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Risk Factors for Post-Endoscopic Retrograde Cholangiopancreatography Pancreatitis: Evidence from 1786 Cases

Authors' Contribution:
Study Design A
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Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
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Background: Postoperative pancreatitis is one of the most serious complications in endoscopic retrograde cholangiopancreatography (ERCP).
To detect potential risk factors for post-ERCP hyperamylasemia and pancreatitis.

Material/Methods: We reviewed 1786 ERCP procedures in Zhongnan Hospital of Wuhan University from January 2015 to April 2018. Clinical data were extracted, and the complications after ERCP procedures were re-evaluated. Single- and multiple-variable analyses were conducted to detect the potential risk factors.

Results: We found that 1786 procedures were applied on 1707 patients; 64 patients (3.58%) developed pancreatitis, while asymptomatic hyperamylasemia occurred in 263 cases (14.73%). In multivariate analysis, pancreatic deep wire pass (odds ratio [OR]: 2.280, 95% CI [confidence interval]: 1.129–4.605, *P*=0.022), endoscopic metal biliary endoprosthesis (OR: 2.399, 95% CI: 1.120–5.138, *P*=0.024), operation after liver transplantation (OR: 3.057, 95% CI: 1.110–8.422, *P*=0.031), and fistulotomy (OR: 3.148, 95% CI: 1.036–9.561, *P*=0.043) were identified as independent risk factors for post-ERCP pancreatitis. Pancreatic deep wire pass (OR: 1.678, 95% CI: 1.136–2.478, *P*=0.009), fistulotomy (OR: 2.553, 95% CI: 1.096–5.948, *P*=0.030), and younger age (OR: 0.990, 95% CI: 0.980–0.999, *P*=0.037) were identified as independent risk factors for hyperamylasemia.

Conclusions: To prevent post-ERCP pancreatitis, it is important to avoid high-risk procedures such as fistulotomy and pancreatic deep wire pass, especially in high-risk patients with liver transplantation. For patients with endoscopic metal biliary endoprosthesis, clinicians should pay more attention to the occurrence of post-ERCP pancreatitis.

MeSH Keywords: Cholangiopancreatography, Endoscopic Retrograde • Hyperamylasemia • Risk Factors

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Background

Endoscopic retrograde cholangiopancreatography (ERCP) has become an invaluable procedure in the treatment of a variety of pancreaticobiliary diseases since 1968 [1]. The incidence of adverse events reported after ERCP is between 5% and 10% [2]. Post-ERCP pancreatitis (PEP) is still one of the most serious complications, and the incidence in several studies was reported to be 1.3% to 15.1% [3–9]. A recent meta-analysis of 108 randomized controlled trials (RCT) involving 13 296 patients reported an overall incidence of 9.7% for PEP (95% CI: 8.6–10.7%), with an increased incidence of 14.7% (95% CI: 11.8–17.7%) in high-risk patients [10]. Precise recognition of risk factors for ERCP complication is critical to reducing adverse events after ERCP.

Many studies have identified numerous patient-related, procedure-related, and surgeon-related factors associated with post-ERCP pancreatitis [3,11,12]. Patient-related factors include previous post-ERCP pancreatitis, younger age, female sex, normal serum bilirubin levels, and history of acute recurrent pancreatitis [3,7,13–15]. Some procedure-related factors have been also identified, such as frequent pancreatic duct visualization, cannulation time >10 min, needle-knife precut, pancreatic sphincterotomy, pancreatic duct stent implantation, and ≥1 pancreatic deep wire pass [3,6,8,16].

The risk factors identified in different studies vary widely. These differences might be due to individual differences, different levels of endoscopists, and different diagnostic criteria of post-ERCP pancreatitis in each study. ERCP-related hyperamylasemia is relevant to damage to pancreatic parenchyma and is manifested as acute or asymptomatic pancreatitis. Hyperamylasemia without clinical symptoms after ERCP is more common than pancreatitis, occurring in 6.8–70% of operations [17–19]. Many previous studies have found that risk factors leading to either asymptomatic hyperamylasemia or acute pancreatitis are similar [17,18]. As asymptomatic hyperamylasemia and acute pancreatitis exhibit different prognoses and clinical symptoms, the risk factors that cause these 2 clinical conditions may be completely different. Determining the differences in these factors between the 2 clinical conditions may provide clues for further understanding of the mechanism of post-ERCP pancreatitis. The aim of the present study was to detect the risk factors for hyperamylasemia and post-ERCP pancreatitis.

