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ORIGINAL ARTICLE

Complications of the treatment of endoscopic biliary strictures developing after liver transplantation

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Abstract
Background Bile duct strictures remain a major source of morbidity after orthotopic liver transplantation (OLT). Endoscopic management by the conventional methods of biliary dilatation and/or stent placement has been successful, but sometimes severe complications occur, necessitating prolonged therapy. The aim of this study is to clarify the complications of the endoscopic approach for endoscopic dilatation and/or stent placement.
Method Of 46 patients who underwent living-donor liver transplantation, 10 were diagnosed as having anatomic biliary strictures by endoscopic retrograde cholangiopancreatography (ERCP). Two patients developing biliary strictures after deceased-donor liver transplantation were also enrolled in the study. For the purpose of comparison, 302 patients with a total of 550 consecutive ERCP cases (including 115 patients with 250 malignant bile duct strictures) were recruited in this study. Success rate, number of endoscopy sessions, the median procedure time for ERCP, and incidence of complications including post-ERCP pancreatitis were compared in the OLT cases and other cases.
Results The following results were obtained in the OLT cases, malignant stricture cases, and all cases, respectively: mean number of endoscopy sessions was 3.62, 2.17, and 1.94 ($P = 0.0216$, $P < 0.0001$); post-ERCP pancreatitis occurred in 5 (12.5%), 10 (4.0%), and 19 cases (3.5%) ($P = 0.0327$, $P = 0.0093$); and severe pancreatitis occurred in 2 cases of OLT. In a univariate analysis for post-ERCP pancreatitis, OLT was extracted as the only significant risk factor.
Conclusions Endoscopic maneuvering for biliary dilatation and/or stent placement following OLT was associated with a higher risk of post-ERCP pancreatitis than the use of the same technique for the treatment of malignant biliary stricture. Endoscopic treatment after OLT was a significant risk factor for post-ERCP pancreatitis.

Keywords Liver transplantation · Post-ERCP pancreatitis · Bile duct strictures · Endoscopic retrograde cholangiopancreatography · Stent placement · Endoscopic dilatation

Abbreviations

DDLT	Deceased-donor liver transplantation
EPBD	Endoscopic papillary balloon dilatation
ERCP	Endoscopic retrograde cholangiopancreatography
EST	Endoscopic sphintectomy
LC	Liver cirrhosis
LDLT	Living-donor liver transplantation
OLT	Orthotopic liver transplantation
SOD	Sphincter of Oddi dysfunction

Introduction

Complications of the biliary tract have been considered the technical “Achilles heel” of orthotopic liver

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transplantation (OLT) because they occur at a high frequency, need long-term treatment, and have potential detrimental effects on the graft and patient survival. Recently, with improvements in organ selection, retrieval, preservation, and standardization of the methods of biliary reconstruction, the incidence of these complications has decreased dramatically [1–3]. However, the biliary tract still remains the most common site of postoperative complications after OLT [4, 5]. Biliary complications, including bile duct strictures and leaks, which occur most frequently, as well as casts, sludge, stones, sphincter of Oddi dysfunction, and hemobilia, develop in 10–25% of cases undergoing OLT and are associated with a mortality rate of up to 10% [1, 2, 6–8]. Endoscopic management of biliary complications after OLT has been well described in a substantial number of patients. Especially, biliary strictures after OLT are a therapeutic endoscopic challenge. Balloon dilatation and/or placement of bile duct stents is the standard endoscopic management and is repeated every 3 to 6 months [9–11]. According to several reports, endoscopic management of biliary strictures after OLT is highly effective and safe [2–4, 11, 12]. On the other hand, such treatment is still very difficult, and the reported success rate is in the range of 60–91% [3, 11, 13–15]. Also, the reported complication rate of endoscopic treatment is in the range of 6.6–24% [3, 10, 12]. We undertook a retrospective review of the OLT cases at our hospital. We also evaluated the complications of endoscopic management of biliary stricture after OLT as compared with those of a similar approach for biliary stricture associated with malignancy.

