

Table 3 Review of double-balloon-assisted ERCP

Author	Year	Total no. of cases	No. of intact papilla	Types of surgery	Success rate of reaching papilla/pancreatobiliary anastomosis	Success rate of cannulation for intact papilla/pancreatobiliary anastomosis	Type of intervention	Major complication
Haruta	2005	1	0	OLT with CJS	NA/100%	NA/100%	Repeated balloon dilation of stenotic hepaticojejunostomy	–
Mehdizadeh	2006	5	2	HJS (1), OLT with HJS (1)	50%/67%	0%/100%	Balloon dilation of stenotic hepaticojejunostomy	–
Emmett	2007	14	6	Whipple with HJS (1) or CJS (1), PJS (1), Frey (1)	100%/NA (85% in 20 total ERCP cases)	88%/NA (80% in 20 total ERCP cases)	Balloon dilation, sphincterotomy, biliary stenting, pancreatic stenting	–
Moreeis	2007	1	0	HJS	NA/100%	NA/100%	Balloon dilation of stenotic hepaticojejunostomy biliary stenting	–
Spahn	2007	1	0	HJS	NA/100%	NA/100%	Balloon dilation of stenotic hepaticojejunostomy stone removal	–
Aabakken	2007	13	1	OLT with HJS (10), CDS (1), HJS (1), PG (1)	94% in 18 total ERCP cases	0%/NA (85% in 17 total ERCP cases)	Biliary stent placement and removal; stone removal	–
Chu	2008	1	0	CJS	NA/100%	NA/100%	Metallic stent removal	–
Mönkemüller	2008	2	1	TG (1), Whipple (1)	100%/100%	100%/100%	Biliary stenting, removal Balloon dilation, biliary stenting	–
Maasser	2008	9	2	PG (1), PG with CDS (1), TG (1), CJS (2), Whipple (2), HJS (1), DPPHR with CJS	100%/100%	100%/57%	Balloon dilation, sphincterotomy, biliary stenting, stone removal, bile aspiration	–
Koornstra	2008	3	0	HJS (1), OLT with HJS (2)	NA/100%	NA/67%	Balloon dilation	–
Zuber-Jerger	2008	1	0	HJS for post-OLT biliary stricture	NA/100%	NA/100%	NA (only contrast)	–
Kuga	2008	6	2	TG (1), GB (1), HJS (3), CJS (1)	100%/100%	100%/83%	Balloon dilation, sphincterotomy, biliary stenting, stone removal	–
Fähndrich	2008	3	2	PPPD, modified B-II with R-Y (2)	100%/100%	100%/100%	Sphincterotomy, biliary stenting, stone removal	–
Pohl	2009	15	0	CJS	NA/100%	NA/84%	Balloon dilation, biliary stenting, stone removal	–
Present study	2009	9	9	TG (8), PG (1)	100%/NA	67% (100%) ^b /NA	Biliary stenting, stone removal, ENPD, EBS, EPS	Perforation ^a

OLT orthotopic liver transplantation, R-Y Roux-en-Y, HJS hepatojejunostomy, CDS choledochodenostomy, CJS choledochojejunostomy, GB gastric bypass, PG partial gastrectomy, TG total gastrectomy, DPPHR duodenum-preserving pancreatic head resection, PPD pylorus-preserving pancreaticoduodenectomy, B-II Billroth-II, EBS endoscopic biliary stenting, EPS endoscopic pancreatic duct stenting, ENPD endoscopic nasopancreatic cyst drainage

^a 100% of diagnostic cholangiography

^b First session 57%, first plus second session 100%, improvement by conservative therapy

resistance occurs when reinserting through the angulated portion of the overtube. Although replacing the DBE with an upper endoscope is not completely reliable and can be cumbersome, major advantages include the ability to use standard accessories.

Before the introduction of double balloon enteroscopes, the next nonsurgical option after failed ERCP in patients with Roux-en-Y anastomosis was to perform PTBD. This often required placement of a relatively large size external tube [18]. In the present study, we conducted the rendezvous technique of placement of a temporary guidewire. The percutaneous approach may be technically difficult in the absence of dilated bile ducts or contraindicated because of large volume ascites and use of clotting disorders. In addition, the percutaneous approach does not usually allow access to the pancreatic ductal system [18]. However, PTBD is reliable in allowing access to the biliary tree compared with attempting another endoscopic session using the same technique.

Other than one perforation, no major complications have been reported using DBE for ERCP (Table 3). However, the actual rates of perforation, bleeding, and pancreatitis using DBE-assisted ERCP in large numbers of patients is unknown.

Recently, there are a few small case reports on the single-balloon enteroscopy (SBE)-assisted ERCP [25, 26], although SBE has only long-type scope. There may be several hurdles for successful SBE-assisted ERCP as well as DBE-assisted ERCP.

In conclusion, DBE-assisted ERCP appears to be a promising method for performing therapeutic ERCP in patients with a Roux-en-Y anastomosis and intact papilla. Further development of the accessories for use in balloon enteroscopy systems is still needed.

Acknowledgment The authors are indebted to Prof. J. Patrick Barron of the International Medical Communication Center of Tokyo Medical University for his review of this manuscript.

Disclosures Drs. Takao Itoi, Kentaro Ishii, Atsushi Sofuni, Fumihide Itokawa, Takayoshi Tsuchiya, Toshio Kurihara, Shujiro Tsuji, Nobuhito Ikeuchi, Katsumasa Fukuzawa, Fuminori Moriyasu, and Akihiko Tsuchida have no conflicts of interest or financial ties to disclose.

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