Material and Methods

Study population

This was a retrospective analysis of 1786 ERCP operations performed from January 2015 to April 2018 at the Department of Gastroenterology, Zhongnan Hospital of Wuhan University. Patients with serum amylase greater than 3 times the normal upper limit before ERCP were excluded. Patients in whom the papilla of Vater was not reached were excluded. Patients who underwent stent removal without catheter cannulation were also excluded. For patients after liver transplantation, it was also necessary to have bile duct stricture and/or bile leakage, and the first ERCP treatment. When bile duct stones or casts were detected during ERCP, they were extracted at the same time. In all, 1786 ERCP procedures were included in this study. For this type of study, formal consent is not required.

Study protocol and data collection

Information on characteristics and outcomes of ERCP patients was retrospectively extracted from medical records, and the following data were included: sex, age, surgical intervention, blood tests, history of smoking, history of drinking, history of HBV, hypertension, history of diabetes, history of ERCP, previous pancreatitis, ERCP individual procedures, and post-ERCP complications. Detailed information on ERCP was collected, including ERCP indications and intubation techniques, sphincterotomy, and other procedures.

Definition

1. The definitions of ERCP complications were consistent with the report by Cotton [20]. Hyperamylasemia was thought to be an increase in serum amylase levels, which is 3 times higher than the normal upper limit at 24 h after ERCP. The diagnosis of post-ERCP pancreatitis was new or more severe abdominal pain after ERCP lasting more than 24 h and serum amylase level increased at least 3 times the normal upper limit at 24 h.
2. The needle-knife fistulotomy technique is usually defined as the use of a needle knife to perform a stepwise procedure by cutting upward or downward until the underlying biliary sphincter is visualized [21].
3. Anastomotic biliary stricture after liver transplantation was defined as a segmental narrowing around the biliary anastomosis by ERCP. Biliary leakage was basically defined as bile leak through the abdomen diagnosed by imaging modalities, including ultrasonography, computerized tomography, and ERCP.

Statistical analyses

The data were analyzed using SPSS 16.0 and tabulated with Microsoft Office software. We analyzed 55 potentially related factors using univariate analysis. Variables with a *P* value less than 0.05 were included in multivariate logistic regression analysis to verify important risk factors for hyperamylasemia or PEP. Odds ratio (OR) with 95% confidence interval

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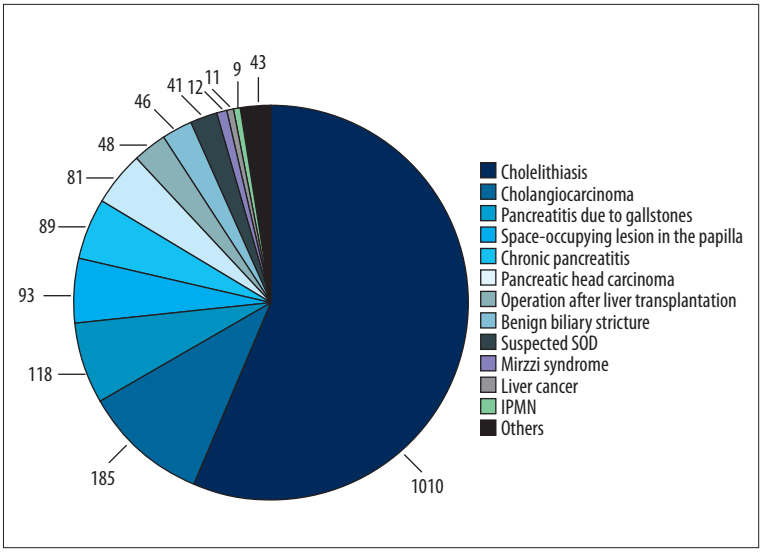

Figure 1. Indications for endoscopic retrograde cholangiopancreatography (ERCP).