Patients and methods

Patients

Between September 1992 and October 2009, 46 consecutive patients underwent living-donor liver transplantation (LDLT) with duct-to-duct biliary anastomosis at the Yokohama City University Hospital. In these patients, we performed duct-to-duct choledochocholedochostomy (for biliary reconstruction) with 5-0 absorbable material. After completion of the suture of the posterior row, a 4 Fr. extranal transanastomotic drainage tube (Pancreatic tube®, Sumitomo, Akita, Japan) was inserted and fixed with posterior row material. Ten patients (21.7%) who underwent endoscopic retrograde cholangiopancreatography (ERCP) for suspected biliary complications were screened for the presence of post-liver-transplant anastomotic strictures. ERCP for suspected biliary complications was also performed in two patients who underwent deceased-donor liver transplantation (DDLT) at another hospital. Thus, a total of 12 patients were referred for ERCP (Table 1). We analyzed 550 consecutive ERCP procedures (302 patients) performed at our hospital between January 2007 and December 2008. We also analyzed a subgroup of 250 consecutive ERCP procedures (115 patients) performed for malignant biliary strictures including 86 in patients with pancreatic cancers (46 patients), 55 in patients with Klaskin tumors (24 patients), 45 in patients with bile duct cancer (18 patients), 20 in patients with metastatic liver tumors (8 patients), 16 in patients with gallbladder cancers (6 patients), 14 in patients with hepatocellular carcinomas

Table 1 Characteristics of the 12 liver transplant patients studied here who underwent endoscopic retrograde cholangiopancreatography

	Donor	Age (years)	Sex	Indication for OLT	Graft	Number of strictures	Time from LT (days)
Case 1	LDLT	16	F	FH	RL	1	582
Case 2	LDLT	56	M	B,C-LC; HCC	RL	1	576
Case 3	LDLT	53	F	FH	RL	2	419
Case 4	LDLT	54	M	B-LC	RL	2	90
Case 5	LDLT	47	F	PBC	RL	1	870
Case 6	LDLT	54	F	LC (AIH)	RL	1	357
Case 7	LDLT	52	F	B-LC, HCC	PS	1	193
Case 8	LDLT	48	F	FH	PS	3	373
Case 9	LDLT	51	M	PBC	LL	1	206
Case 10	LDLT	38	M	PSC	LL	1	42
Case 11	DDLT	57	M	LC (alcohol)	TL	1	83
Case 12	DDLT	50	M	C-LC	TL	1	588

OLT Orthotopic liver transplantation, *LDLT* living donor liver transplantation, *DDLT* deceased donor liver transplantation, *FH* fulminant hepatitis, *LC* liver cirrhosis, *HCC* hepatocellular carcinoma, *PBC* primary biliary cirrhosis, *AIH* autoimmune hepatitis, *PSC* primary sclerosing cholangitis, *RL* right lobe graft, *PS* posterior segment graft, *LL* left lobe graft, *TL* total liver transplantation, *B* hepatitis B virus, *C* hepatitis C virus

(3 patients), 9 in patients with ampullary tumors (6 patients), and 5 in patients with intrahepatic cholangiocarcinomas (4 patients). In addition to the 115 patients with malignant biliary strictures and the 12 patients with liver transplantation, this analysis included 175 patients who underwent therapeutic or diagnostic ERCP (98 patients with choledocholithiasis, 24 patients with cystic and/or solid neoplasms of pancreas, 23 patients with chronic pancreatitis, 9 patients with primary sclerosing cholangitis, 9 patients suspected with gallbladder or bile duct carcinoma without obstructive jaundice, 5 patients suspected of pancreas divisum, 3 patients suspected of anomalous union of the pancreatobiliary duct, 2 patients suspected of sphincter of Oddi dysfunction, and 2 patients with elevated levels of serum CA19-9).

Endoscopic procedure

Informed consent for the endoscopic procedure was obtained from each patient. The ERC was mainly performed by two endoscopists (N.K., K.K.) with experience performing about 2,000 biliary interventions. Antibiotics and nafamostat mesylate were administered routinely before the procedure. After overnight fasting, all the patients were referred for ERC via a videoduodenoscopic approach (TJF or JF-260V, Olympus, Tokyo, Japan). All the patients were sedated by intravenous midazolam prior to the procedure. We defined "total procedure time" as the time from the intravenous sedation to completion of the endoscopic procedure. After confirmation, a 0035-in. guidewire (Jagwire, Boston Scientific, MA, USA) was passed through the biliary strictures and the strictures were dilated with a balloon catheter (Quantum TTC Biliary Balloon Dilator, Wilson-Cook Medical, NC, USA) for 1 min each per stricture, followed by insertion of 7 or 8.5 Fr. Amsterdam-type fluorinated-ethylene-propylene endoprostheses (Cook Endoscopy, Amsterdam, The Netherlands) occupying the entire bile duct ("inside stent") to prevent reflux of the intestinal contents into the biliary tree [9, 13]. To easily remove the stent from the bile duct, a nylon thread was tied to the stent via the distal hole. If we could not place this "inside stent," we placed the same stent or nasobiliary catheter by the conventional method. Stents were exchanged every 3–6 months until the bile duct strictures disappeared. If cholangitis or bile duct obstruction occurred, we smoothly exchanged the stent.

