Usefulness of the Rendezvous Technique for Biliary Stricture after Adult Right-Lobe Living-Donor Liver Transplantation with Duct-To-Duct Anastomosis

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Background/Aims: Replacement of a percutaneous transhepatic biliary drainage (PTBD) catheter with inside stents using endoscopic retrograde cholangiography is difficult in patients with angulated or twisted biliary anastomotic stricture after living donor liver transplantation (LDLT). We evaluated the usefulness and safety of the rendezvous technique for the management of biliary stricture after LDLT. **Methods:** Twenty patients with PTBD because of biliary stricture after LDLT with duct-to-duct anastomosis underwent the placement of inside stents using the rendezvous technique. **Results:** Inside stents were successfully placed in the 20 patients using the rendezvous technique. The median procedure time was 29.6 (range, 7.5-71.8) minutes. The number of inside stents placed was one in 12 patients and two in eight patients. One mild acute pancreatitis and one acute cholangitis occurred, which improved within a few days. Inside stent related sludge or stone was identified in 12 patients during follow-up. Thirteen patients achieved stent-free status for a median of 281 (range, 70-1,351) days after removal of the inside stents. **Conclusions:** The rendezvous technique is a useful and safe method for the replacement of PTBD catheter with inside stent in patients with biliary stricture after LDLT with duct-to-duct anastomosis. The rendezvous technique could be recommended to patients with angulated or twisted strictures. (*Gut Liver* 2010; 4:68-75)

Key Words: Rendezvous; Biliary stricture; Liver transplantation; Endoscopic retrograde cholangiography; Per-

cutaneous transhepatic biliary drainage

INTRODUCTION

The rendezvous procedure combines the endoscopic technique with percutaneous transhepatic cholangiography (PTC) to facilitate cannulation of the bile duct in cases where previous endoscopic attempts have failed.¹⁻⁴ The combined technique increases the success rate of biliary tract cannulation and thus facilitates the diagnosis and treatment of biliary tract disorders.⁵⁻⁷ Regarding biliary complication after liver transplantation, a few cases were reported that support the usefulness of the rendezvous technique in biliary leakage from bile duct anastomosis or anastomotic biliary stricture and biliary stones.⁸⁻¹⁰ However, the usefulness of the rendezvous technique for the management of biliary stricture after living-donor liver-transplantation (LDLT) has not been evaluated.

The successful performance of primary or rescue PTC in patients with biliary stricture after LDLT sometimes leads to a recommendation of subsequent endoscopic retrograde cholangiography (ERC) with the placement of inside stents, as percutaneous transhepatic biliary drainage (PTBD)-related complications, such as bile leakage, pain, infection, and the accidental removal of the PTBD catheter, are not uncommon.¹¹ Although PTBD catheter is placed successfully over the stricture, placement of inside stents is difficult when the anastomotic angle between the common bile duct (CBD) of the recipient and the right hepatic duct of the donor is too sharp or twisted to

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allow passing a guidewire over the anastomotic stricture.¹²⁻¹⁴ The rendezvous technique is useful in these cases and enables the successful placement of an inside stent. Here, we analyzed 20 patients who underwent the placement of inside stents using the rendezvous technique for the replacement of a PTBD catheter. We evaluated the usefulness and safety of the rendezvous technique.

MATERIALS AND METHODS

1. Patients

Three hundred ninety-seven adult right lobe-LDLTs with duct-to-duct biliary anastomosis were performed between January 2000 and June 2009 at Seoul St. Mary's Hospital. Endoscopic retrograde cholangiography (ERC) was performed in 122 patients (380 ERCs) who had developed biliary stricture after LDLT. Biliary stricture was diagnosed when bile duct stenosis and dilatation of proximal bile duct were observed on abdominal computed tomography or magnetic resonance cholangiography and liver biochemical parameters, such as serum bilirubin, r-glutamyltransferase, and alkaline phosphatase, were abnormal regardless of presence of abdominal and fever. The

rendezvous technique was used in 20 (5.3%) ERCs. The rendezvous technique was performed in patients selected among those who had undergone PTBD for the management of biliary stricture after LDLT with duct-to-duct anastomosis. The indications for the use of the rendezvous technique were that ERC failed previously or was not performed because the angle between the CBD of the recipient and the right hepatic duct of the donor was sharp or twisted. The contraindications for the rendezvous technique were the same as the general contraindications for endoscopy or PTC. Patient anonymity was preserved and the Institutional Review Board of Seoul St. Mary's Hospital approved the study. The study protocol was in complete compliance with the Declaration of Helsinki, as revised in Edinburgh in 2000.