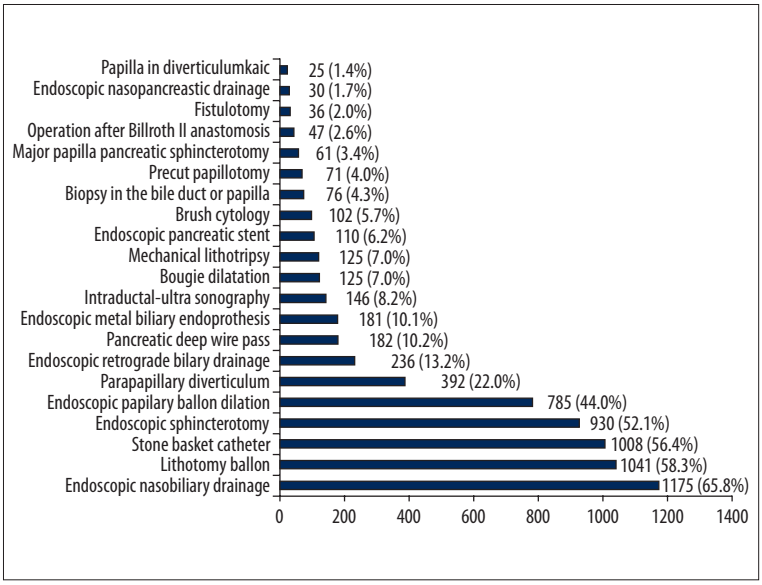

Figure 2. Endoscopic techniques or operations used in this study.

were calculated. The receiver operating characteristic (ROC) curve was plotted to show the cut-off values. The area under the ROC curve was evaluated. A *P* value of less than 0.05 was regarded as statistically significant.

Results

Patient characteristics

There were 1786 operations performed on 1707 patients. Indications for ERCP are shown in Figure 1. The operations used in ERCP are listed in Figure 2. The main indication was cholelithiasis (56.6%). The most common corresponding techniques were endoscopic nasobiliary drainage (65.8%), followed by bile duct stone removal with lithotomy balloon (58.3%). Based on the recorded ERCP, complications occurred in 80 (4.48%) patients. Post-ERCP complications included ERCP-induced pancreatitis (n=64, 3.58%), asymptomatic hyperamylasemia (n=263, 14.02%), hemorrhage (n=8, 0.45%), perforation (n=5, 0.28%), acute cerebral infarction (n=2, 0.11%), and cardia tearing (n=1, 0.06%) (Table 1). Hyperamylasemia after ERCP occurred in 327 (18.31%) patients, 64 with acute pancreatitis and 263 with asymptomatic pancreatitis (Table 1). Other complications are shown in Table 1. In this study we only analyzed risk factors for hyperamylasemia and pancreatitis, and other complications were not analyzed because the number was too small.

Univariate analysis

We evaluated 55 variables, including 14 patient factors, 18 operation-related factors and, 23 blood tests. Seven factors were

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Table 1. Overall complications of endoscopic retrograde cholangiopancreatography (ERCP).

Complications	Cases (%)
Hyperamylasemia	327 (18.31)
Asymptomatic hyperamylasemia	263 (14.02)
Post-ERCP pancreatitis	64 (3.58)
Hemorrhage	8 (0.45)
Perforation	5 (0.28)
Acute cerebral infarction	2 (0.11)
Cardia tearing	1 (0.06)

verified to be significantly relevant to post-ERCP pancreatitis by univariate analysis, among which 2 were patient-related factors and 5 were operation-related factors (Table 2). Important patient-related risk factors were operation after liver transplantation and pancreatitis history. Significant operation-related risk factors were endoscopic nasobiliary drainage, pancreatic deep wire pass, endoscopic metal biliary endoprosthesis, fistulotomy, and stone basket catheter.

Thirteen factors were significantly relevant to hyperamylasemia in univariate analysis, among which 8 were blood-related factors, 3 were patient-related factors, and 2 were operation-related factors (Table 2). Important risk factors associated with

Table 2. Univariate analysis of risk factors for post-ERCP pancreatitis and hyperamylasemia.