We did not perform endoscopic sphincterotomy (EST) or endoscopic papillary balloon dilatation (EPBD) in this procedure. We also placed a pancreatic stent (5 Fr. 3 cm) to reduce the risk of post-ERCP pancreatitis in difficult cannulation cases.

Evaluation of endoscopic management

The endoscopic therapy was judged as successful when all the cholestasis parameters returned to near-normal values, fluoroscopic evaluation of the morphology of the anastomosis showed no significant narrowing, and the contrast medium discharged rapidly from the proximal biliary system. If the endoscopic procedure was judged to have failed, percutaneous or surgical treatments were undertaken in addition. The post-ERCP complications were graded according to Cotton's grading system [16]. Statistical analysis was performed using the Stat View program (SAS Institute, Cary, NC, USA). Categorical variables were compared using the χ^2 test. Continuous variables were analyzed using Student's t test. P values of <0.05 were considered to be statistically significant.

Results

The clinical features of the patients in whom endoscopic management was undertaken are summarized in Table 1. The patients included 6 men and 6 women, with a median age of 42 years (16–58). The indications for the liver transplantation were fulminant hepatitis (3 cases), viral liver cirrhosis (LC; 2 cases), LC with hepatocellular carcinoma (2 cases), LC derived from autoimmune hepatitis (1 case), primary biliary cirrhosis (3 cases), and alcoholic LC (1 case). The right lobe, left lobe, right posterior segment, and the entire liver were used as the graft in six, two, two, and two patients, respectively. None of the patients had hepatic artery thrombosis. The median time interval between two successive procedures was 373 days (range 28–870 days). A total of 40 ERCP sessions (mean 3.62; range 1–8) were performed on the 12 patients. Biliary strictures were found in all patients, and bile leaks with biliary strictures were found in one patient (#9). The number of biliary strictures per patient ranged from 1 to 3 (average 1.33). The total procedure time was 46.0 min (10–105 min).

The biliary strictures were successfully treated in 10 patients (83.3%) (Table 2). The guidewire could not be passed through severe strictures in two patients (#2, 12). For these two failed cases, percutaneous transbiliary drainage was performed in one (#12) and close follow-up was undertaken in the other (#2). Balloon dilatation of strictures was performed in 21 of the sessions (10 patients) and temporary inside stents for biliary stricture were placed in 12 sessions (#1, 3, 4, 6, 7, 8, 9, 10); in the remaining, balloon dilatation and/or placement of nasobiliary catheters or plastic stents was undertaken as treatment for the biliary stricture (Table 2). We placed pancreatic stents in difficult

Table 2 Summary of biliary stricture treatments with endoscopic retrograde cholangiopancreatography (ERCP)

	Donor	ERCP sessions (*n*)	Balloon dilation (*n*)	Inside stent (*n*)	Success of endoscopic treatment	Complication (Cotton grading system [16])
Case 1	Living	8	+ (5)	+ (3)	Yes	
Case 2	Living	2	–	–	No (observation)	
Case 3	Living	5	+ (5)	+ (2)	Yes	
Case 4	Living	4	+ (1)	+ (1)	Yes	
Case 5	Living	2	+ (1)	–	Yes	Pancreatitis (severe)
Case 6	Living	2	+ (1)	+ (1)	Yes	
Case 7	Living	4	+ (2)	+ (2)	Yes	Pancreatitis (mild)
Case 8	Living	5	+ (4)	+ (1)	Yes	Cholangitis (mild), pancreatitis (mild)
Case 9	Living	4	+ (1)	+ (1)	Yes	Pancreatitis (moderate)
Case 10	Living	1	+ (1)	+ (1)	Yes	
Case 11	Deceased	2	+ (1)	–	Yes	
Case 12	Deceased	1	–	–	No (PTBD)	Pancreatitis (severe)