2. PTC

All patients had one or two PTBD catheters passing over the stricture site. The mean diameter of the PTBD catheter was 11.1 ± 2.7 F. In cases where the anastomotic stricture was tight, the balloon dilatation of the stricture site was performed in the previous PTC. After an overnight fast, the patient was sedated using midazolam and pethidine in the supine position. PTC was performed by

Fig. 1. Rendezvous technique using a duodenoscope. (A) The PTBD catheter was located over the anastomotic stricture into the duodenum. The angle between the right hepatic duct and the common bile duct was sharp (93°). (B) The 0.035 inch guidewire was inserted through the PTBD catheter, and the PTBD catheter was then removed. (C) The guidewire was noted outside the major ampulla. (D) Endoscopic sphincterotomy was performed along the catheter. (E, F) A bottle-top metal-tip ERC catheter was inserted along the guidewire. (G) An inside stent was placed over the stricture. (H) The distal end of the inside stent was noted at the major ampulla.

injection of the contrast medium through the PTBD catheter (Figs 1A, 2A, and 3A). The guidewire (0.035 inch Jagwire; Boston Scientific, Natick, MA, USA) was introduced along the PTBD catheter until it advanced over the major ampulla, which was followed by removal of the PTBD catheter (Figs 1B, 2B, and 3A).

3. ERC

After the patients were moved into the prone position, ERC was performed using a video duodenoscope (ED-450XT5; Fujinon, Saitama City, Saitama, Japan). The guidewire outside the ampulla within the duodenal lumen was identified using the duodenoscope (Figs 1C and 3B). Minor sphincterotomy was performed alongside the guidewire in cases where endoscopic sphincterotomy had not been performed (Fig. 1D). A bottle-top metal-tip ERC catheter (MTW Endoscopie, Wesel, Germany) was introduced through the accessory channel of the duodenoscope. The bottle-top metal-tip ERC catheter and the guidewire were manipulated cautiously to insert the end of the guidewire into the ERC catheter, which minimized the damage to the guidewire (Fig. 1E, 1F, 2C, and 2D). The guidewire was introduced through the ERC catheter by an assistant from the percutaneous side until the end of guidewire came out of the ERC catheter at the endoscopic side, and the ERC catheter was then removed. When the stricture at anastomotic site remained on ERC, balloon dilatation of anastomotic strictures was performed using a balloon catheter (6 or 8 mm in diameter;

Hurricane RX; Boston Scientific) (Fig. 2E). The inside stent was placed over the guidewire; Amsterdam-type biliary stents (7-11.5 F in diameter, 10-16 cm in length; Wilson-Cook Medical Winston-Salem, NC, USA, or Medi-Globe, Aachenmuhle, Germany) were used. The proximal side of the stent was located sufficiently covering the stricture, and the distal side of the stent passed 1-2 cm outside the major papilla (Figs 1G, 1H, 2F, 3E, and 3F). In cases where the location of the inside stents was deviated to the proximal or distal side, the inside stent was manipulated to a suitable position with a grasping forcep (shark tooth; Olympus Optical Co., Ltd., Tokyo, Japan). If we intended to insert two inside stents, we tried inserted another guidewire retrogradely over the stricture site, and a second inside stent was placed over the second guidewire (Fig. 2F). In cases where two guidewires had been inserted previously at a different branch of the bile duct during PTC, two inside stents were placed over these guidewires by the rendezvous technique. We tried to place the proximal tip of the internal stent in the bile duct not in the liver parenchyma with assistance from fluoroscopic image. In some patients, the proximal tip of internal stent was somewhat introduced into the liver parenchyma of previous of PTBD tract to place internal stent at the stable position.