Variables	PEP			Hyperamylasemia		
	OR (95% CI)		*P* value	OR (95% CI)		*P* value
Basic characteristics						
Age	0.992	(0.976–1.008)	0.325	0.985	(0.976–0.993)	<0.001
Male sex	0.683	(0.414–1.127)	0.136	0.871	(0.685–1.108)	0.261
Smoking	0.826	(0.389–1.753)	0.618	1.001	(0.713–1.405)	0.996
Drinking	0.237	(0.033–1.727)	0.155	0.639	(0.393–1.038)	0.071
Hypertension	0.949	(0.527–1.710)	0.862	0.853	(0.640–1.136)	0.276
Diabetes	1.587	(0.770–3.270)	0.211	1.129	(0.759–1.678)	0.549
HBV	1.874	(0.873–4.019)	0.107	1.439	(0.943–2.195)	0.092
Liver cirrhosis	1.037	(0.318–3.377)	0.952	1.948	(1.190–3.189)	0.008
Pancreatitis history	3.310	(1.138–9.626)	0.028	1.846	(0.906–3.761)	0.091
Parapapillary diverticulum	0.903	(0.486–1.678)	0.748	0.859	(0.637–1.157)	0.317
Operation history						
Post- liver transplantation	3.309	(1.265–8.658)	0.015	2.526	(1.381–4.622)	0.003
Prior cholecystectomy	0.824	(0.463–1.465)	0.509	1.061	(0.815–1.380)	0.659
History of ERCP	0.595	(0.254–1.394)	0.232	1.068	(0.764–1.492)	0.701
Billroth II anastomosis	0.578	(0.078–4.261)	0.591	0.776	(0.344–1.748)	0.541
Endoscopic techniques or operation						
Endoscopic metal biliary endoprosthesis	2.607	(1.411–4.816)	0.002	1.303	(0.897–1.893)	0.165
Pancreatic deep wire pass	2.342	(1.248–4.395)	0.008	1.815	(1.278–2.576)	0.001
Endoscopic nasobiliary drainage	0.541	(0.328–0.892)	0.016	0.861	(0.671–1.105)	0.239
Fistulotomy	3.521	(1.207–10.273)	0.021	2.278	(1.127–4.603)	0.022
Stone basket catheter	0.551	(0.333–0.913)	0.021	0.962	(0.756–1.225)	0.753
Mechanical lithotripsy	0.205	(0.028–1.487)	0.117	1.315	(0.848–2.039)	0.221
Endoscopic sphincterotomy	0.806	(0.489–1.329)	0.398	1.123	(0.883–1.429)	0.344
Needle-knife precut	0.773	(0.185–3.225)	0.724	1.100	(0.605–1.999)	0.754

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Table 2 continued. Univariate analysis of risk factors for post-ERCP pancreatitis and hyperamylasemia.

Variables	PEP			Hyperamylasemia		
	OR (95% CI)		*P* value	OR (95% CI)		*P* value
Brush cytology	0.523	(0.126–2.170)	0.372	0.758	(0.432–1.329)	0.334
Intraductal-ultra sonography	0.742	(0.266–2.071)	0.568	0.732	(0.454–1.182)	0.202
Biopsy in the bile duct or papilla	0.718	(0.172–2.994)	0.650	0.917	(0.499–1.688)	0.782
Endoscopic papillary balloon dilation	1.059	(0.641–1.748)	0.823	1.020	(0.801–1.298)	0.875
Endoscopic retrograde biliary drainage	1.220	(0.612–2.429)	0.572	1.156	(0.821–1.628)	0.406
Endoscopic nasopancreatic drainage	0.960	(0.129–7.166)	0.968	1.716	(0.753–3.909)	0.199
Endoscopic pancreatic stent	0.482	(0.116–1.997)	0.314	1.398	(0.853–2.293)	0.184
Transpancreatic precut	1.411	(0.430–4.630)	0.570	1.764	(0.994–3.128)	0.052
Lithotomy balloon	0.805	(0.488–1.327)	0.395	1.038	(0.813–1.324)	0.766
Bougie dilatation	1.394	(0.589–3.296)	0.450	1.125	(0.713–1.774)	0.612
Blood examination before ERCP						
White blood cell count	0.929	(0.852–1.014)	0.098	0.957	(0.922–0.994)	0.021
Red blood cell count	1.068	(0.732–1.558)	0.734	1.232	(1.023–1.484)	0.028
Hemoglobin concentration	1.006	(0.993–1.019)	0.360	1.007	(1.000–1.013)	0.035
Platelet count	0.999	(0.996–1.002)	0.542	1.001	(0.999–1.002)	0.252
Alanine aminotransferase	1.000	(0.998–1.002)	0.838	1.000	(0.999–1.001)	0.670
Aspartate aminotransferase	1.000	(0.997–1.002)	0.677	1.000	(0.999–1.001)	0.670
Serum total bilirubin	1.000	(0.997–1.002)	0.939	0.999	(0.997–1.000)	0.065
Conjugated bilirubin	1.000	(0.996–1.004)	0.873	0.998	(0.996–1.000)	0.056
Unconjugated bilirubin	1.001	(0.995–1.006)	0.792	0.997	(0.994–1.001)	0.112
Serum albumin	1.014	(0.990–1.039)	0.248	1.029	(1.009–1.049)	0.004
γ-glutamyl transferase	0.999	(0.999–1.000)	0.201	1.000	(0.999–1.000)	0.040
Alkaline phosphatase	1.000	(0.999–1.001)	0.951	0.999	(0.999–1.000)	0.037
Prothrombin time	0.838	(0.696–1.008)	0.061	0.906	(0.834–0.985)	0.020
Activated partial thromboplastin time	1.003	(0.959–1.049)	0.901	0.987	(0.963–1.012)	0.317
Thrombin time	0.988	(0.895–1.090)	0.807	1.001	(0.990–1.012)	0.886
Fasting blood glucose	0.857	(0.718–1.023)	0.087	0.958	(0.889–1.021)	0.184
Blood urea nitrogen	0.966	(0.876–1.064)	0.480	0.994	(0.969–1.019)	0.630
Serum creatinine	0.995	(0.985–1.005)	0.341	0.996	(0.992–1.000)	0.082
Blood uric acid	1.001	(0.999–1.003)	0.278	1.001	(1.000–1.002)	0.075
Serum kalium	0.987	(0.836–1.167)	0.882	0.992	(0.937–1.050)	0.779
Serum natrium	1.055	(0.987–1.128)	0.112	1.052	(1.019–1.087)	0.002
Serum chlorine	1.049	(0.987–1.115)	0.126	1.027	(0.997–1.057)	0.079
Serum calcium	0.998	(0.975–1.023)	0.898	0.998	(0.988–1.009)	0.764