PTBD Percutaneous transbiliary drainage

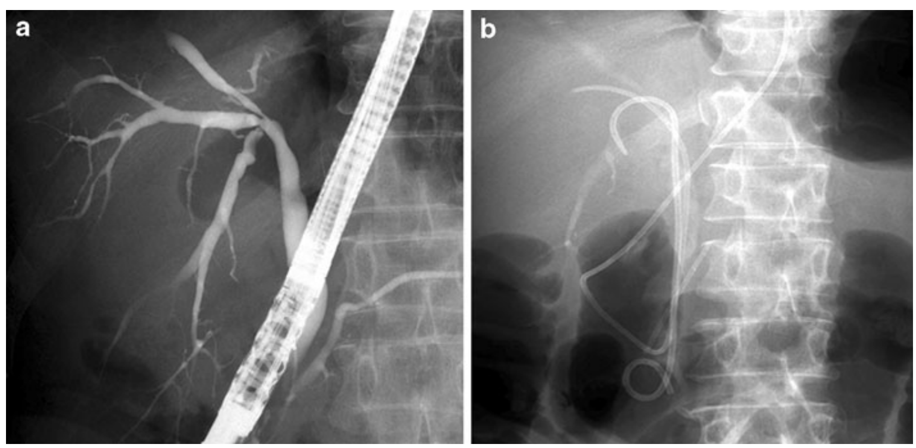

Fig. 1 Patient #8. **a** The cholangiogram showed three biliary strictures after liver transplantation. We performed balloon dilatation and placed a plastic stent for biliary strictures. **b** This patient developed acute cholangitis, and we replaced the plastic stent and endoscopic nasobiliary tube on the following day

cannulation cases (8 sessions; 20.0%) to prevent post-ERCP pancreatitis.

Of the OLT patients with biliary stricture managed thus, five developed acute pancreatitis (#5, 7, 8, 9, 12) and one developed acute cholangitis (#8). All cases of acute pancreatitis occurred at the first session. Acute cholangitis occurred in the case where the plastic stent obstructed another bile duct. We replaced the plastic stent and endoscopic nasobiliary tube on the following day in this case (Fig. 1). In the two patients who developed acute severe pancreatitis (#5, 12), open necrosectomy was performed; in #12, it took place 5 months after the diagnosis of severe pancreatitis (Figs. 2, 3).

We compared the OLT cases (A) with 250 cases of malignant biliary stricture (B) and all ERCP cases together (C) (Table 3). The median age (A vs. B; 42 vs. 50 years: $P < 0.0001$) (A vs. C; 42 vs. 69 years: $P < 0.0001$) was significantly younger in OLT cases. The gender distribution (male/female A vs. B; 6/6 vs. 67/48: $P = 0.5831$) (male/female A vs. C; 6/6 vs. 167/135: $P = 0.9143$) was not significantly different among the three groups. The rate of successful treatment was not significantly different among the three groups (A vs. B; 83.3 vs. 94%: $P = 0.8029$) (A vs. C; 83.3 vs. 95.6%: $P = 0.8500$). The number of ERCP procedures, however, was significantly higher in the OLT cases (A vs. B; 3.62 vs. 2.17: $P = 0.0216$) (A vs. C; 3.62 vs. 1.94: $P < 0.0001$). The total procedure time was not significantly different among the three groups (A vs. B; 46 vs. 40 min: $P = 0.3776$) (A vs. C; 46 vs. 36 min: $P = 0.1729$). The incidence of post-ERCP pancreatitis was significantly higher in the OLT cases (A vs. B; 12.5 vs. 4.0%: $P = 0.0327$) (A vs. C; 12.5 vs. 3.5%: $P = 0.0093$). Rate of acute cholangitis in OLT cases was significantly higher than the rate in total ERCP cases (A vs. C; 2.5 vs. 0.5%: $P = 0.0148$). The rate of pancreatic stent placement and other complications was not significantly different among the three groups.