In patients for whom passing the duodenoscope over the pyloric ring was impossible because of a distorted antrum, a two-channel endoscope (EG-450D5; Fujinon) was used instead of a duodenoscope for the placement of an

Fig. 2. Rendezvous technique using a duodenoscope. (A) A PTBD catheter was located over anastomotic stricture into the duodenum. The angle between the right hepatic duct and the common bile duct was sharp (100°). (B) A 0.035 inch guidewire was inserted through PTBD catheter and the PTBD catheter was then removed. (C) The end of the guidewire was placed outside the ampulla. (D) A bottle-top metal-tip ERC catheter was inserted along the guidewire. (E) Balloon dilatation was performed at the anastomotic stricture. (F) Two inside stents were placed over the stricture in anterior and posterior branches of the right hepatic duct of the recipient's liver.

Fig. 3. Rendezvous technique using a two-channel endoscope. (A) A 0.035 inch guidewire was inserted alongside the PTBD catheter. (B) The end of the guidewire was placed outside the ampulla. (C) Because the duodenoscope failed to pass through the pyloric ring, a two-channel endoscope was introduced. The tip of the endoscope was bent nearly 180° to pass over the pyloric ring. (D) The guidewire was captured into the two-channel endoscope, and a bottle-top metal-tip ERC catheter was introduced along the guidewire. (E) An inside stent was placed over the stricture. (F) The distal end of the inside stent was noted at the ampulla.

inside stent (Fig. 3C and D). The inserted guidewire was captured with a basket and withdrawn via the accessory channel. An inside stent was placed over the guidewire via the accessory channel of the two-channel endoscope.

We measured the anastomotic angle between the common hepatic duct of the recipient and the right hepatic duct of the donor (confluent duct of anterior and posterior branch). If confluent duct was not obvious, we used the IHD of donor in which PTBD catheter was placed for measuring the angle.

After the successful insertion of the stent, a follow-up ERC was performed within three to six months if possible. During the follow-up ERC, the stents placed previously were removed, and the degree of improvement in the biliary stricture was evaluated. If the stricture remained, redilatation of the stricture and restenting were performed.

RESULTS

1. Outcome of rendezvous procedure

Between November 2006 and June 2009, inside stents were placed using the rendezvous technique in 20 patients who undergone LDLT with duct-to-duct anastomosis. The mean age of the patients was 52.2 ± 9.7 years, and 13 patients were men. Pretransplantation liver diseases in the cohort included end-stage liver cirrhosis in six patients, hepatocellular carcinoma in nine patients, and fulminant hepatitis in five patients (Table 1). The median duration between internal PTBD and rendezvous procedure was 80 days (range, 29-255 days; Table 2). In all patients, primary or rescue PTC was successfully performed using a PTBD catheter over the stricture. Severe pain at the PTBD catheter insertion site was reported by five patients (duration of PTBD; 29, 52, 93, 78, and 123 days), and leakage of bile or pus at the PTBD site was found in two patients (duration of PTBD; 82 and 255 days). Discomfort and unwillingness to keep PTBD were the reasons why the rendezvous procedure was performed

Table 1. Characteristics of the Patients Included in the Study Population

	No. (%)
Total patients	20
Mean age, y (SD)	52.2 (9.7)
Male sex	13 (65)
Pretransplantation liver disease	
End-stage liver cirrhosis	
Hepatitis B	3 (15)
Hepatitis B and alcohol	2 (10)
Cryptogenic	1 (5)
Hepatocellular carcinoma	
Hepatitis B	7 (35)
Hepatitis B and alcohol	2 (10)
Fulminant hepatitis	
Hepatitis B	3 (15)
Alcohol	1 (5)
Unknown origin	1 (5)
No. of previous ERC (SD)	1.0 (1.0)
Median duration between LDLT and rendezvous procedure, days (range)	340 (98-803)
Median duration between PTBD* and rendezvous procedure, days (range)	80 (23-255)
Mean angle [†] , ° (SD)	110° (15)

SD, standard deviation; ERC, endoscopic retrograde cholangiography; LDLT, living donor liver transplantation; PTBD, percutaneous transhepatic biliary drainage.

