

# Efficacy and safety of ERCP in patients with gastroesophageal varices

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## Abstract

Addressing pancreaticobiliary disorders concomitant with gastroesophageal varices remains challenging. The goal of this study was to evaluate and compare the efficacy and safety of endoscopic retrograde cholangiopancreatography (ERCP) in cirrhotic and noncirrhotic patients with gastroesophageal varices.

We retrospectively analyzed the data of consecutive patients with gastroesophageal varices who underwent ERCP.

Two hundred seventy ERCP procedures were performed on 208 patients. The overall technical success rate was 98.5%, and no difference was found between cirrhotic and noncirrhotic patients (98.7% vs 97.7%,  $P = .511$ ); of these, endoscopic retrograde biliary drainage, endoscopic metal biliary endoprosthesis placement, endoscopic retrograde pancreatic drainage, and stone extraction were conducted in 173/270 (64.1%), 27/270 (10.0%), 26/270 (9.6%), and 116/270 (43.0%) cases, respectively. Endoscopic retrograde biliary drainage and stone extraction were more frequently performed in cirrhotic cases (67.7% versus 45.5%,  $P = .005$ ; 46.5% versus 25.0%,  $P = .009$ , respectively), while the noncirrhotic group had significantly higher rates of endoscopic metal biliary endoprosthesis placement (31.8% versus 5.8%,  $P = .000$ ) and endoscopic retrograde pancreatic drainage (18.2% versus 8.0%,  $P = .036$ ) than the cirrhotic group. The overall rate of adverse events was 21.1%, including fever (6.7%), post-ERCP pancreatitis (3.0%), hyperamylasemia (6.3%), duodenal papilla bleeding (3.3%), cardiac mucosal laceration (1.1%), and perforation (0.4%). No differences in any of the adverse events were found between the 2 groups. Additionally, gastroesophageal variceal bleeding occurred in 1 patient with grade III varices 7 days after ERCP.

ERCP may be effective and safe for patients with gastroesophageal varices, irrespective of the etiologies caused by liver cirrhosis.

**Abbreviations:** EMBE = endoscopic metal biliary endoprosthesis, ERCP = endoscopic retrograde cholangiopancreatography, ERBD = endoscopic retrograde biliary drainage, ERPD = endoscopic retrograde pancreatic drainage, EV = esophageal varices, INR = international normalized ratio, MELD = model for end-stage liver disease, PEP = post-ERCP pancreatitis.

**Keywords:** adverse event, cirrhosis, endoscopic retrograde cholangiopancreatography, gastroesophageal varices, pancreatic portal hypertension

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## 1. Introduction

Gastroesophageal varices due to portal hypertension are predominately caused by decompensated cirrhosis and pancreatic diseases.<sup>[1–4]</sup> Variceal bleeding occurs in approximately 15% to 50% of patients with chronic pancreatitis.<sup>[3,5]</sup> In addition, the 5-year mortality of variceal hemorrhage varies from 20% (isolated complication) to more than 80% (combined with other complications) in cirrhotic patients.<sup>[6]</sup> These results demonstrate that variceal hemorrhage may be lethal for these patients.<sup>[4]</sup>

Pancreaticobiliary disorders concomitant with gastroesophageal varices are not uncommon and remain a great challenge for clinicians. Universal procedures for cholelithiasis, such as cholecystectomy, choledochotomy, choledochojunostomy, and hepatic resection, are risk factors for poor prognosis in patients with cirrhosis undergoing surgical operation. Furthermore, surgery is completely contraindicated for patients with severe hepatitis, Child-Pugh class C cirrhosis, poor coagulation (prolongation of the prothrombin time of more than 3 seconds) and low platelet counts (less than 50/ $\mu$ L).<sup>[7]</sup>

ERCP is putatively effective for managing pancreaticobiliary disorders.<sup>[8,9]</sup> Adverse events of ERCP, such as PEP, cholecystitis, cholangitis, bleeding, perforation, and cardiopulmonary issues, do not frequently occur.<sup>[10]</sup> Theoretically, the risk of post-ERCP

bleeding is potentially increased for patients with gastroesophageal varices, predominately due to direct mechanical damage and abnormal coagulation and platelet counts. Indeed, compared to the general population, both compensated and decompensated cirrhotic patients undergoing therapeutic ERCP and biliary sphincterotomy show a significant increase in postprocedural bleeding.<sup>[11]</sup> However, a recent study reveals that therapeutic ERCP has been verified as an effective and safe procedure for patients with cirrhosis, and the prevalence of adverse events is comparable to that in the general population.<sup>[12]</sup> Further study is needed to verify these inconsistent results.