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Table 3. Multivariate analysis of independent risk factors for post-ERCP pancreatitis and hyperamylasemia.

Variable	PEP		Hyperamylasemia	
	P value	OR (95% CI)	P value	OR (95% CI)
EMBE	0.024	2.399 (1.120–5.138)	–	–
Liver transplantation	0.031	3.057 (1.110–8.422)	0.142	1.969 (0.798–4.860)
Fistulotomy	0.043	3.148 (1.036–9.561)	0.030	2.553 (1.096–5.948)
Pancreatic deep wire pass	0.022	2.280 (1.129–4.605)	0.009	1.678 (1.136–2.478)
Age	–	–	0.037	0.990 (0.980–0.999)

OR – odds ratio; CI – confidence interval; EMBE – endoscopic metal biliary endoprosthesis.

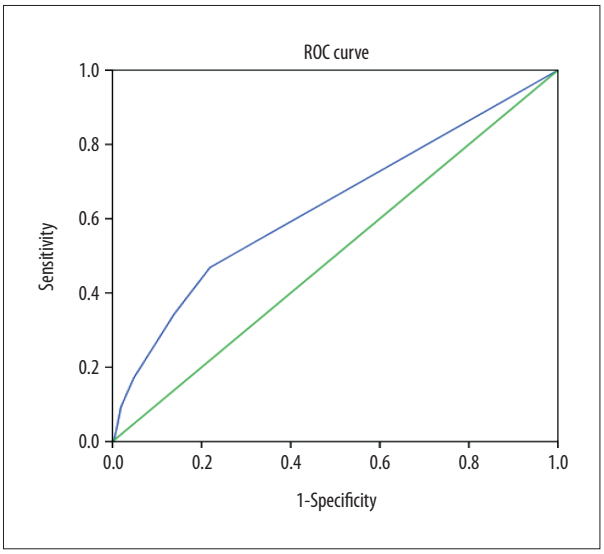

Figure 3. Receiver operating characteristic (ROC) curve analysis.

patients included liver cirrhosis history, younger age, and operation after liver transplantation. Significant operation-related risk factors included fistulotomy and pancreatic deep wire pass. Significant blood-related risk factors included white blood cell count, red blood cell count, hemoglobin concentration, γ-glutamyl transferase, serum albumin, alkaline phosphatase, serum natrium, and prothrombin time.

Multivariate analysis

Those factors with a *P* value of less than 0.05 were included in the multivariate logistic regression analysis. Table 3 shows the logistic regression results for 7 important risk factors. Four risk factors were determined to be relevant to PEP, including operation after liver transplantation (5 of 48 patients with liver transplantation complicated with pancreatitis after ERCP), endoscopic metal biliary endoprosthesis, fistulotomy, and pancreatic deep wire pass.