*PTBD catheter was successfully placed over the stricture; [†]Between the right hepatic duct of the donor and the common bile duct of the recipient.

in remaining patients. Sixteen patients (80%) had undergone ERC before PTBD. In these patients, insertion of the inside stent had failed because the guidewire did not pass over the stricture site because of the presence of a sharp or twisted angle with stricture at the anastomosis site. The remaining four patients had undergone PTBD as a first treatment of biliary stricture, instead of ERC, because a sharp or twisted angle at the anastomotic stricture was found on abdominal computed tomography or magnetic resonance cholangiography.

The median procedure time of the rendezvous technique after PTC was 29.6 min (range, 7.5-71.8 min). Dilatation of the stricture and removal of multiple IHD stones were performed in the patient for whom the procedure lasted for 71.8 min. The mean angle between the CBD of the recipient and the right hepatic duct of the donor was as sharp as $110 \pm 15^\circ$. Inside stents were successfully placed using the rendezvous technique in all patients. An inside stent was placed in 12 patients, and two inside stents were placed in eight patients. The mean diameter of the inside stents was 9.9 ± 1.4 F. Three patients kept two PTBD catheters previously. The guidewires were inserted during the PTC in each anterior and

posterior branch of the grafted liver, and two inside stents were placed. In five patients, an additional guidewire was placed retrogradely, and the second inside stent was then placed over it. A duodenoscope could not pass over the pyloric ring previously because of the presence of a distorted antrum in two patients. We used a two-channel endoscope instead of a duodenoscope for the placement of the inside stent (Fig. 3). We were able to pass the two-channel endoscope over the pyloric ring and place the inside stent.

Liver function was good before the rendezvous procedure in most of the patients by the management of biliary strictures using PTBD. Only two patients showed slightly elevated serum total bilirubin as 3.64 and 3.02 mg/dL. After rendezvous procedure, four patients (20%) showed further elevation of serum total bilirubin more than 3 mg/dL comparing with that before the procedure. The days showing the peak level of serum total bilirubin followed by the procedure were two days in three patients (total bilirubin levels reached 3.8, 3.5, and 4.2 mg/dL) and four days in one patient (total bilirubin level reached 8.1 mg/dL). Their elevated serum total bilirubin levels were normalized after 7, 15, 45, and 53 days after procedure.

We planned a rendezvous procedure for additional two patients (other than the 20 original patients). However, they did not need the rendezvous technique. It is because the stricture was dilated enough after PTBD to allow passing a catheter and guidewire into the proximal bile duct above the stricture, although the angle at the anastomosis site was sharp in these patients. Therefore, we did not use the guidewire inserted during the PTC.

2. Complications and follow-up after rendezvous procedure

Complications of the rendezvous procedure included one mild acute pancreatitis and one acute cholangitis. The patient with acute pancreatitis exhibited improvement of the abdominal discomfort and serum amylase two days after the procedure. Another patient had proximal migration of the inside stent obstructing distal CBD and developed acute cholangitis. The inside stent was repositioned by ERC the next day, and the acute cholangitis improved within a day.

The patients were followed after the rendezvous procedure for a median of 590 (range, 208-1,488) days. Follow-up ERC was performed at a mean frequency of 2.0 (range, 0-5) times for the change of inside stents or removal of biliary stones. Inside stent related sludge or stone was identified in 12 patients (80%) among 15 patients who underwent follow-up ERC. IHD stone devel-

Table 2. Details and Outcomes of the Rendezvous Technique in Patients with Biliary Strictures after RL-LDLT