In a few cases, gastroesophageal varices occurred in patients with sinistral portal hypertension mainly due to pancreatic diseases.<sup>[3,13,14]</sup> Coagulation and platelet counts in these patients remain normal and are comparable to those in the general population. However, the efficacy and safety of ERCP in these patients have not been evaluated and compared to cirrhotic patients. Therefore, the present study aimed to address these issues.

## 2. Methods

### 2.1. Study design and patients

We performed a retrospective study of all patients with gastroesophageal varices who underwent ERCP due to pancreaticobiliary disorders from January 2010 to January 2018 at the First Affiliated Hospital of Nanchang University. The medical records, endoscopy results, laboratory results, and radiological studies were reviewed for all patients included in the study. The exclusion criteria included

1. contraindications to ERCP;
2. ERCP failure due to gastrointestinal stricture;
3. hepatic encephalopathy;
4. altered anatomy (Roux-en-Y gastric bypass and choledochojejunostomy);
5. age under 18 years; and
6. pregnancy.

### 2.2. Perioperative preparation

The results of coagulation tests, biochemical function (liver and renal function, serum myocardial enzymogram, electrolytes, and amylase), blood gas analysis, routine blood tests, blood ammonia, echocardiography, and electrocardiograms were obtained. Patients were given fresh frozen plasma and/or vitamin K1 upon extension of more than 3 seconds of the upper limit of the prolongation of the prothrombin time and/or the international normalized ratio >1.5. In addition, platelets were infused into thrombocytopenic patients when the platelet count was less than 50,000/ $\mu$ L. Antibiotics were administered to patients with infections (biliary infection, spontaneous peritonitis, hematoses, etc). Scleroligation was applied to the patients when it was necessary.<sup>[15]</sup> Indications and contraindications for ERCP were evaluated by endoscopists and anesthesiologists before the procedure.

### 2.3. Evaluation of gastroesophageal varices

Gastroesophageal varices were diagnosed via esophagogastrointestinal endoscopy under anesthesia before ERCP, and

esophageal varices (EVs) were classified as grade I, II, or III.<sup>[4,16]</sup> Gastroesophageal varices were treated with nonselective beta-blockers and/or endoscopic therapies when necessary.<sup>[4]</sup>

### 2.4. Evaluation of Child-Pugh and model for end-stage liver disease (MELD) scores

A MELD score of 12 was considered a cutoff value for predicting adverse events.<sup>[17,18]</sup> Child-Pugh classifications were defined as class A (5–6 scores), class B (7–9 scores), and class C (10–15 scores).<sup>[16]</sup>

### 2.5. ERCP procedure

Routine esophagogastrointestinal endoscopy was performed under anesthesia before ERCP to determine the presence and grading of gastroesophageal varices. A cap-assisted forward-viewing endoscope was used for patients with surgically altered gastrointestinal anatomy (Billroth-II reconstruction). Wire-guided cannulation with a sphincterotome was conducted in all patients; therapeutic procedures (sphincterotomy, balloon dilation, stent implantation, bougienage, stone extraction, etc) were performed when appropriate, and a precut sphincterotomy or the double-wire technique was utilized as an alternative when cannulation failed.<sup>[19]</sup>