Three factors were evaluated as being associated with hyperamylasemia: age, fistulotomy, and pancreatic deep wire pass. The multivariate logistic regression analysis for post-ERCP pancreatitis compared with hyperamylasemia suggested that fistulotomy was the same risk factor for the 2 complications.

Multi-factor joint diagnosis of ROC curve

Four risk factors were considered to be relevant to post-ERCP pancreatitis: operation after liver transplantation, endoscopic metal biliary endoprosthesis, fistulotomy, and pancreatic deep wire pass. We combined the post-ERCP of 4 risk factors to draw the ROC curve. As show in Figure 3, the AUC was 0.634 with a 95% CI of 0.557-0.711 ($P<0.001$) for joint factor.

Discussion

ERCP is the preferred procedure for treating biliary tract and pancreatic diseases. Despite development of the technology and equipment of ERCP in recent years, the incidence of PEP has not decreased significantly. PEP was the most serious and common complication in ERCP. How to determine risk factors for PEP is an urgent clinical issue because it is essential for identifying patients at high risk and subsequently choosing other suitable treatments. In different prospective studies, there were some differences in risk factors for pancreatitis after ERCP. We initially understood the risk factors for PEP based on many multicenter studies [3–8]. Our results suggest that endoscopic metal biliary endoprosthesis, pancreatic deep wire pass operation after liver transplantation, and fistulotomy are important risk factors for pancreatitis after ERCP.

A multicenter study has shown that pancreatic deep wire pass is an important risk factor for asymptomatic hyperamylasemia and pancreatitis [16]. Consistent with previous studies, our findings suggest that pancreatitis after ERCP and hyperamylasemia are closely related to pancreatic deep wire pass. The guide wire can be used to deeply intubate the desired duct.

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Repeated pancreatic deep wire passes leads to injury of the pancreatic tissue and increases the incidence of asymptomatic hyperamylasemia and post-ERCP pancreatitis. However, the causes in some patients with asymptomatic hyperamylasemia and other patients with pancreatitis remain unclear. There are 2 possible mechanisms: one may be due to the severity of pancreatic injury, and the other due to the difference in the extent of inflammatory response to pancreatic injury [22]. Pancreatitis after ERCP may be related to more severe pancreatic damage and pancreatic inflammation. Hyperamylasemia without clinical symptoms may be only relevant to mild pancreatic injury and may have no inflammatory response in the pancreas.

Among pathogenic factors of PEP, cannulation trauma to the papilla was the most common cause of sphincter of Oddi spasm and/or edema of the papilla. It can create an obstacle to the flow of pancreatic juice, and subsequently determined to be an acute pancreatic inflammation. The retention of pancreatic juice can lead to an increase of blood amylase. A longer retention time is associated with a higher risk of pancreatitis. Both the time and the amount of pancreatic juice were important factors. We speculate that patients with large amounts of pancreatic juice and long-term shed outflow have an increased risk of pancreatitis. Of course, this speculation needs further research to confirm.

Endoscopic metal biliary endoprosthesis is considered as an effective therapy for biliary strictures [23]. Use of a metal biliary endoprosthesis is important to keep luminal patency of the obstructed bile duct, but the rate of PEP with metal biliary endoprosthesis was significantly higher, and post-ERCP pancreatitis occurred in 7.3%. However, the frequency of post-ERCP pancreatitis was similar between covered (6.9%) and uncovered (7.5%) metal biliary stents [7,24]. Consistent with prior studies, our study found the frequency of post-ERCP pancreatitis with metal biliary endoprosthesis was 7.7% (14 of 181 patients). A possible explanation for this finding is axial force. Axial force is a relatively new concept proposed by Isayama et al., which is understood as the recovery or straightening force when the metal biliary stent is bending [25,26]. Compression of the orifice of the pancreatic duct due to axial force is a possible cause of pancreatitis. There were some reports on the prevention of pancreatitis after endoscopic metal biliary endoprosthesis. Most studies showed no benefit of endoscopic sphincterotomy in reducing the incidence of pancreatitis [24,27]. Other reports showed that non-pancreas cancer cases and metal biliary stents with high axial force were strong predictive factors of pancreatitis after endoscopic metal biliary endoprosthesis [26,28]. Even in pancreas cancer cases, sphincterotomy did not effectively prevent pancreatitis after covered metal biliary stents in a randomized controlled study [27].