Patient No.*	PTBD-ERC (days) [†]	Diameter of PTBD catheter	No. of stents inserted	Inside stent diameter	Time [‡] required (min)	Angle [§] (°)	No. of follow-up ERC	Complication after rendezvous procedure	Duration of stent	Current status
1	126	8	1	10	32.2	123	5	CBD, IHD stone	896	No stent
2	112	10	1	11.5	18.6	133	2	CBD stone	137	No stent
3	92	12	1	11.5	15.3	121	2	CBD stone	161	No stent
4	68	14	2	10/7	20.9	106	3	Sludge	182	No stent
5	123	8	2	10/10	17.2	117	3	IHD stone	875	No stent
6	130	14	1	11.5	31.6	87	1	Sludge	218	No stent
8	136	14	1	11.5	22.0	104	3	IHD stone	910	2 stents
10	69	14	2	11.5/7	18.4	107	1	•	217	No stent
11	87	8	1	11.5	14.1	122	3	Sludge	75	No stent
12	78	14/14	2	10/10	7.5	124	0	•	398	Expired
13	93	12/12	2	10/10	71.8	104	2	IHD stone	272	No stent
14	82	10/10	2	10/7	52.6	141	4	CBD stone	377	No stent
15	73	8	1	10	31.4	96	1	•	215	No stent
16	255	14	2	10/10	36.5	119	1	•	99	No stent
17	47	8	1	10	28.8	87	1	Cholangitis	335	1 stent
18	49	8	1	10	17.1	114	0	•	377	1 stent
19	29	8	2	10/7	50.0	100	1	IHD stone	256	2 stents
20	52	8	1	10	30.5	108	1	IHD stone	127	No stent
21	29	8.5	1	10	48.1	98	0	Pancreatitis	210	1 stent
22	48	8	1	10	39.1	93	0	•	209	1 stent

RL-LDLT, right-lobe living-donor liver transplantation; PTBD, percutaneous transhepatic biliary drainage; ERC, endoscopic retrograde cholangiography; CBD, common bile duct; IHD, intrahepatic duct.

*The order was according to the date of the rendezvous procedure; [†]Duration between internal PTBD and rendezvous procedure;

[‡]Time after PTC until the placement of inside stents; [§]Angle between the right hepatic duct of the donor and the common bile duct of the recipient; ^{||}IHD stone and biliary cast.

oped in five patients (33%), CBD stone developed in three patients (20%), and both IHD and CBD stones developed in one patient (7%). Only sludge was noted in three patients (20%). These sludge or stone was removed during follow-up ERC. We found biliary cast in one patient who had IHD stone.

Inside stents were kept for median 215 (range, 75-896) days in currently stent-free 13 patients. They underwent change of inside stents at a mean frequency of 1.0 (range, 0-4) time and the interval of ERC was median 178 (range, 62-337) days. After removal of stents, follow-up ERC was performed in two patients for removal of CBD stone. In six patients with currently keeping inside stents and one patient who died with stents, they had ERBD stents for median 296 (range, 127-910) days with mean 0.7 (range, 0-3) times of stent change and the interval of ERC was median 252 (range, 187-308) days. At the last follow-up, 13 patients (65%) had no stent and exhibited a good health status for a median of 281 (range, 70-1,351) days after removal of the inside stents, and six patients (30%) had inside stents for a median of 200 (range, 30-377) days after the last ERC. One patient died

398 days after the rendezvous procedure from pneumonia and recurrent hepatocellular carcinoma.

DISCUSSION

In the present study, inside stents were placed successfully using the rendezvous technique in 20 patients for whom the insertion of inside stents using ERC was expected to be difficult because of the presence of a sharp or twisted angle at the stricture or because of a severely distorted antrum. There were no significant complications. These result demonstrated that the rendezvous technique is useful and safe for the management of biliary stricture after LDLT with duct-to-duct anastomosis.

Biliary strictures develop in about 30% of patients after LDLT.^{12,15} Some studies demonstrated that ERC is preferable as the first approach and PTC might be reserved for a rescue therapy in the management of posttransplant biliary stricture.^{11,16,17} Although 50-70% of biliary strictures can be treated by ERC,^{5,12,18,19} PTBD or surgical treatment is considered a good first treatment and is also recommended for the patients who failed in ERC.^{11,20,21}