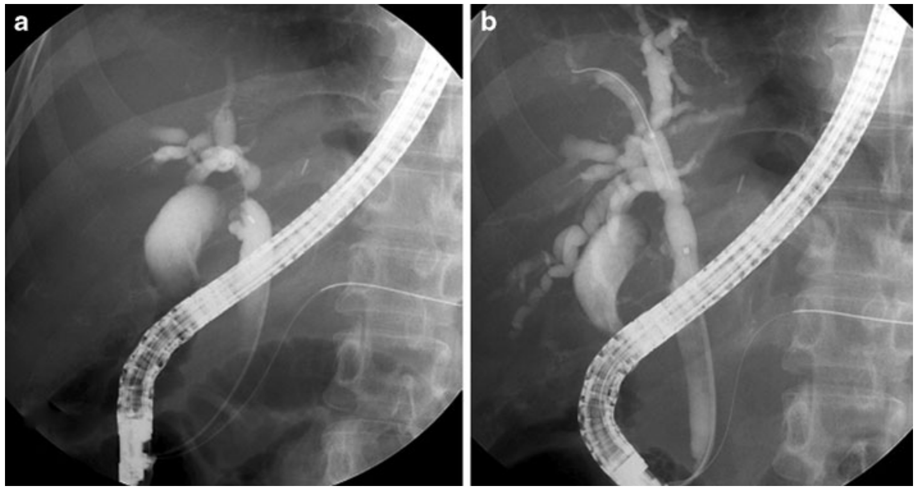

Fig. 2 Patient #5. **a** The cholangiogram showed a biliary stricture after liver transplantation. **b** We performed balloon dilatation and placed a plastic stent for a biliary stricture, but this patient developed severe acute pancreatitis

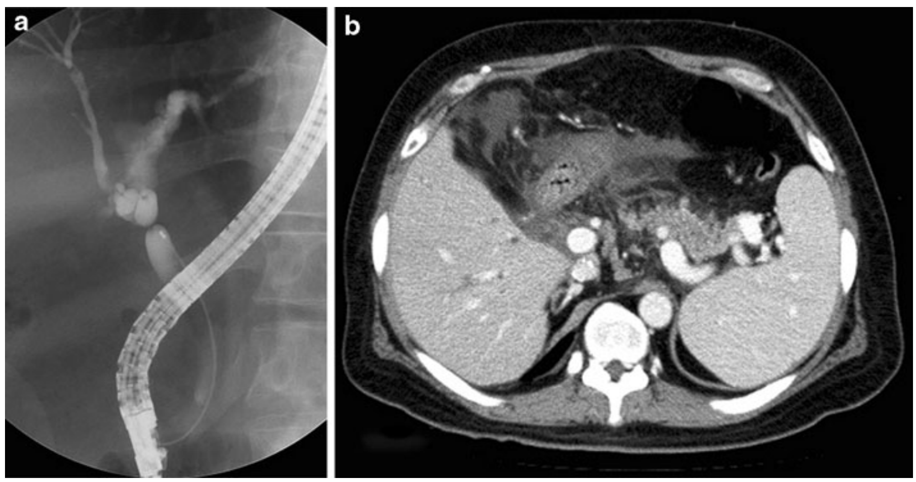

Fig. 3 Patient #12. **a** The cholangiogram showed biliary strictures after liver transplantation. We could not perform balloon dilatation or place plastic stent for severe biliary stricture. **b** This patient developed severe acute pancreatitis, and open necrosectomy was performed after 5 months

We analyzed the risk factors for post-ERCP pancreatitis in OLT cases and malignant biliary stricture cases (Table 4). Univariate analysis identified OLT and longer procedure time for ERCP as significant risk factors for the development of post-ERCP pancreatitis ($P = 0.0327$, $P = 0.0245$). However, in a multivariate analysis, only a longer procedure time (over 40 min) for ERCP was identified as a significant risk factor for post-ERCP pancreatitis ($P = 0.0423$). We also analyzed the risk factors for post-ERCP pancreatitis in total ERCP cases (Table 5). OLT was the only significant risk factor for post-ERCP pancreatitis in total ERCP cases by univariate analysis ($P = 0.0093$). There was no significant risk factor for post-ERCP pancreatitis by multivariate analysis.

Discussion

Acute pancreatitis remains the most common complication of ERCP. According to most reliable unselected prospective series, the incidence of post-ERCP pancreatitis ranges from 2 to 9% [17–19]. One of the most important revelations of a recent multivariate analysis is that the risk of post-ERCP pancreatitis is determined at least as much by the patient characteristics as by the endoscopic technique or maneuver. According to the results of multivariate analyses in some studies and one meta-analysis, young age is associated with a higher risk of post-ERCP pancreatitis [17, 20, 21]. Women appear to be at a higher risk according to the results of many studies [17, 18, 20]. In our study, the OLT cases with complications were significantly younger and more often female than other cases with the complication. Also, the OLT patients were on the immunosuppressive agent tacrolimus (Prograf®). In two previous reports, drug-induced acute pancreatitis was reported in OLT patients [22, 23], and impairment of pancreatic endocrine as well as exocrine function has been demonstrated in rats treated with tacrolimus [24]. Sphincter of Oddi dysfunction (SOD) is a syndrome that typically occurs in women after cholecystectomy, in which functional or structural abnormalities of the sphincter of Oddi are thought to cause recurrent pain with or without