Complications in the biliary tract occur in 5–30% of patients after liver transplantation [29]. Biliary complications of liver transplantation can be managed by either therapeutic ERCP, percutaneous transhepatic biliary drainage, or surgery. Endoscopic therapy is the preferred approach for disease management. Most of the complications are successfully managed with ERCP. The incidence and risk factors for post-ERCP complications after liver transplantation are not well-described. According to a Danish study, post-ERCP complications occurred in 8.2% of patients, with pancreatitis in 2.7%, bleeding in 1.7%, and cholangitis in 4.5% [30]. Our study found the incidence of post-ERCP pancreatitis after liver transplantation was 10.4% (5 of 48 liver transplantation patients). There may be 2 underlying mechanisms of post-ERCP pancreatitis after liver transplantation: one may be due to the biliary stricture reconstruction induced by the difficult cannulation, and the other may be endoscopic metal biliary endoprosthesis after liver transplantation.

Needle-knife precut papillotomy can improve the success rate of cannulation. The incidence of higher rates of pancreatitis after precut sphincterotomy is controversial due to the precutting itself or the repeated cannulation attempts [31]. A randomized controlled trial comparing precutting papillotomy and continuous cannulation showed similar incidence of pancreatitis [32], but a meta-analysis indicated that precut sphincterotomy was a highly significant risk factor for pancreatitis after ERCP [33]. We evaluated several specific precut techniques: fistulotomy, transpancreatic precut, and needle-knife precut. Our study showed that only fistulotomy was an important risk factor for hyperamylasemia and pancreatitis (OR: 2.565 and 4.007, respectively). The risks associated with fistulotomy may be more relevant to techniques that involve pancreatic deep wire pass and repeated cannulation attempts. ESGE recommends needle-knife fistulotomy as the preferred technique for precutting [21], but it has been reported that fistulotomy is a risk factor for pancreatitis after ERCP [34]. The incidence of pancreatitis after ERCP in patients who used fistulotomy in Tae Hoon Lee's study was 2.5% (3/120) [35]. Other literature reports that fistulotomy needs to be implemented early or performed by an experienced endoscopist to prevent postoperative pancreatitis. A skillful endoscopist may expect to master fistulotomy easily, with few adverse events. Lopes et al. propose a minimum of 20 fistulotomy precuts to establish a trainee's competence in this procedure [36]. The reasons why our data are contrary to previous evidence may include the following aspects: our sample size may be too small, and our endoscopists may not have fully mastered fistulotomy because we only performed 36 fistulotomy precuts in 3 years. Our results still need to be verified by randomized controlled trials.

Some studies have reported that younger patients are more prone to postoperative pancreatitis [6,8,9]. An earlier study

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found that decreased pancreatic exocrine function in elderly patients may protect them from pancreatic damage [37]. Our results showed that younger age was a significant risk factor for hyperamylasemia but not for post-ERCP pancreatitis, but another single-center study found that younger age (<50 y) was a risk factor for hyperamylasemia and post-ERCP pancreatitis [17]. The difference between pancreatitis and hyperamylasemia needs to be confirmed by large-scale prospective multicenter trials.

From our study, we conclude that operation after liver transplantation, endoscopic metal biliary endoprosthesis, fistulotomy, and pancreatic deep wire pass are risk factors for post-ERCP pancreatitis. Our results suggest that pancreatic deep wire pass is independently related to hyperamylasemia and post-ERCP pancreatitis. Patients with liver transplantation or endoscopic metal biliary endoprosthesis are more prone to pancreatitis but not asymptomatic hyperamylasemia.

There were some limitations to the current study. First, the study was carried out at a single center. Moreover, this study was a retrospective analysis that might have underestimated the occurrence of complications. Furthermore, some known risk factors for PEP were not included, such as the duration of the operation and the number of cannulations tried. Some clinical characteristics were not documented and detailed.

Conclusions

In conclusion, to prevent post-ERCP pancreatitis, it is important to avoid high-risk operations such as fistulotomy and pancreatic deep wire pass, especially for liver transplantation patients. For patients with endoscopic metal biliary endoprosthesis, clinicians should pay more attention to the occurrence of post-ERCP pancreatitis.

Conflict of interest

None.

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