For the treatment of biliary strictures, a larger number or diameter of stents and a longer duration of stenting are recommended.²²⁻²⁴ Therefore, the maintenance of the PTBD catheter for a long period is beneficial in patients with PTBD. However, this may be difficult for the some patients developing PTBD catheter-related complications, such as leakage, pain, infection, and the accidental removal of the PTBD catheter. The discomfort caused by carrying a PTBD catheter also reduces the patient's quality of life and disturbs the usual course of daily routine. Hence, replacing PTBD catheters by inside stents is recommended in these patients instead of PTBD. However, stenting by ERC is difficult in some patients because of the presence of angulated or twisted strictures, or because of a distorted antrum. Our study showed that the rendezvous technique is a useful alternative method for the successful placement of inside stents in these patients. In addition, the inserted rendezvous guidewire outside the ampulla reduced the time needed for cannulation of the CBD and facilitated the performance of sphincterotomy in patients who did not undergo previous endoscopic sphincterotomy. We performed insertion of the guidewire into the bottle-top metal-tip ERCP catheter, instead of capturing the guidewire with a basket, to minimize the damage to the guidewire. We became familiar with this procedure quickly and were able to perform in less than one minute. However, we thought that the traditional method of capturing the guidewire with a basket is also good and easy method. In cases where the duodenoscope cannot pass over the pyloric ring because of the presence of a distorted gastric antrum after LDLT, rendezvous technique using a two-channel endoscope can be used to pass the scope over the pyloric ring and to place inside stents. Because the duodenoscope does not show a frontal view and the upward angulation of this scope is less than that of upper endoscope, passing a duodenoscope over the pyloric ring is difficult in patients with a severely distorted antrum after LDLT. A shortcoming using of the two-channel endoscope is that the placement of an additional inside stent is difficult, as the ampulla is not well shown in a frontal view. Therefore, it should be used in selected patients only.

Both PTC and ERC are possible methods for the placement of inside stents. However, ERC is more suitable for placement of inside stents in the following aspects. First, correction of stent position is not easy during PTC. The position of a stent should be corrected in cases where the inside stent is not well positioned for adequate covering of the stricture site, located too distally or proximally. During ERC, the inside stent can be moved easily using a grasping forcep. In contrast, this manipulation is difficult

during PTC. Second, the placement of more than two inside stents is difficult during PTC. For the placement of more than two stents, two inside stents are placed at the same branch of the bile. However, the first stent often migrates to the distal side in the course of the placement of the second stent, and the repositioning of the first stent is troublesome during PTC. To avoid this problem, more than two PTBD catheters placed previously at a different branch of the bile duct. The placement of more than two PTBD catheters is burdensome for patients because of discomfort and more frequent complications. During ERC, attempts can be made easily to place an additional stent at a different branch of the bile duct. ERC showed that the lower rate of migration of the first stent because of the tapering of the proximal bile duct and the position of first stent also can be corrected, even if it migrates to the proximal side along the second stent. Third, removal of accompanying bile duct stones is easier during ERC.

The rendezvous technique is sometimes considered as time-consuming or complicated. In the present study, the median procedure time was less than 30 min. The procedure time was slightly long in a few patients because of the necessity to dilate the stricture or to removing multiple bile duct stones. We consider that the time for the rendezvous procedure itself was not long and was acceptable. Liver function was good by the management of biliary strictures using PTBD previously in patients who underwent the rendezvous technique. This renders the rendezvous technique safe and less complicated after the procedure. Unprotected guidewires could be associated with laceration of the liver capsule and parenchyma during manipulation. Thus, we used protective catheter covering the guidewire while moving the guidewire through the PTBD tract to reduce liver damage, and we also made an effort to keep the guidewire sterile and to manipulate it gently. The proximal tip of internal stent was somewhat introduced into the liver parenchyma of previous PTBD tract to place internal stent at the stable position in some patients of our study, which did not make additional liver damage during and after rendezvous procedure. During the present study, we did not use the guidewire inserted during the PTC in two patients in whom the rendezvous procedure was prepared because the stricture was dilated enough to pass the guidewire and ERC catheter. However, it is difficult to select these patients before ERC. We recommended the rendezvous technique in patients with angulated or twisted anastomotic strictures to avoid failure in the placement of inside stents or to reduce the procedure time needed for stenting by ERC. Further studies concerning specific indications are needed

in the future.

In conclusion, the rendezvous technique is a useful and safe method for the replacement of PTBD catheter with inside stent in patients with biliary stricture after LDLT with duct-to-duct anastomosis. The rendezvous technique could be recommended to patients with angulated or twisted anastomotic strictures. Further studies using a larger cohort of patients should be performed to improve the rendezvous technique and to identify proper indications for this procedure.

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