Table 3 Comparison of group characteristics for OLT cases (A), cases of malignant biliary stricture (B), and all ERCP cases together (C)

	Cases of biliary stricture after liver transplantation: A ($n = 12$)	Cases of malignant biliary stricture: B ($n = 115$)	*P* value (A vs. B)	All cases of ERCP: C ($n = 302$)	*P* value (A vs. C)
ERCP sessions (*n*)	40	250		550	
Male/female	6/6	67/48	0.5831*	167/135	0.9143*
Age (years), median (range)	42 (16–58)	50 (39–89)	<0.0001#	69 (16–96)	<0.0001#
Rate of successful treatment	83.3%	94.0%	0.8029*	95.6%	0.8500*
ERCP procedures per patient (*n*), mean (range)	3.62 (1–8)	2.17 (1–8)	0.0216#	1.94 (1–9)	<0.0001#
Time of ERCP procedure (min), median (range)	46.0 (10–105)	40.0 (10–120)	0.3776#	36.0 (10–150)	0.1729#
Cases of pancreas stent placement, *n* (%)	8 (20%)	37 (14.8%)	0.7015*	93 (16.9%)	0.4715*
Post-ERCP pancreatitis (mild/moderate/severe), *n* (%)	5 (2/1/2) (12.5%)	10 (6/3/1) (4.0%)	0.0327*	19 (10/6/3) (3.5%)	0.0093*
Bleeding (mild/moderate/severe), *n* (%)	0 (0%)	8 (6/0/2) (3.2%)	0.9722*	14 (10/2/2) (2.5%)	0.9715*
Cholangitis (mild/moderate/severe), *n* (%)	1 (1/0/0) (2.5%)	2 (2/0/0) (0.8%)	0.0646*	3 (3/0/0) (0.5%)	0.0148*
Perforation (mild/moderate/severe), *n* (%)	0 (0%)	2 (2/0/0) (0.8%)	0.9728*	2 (2/0/0) (0.4%)	0.9838*

* χ^2 test

Student's *t* test

Table 4 Risk factors associated with post-ERCP pancreatitis in orthotopic livertransplantation cases and malignant biliary stricture cases

	Univariate analysis			Multivariate analysis		
	Odds ratio	95% confidence interval	*P* value	Odds ratio	95% confidence interval	*P* value
Case of liver transplantation	3.429	1.107–10.621	0.0327	2.872	0.893–8.954	0.072
Female	1.543	0.544–4.376	0.4144			
Age <60 years	1.665	0.539–5.145	0.3755			
Unsuccessful treatment	1.156	0.143–9.356	0.8917			
ERCP duration >40 min[a]	3.826	1.188–12.319	0.0245	3.408	1.044–11.127	0.0423
Pancreas stent required	0.661	0.178–2.449	0.5356			
EST or EPBD treatment	1.227	0.266–5.667	0.7936			

ERCP Endoscopic retrogradecholangiopancreatography, *EST* endoscopic sphincterotomy, *EPBD* endoscopic papillary balloondilatation

[a] Two groups were divided by the median

Table 5 Risk factors for post-ERCP pancreatitis considering all ERCP cases together

	Univariate analysis			Multivariate analysis		
	Odds ratio	95% confidence interval	*P* value	Odds ratio	95% confidence interval	*P* value
Case of liver transplantation	3.992	1.407–11.329	0.0093	4.878	0.796–29.885	0.0866
Female	2.137	0.920–4.965	0.0774			
Age <60 years	1.596	0.638–3.995	0.3179			
Unsuccessful treatment	1.063	0.138–8.191	0.9533			
ERCP duration >40 min	1.309	0.541–3.170	0.5506			
Pancreas stent required	0.582	0.225–1.507	0.2648			
EST or EPBD treatment	1.066	0.390–2.913	0.9007			

ERCP Endoscopic retrogradecholangiopancreatography, *EST* endoscopic sphincterotomy, *EPBD* endoscopic papillary balloondilatation associated abnormalities of the biliary or pancreatic chemistries or duct dilatation [25]. It is indisputable that the complication rate of ERCP in patients with suspected SOD is very high, including pancreatitis in 10–30% of the cases, regardless of whether the ERCP is diagnostic, manometric, or therapeutic [26]. SOD following liver transplantation has been shown to occur at a higher frequency (3–7%) than post cholecystectomy [27]. In our study, there was no evidence of post-ERCP pancreatitis being caused by tacrolimus, and none of the cases fulfilled the Rome II diagnostic criteria for sphincter of Oddi dysfunction [28]. Also, based on a comparison of the patient background factors, we speculated that OLT cases were at a higher risk of post-ERCP pancreatitis than other cases.

Technical factors have also been recognized as important in the pathogenesis of post-ERCP pancreatitis. Papillary trauma, which often occurs when cannulation is technically difficult, has been identified as an independent risk factor for post-ERCP pancreatitis [29]. Recently, a prospective randomized controlled study indicated that balloon dilatation plus stenting may be associated with a higher complication rate than balloon dilatation alone [30]. In our case, post-ERCP pancreatitis occurred in two cases without stent placement and three cases in which a stent was placed in the bile duct. We did not identify stenting as a risk factor for post-ERCP pancreatitis in our study. According to our analysis, the total procedure time for ERCP was the only risk factor identified by the multivariate analysis. We speculated that a longer procedure time for ERCP might reflect technical difficulty encountered in the cannulation of the duct orifice, passage through the biliary stricture, balloon dilatation, and/or placement of the plastic stent and/or ENBD tube. At these moments during the procedure, very high pressure is exerted not only at the point of the bile duct stricture, but also on the papilla. Papillary trauma might occur not only at the time of cannulation of the orifice, but also during passage through the biliary stricture and bile duct stenting. These procedures might be more difficult in the OLT cases than in the patients with malignant strictures.

In the OLT cases, we did not perform EST or EPBD to avoid retrograde cholangitis and papillary trauma. There is no evidence EST or EPBD induced reflux cholangitis in patients with post-OLT biliary stricture. But EST is associated with a permanent loss of sphincter function, resulting in duodenocholedochal reflux and bacterial colonization of the biliary tree [31, 32]. Past reports have shown that bacteriobilia occurred about 60–80% of EST cases and 67–92% of EPBD cases [33, 34]. In post-OLT cases with biliary stricture, all patients took immunosuppressive drug, so acute cholangitis might be more likely in these cases. On the other hand, the frequency of post-ERCP pancreatitis has been reported to be higher following EPBD [35, 36]. And EST (including the pre-cut method) was also a significant risk factor for post-ERCP pancreatitis [17, 37]. We avoided these papillary traumatic procedures in order to reduce the risk of post-ERCP pancreatitis and cholangitis. We also placed a pancreatic stent in risky cases to avoid pancreatitis. Placement of pancreatic stent was not significant as a preventive procedure against post-ERCP pancreatitis in our study. According to many past studies, however, placement of pancreatic stent was significantly effective for preventing post-ERCP pancreatitis [38, 39]. In fact, in the four cases (80%) of OLT patients who developed post-ERCP pancreatitis, we could not place a pancreatic stent. We make an effort to place pancreatic stents more frequently in OLT cases than in malignant cases, as post-ERCP pancreatitis is more likely to occur in OLT cases.

The technique for duct–duct choledochocholedochostomy is very difficult. We used 5.0 absorbable thread and the end point of the suture was located outside of the duct. A 4 Fr. extranal transanastomotic drainage tube was fixed from the donor bile duct to the recipient bile duct for bile juice drainage. This is a standard technique for duct–duct choledochocholedochostomy in our hospital. Recently, however, inside the bile duct, we placed a 5–7 Fr. internal tube from the donor duct through the anastomosis to the recipient duct during intraoperative treatment. We planned to remove this tube after 3 or more months. This method might prevent severe biliary stricture in post-OLT cases.

We wish to emphasize that OLT cases with strictures are more likely to develop post-ERCP pancreatitis, depending on the patient characteristics and the endoscopic techniques. However, the success rates of percutaneous transhepatic radiologic interventions are lower than those of transpapillary endoscopic treatment in OLT cases with biliary strictures [12], and surgery for biliary complications should be avoided. Careful and speedy performance of endoscopic maneuvers for biliary stricture should be ensured in OLT cases.

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