### 2.6. Outcome evaluation

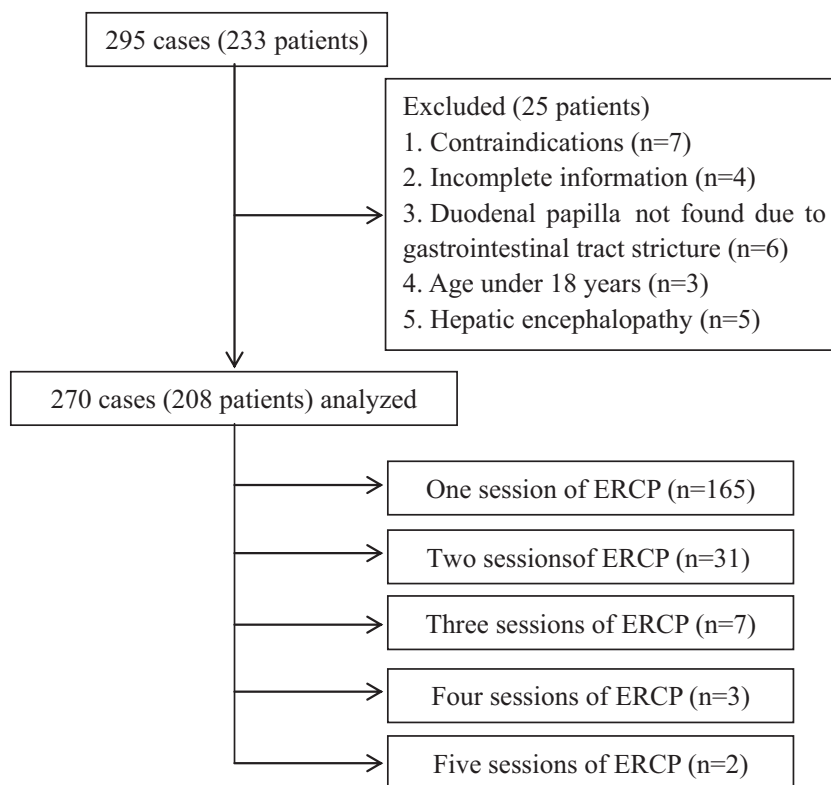
The primary outcome was technical success, defined as the accomplishment of ERCP with successful placement of a biliary stent (ERBD or EMBE, ERPD and/or stone extraction).<sup>[20]</sup> The secondary outcome was the prevalence of adverse events, including PEP, fever (biliary infection, lung infection, hematoses, etc), hyperamylasemia, hemorrhage, perforation,<sup>[10]</sup> cardiac mucosal laceration, and variceal hemorrhage. Patients were contacted at 30 days to evaluate late adverse events (including gastroesophageal variceal hemorrhage, delayed duodenal papilla hemorrhage, or acute pancreatitis), which was also the final follow-up.

### 2.7. Definition of PEP and hyperamylasemia

PEP and its severity were defined according to a universal consensus.<sup>[21]</sup> Hyperamylasemia has been defined as an elevation in serum amylase levels more than 2-fold higher than the upper normal limit at 6 or 24 hour after the ERCP.<sup>[22]</sup>

### 2.8. Statistical analysis

All statistical analyses were performed by the Statistical Package for Social Science software suite (version 17.0; SPSS, Inc., Chicago, IL). The  $\chi^2$ -test or Fisher exact test (for categorical data) and *t* test (for numerical data) were used to estimate the significance of differences, which were described by the odds ratio and 95% confidence interval (CI). All tests were 2-sided, and a *P* value of less than .05 was considered statistically significant. In particular, Bonferroni correction was applied to express the 2-sided significance at *P* < .008 (0.05/6) for the effect of Child-Pugh scores on side effects.



**Figure 1.** Flow chart of this study. ERCP = endoscopic retrograde cholangiopancreatography.

### 2.9. Ethical considerations

This clinical trial was approved by the Ethics Committee of the First Affiliated Hospital of Nanchang University, and informed consent was obtained from all patients prior to enrollment.

## 3. Results

### 3.1. Patient screening

A total of 295 cases (233 patients) were screened. Of these patients, 25 were excluded. Ultimately, 270 cases (208 patients) were included in the study, and 165, 31, 7, 3, and 2 patients underwent 1, 2, 3, 4 and 5 ERCP procedures, respectively (Fig. 1).

### 3.2. Clinical characteristics of the 270 cases

No differences in demographic variables (age and sex) were observed between the cirrhotic and noncirrhotic groups. The overall incidence rate of a platelet count  $<50/\mu\text{L}$  was 17.8%, which was significantly higher in the cirrhotic group than in the noncirrhotic group (20.8% versus 2.3%, respectively,  $P=.002$ ) (Table 1).

The prevalence rates of EVs, isolated gastric varices and concomitant gastric varices and EVs were 73.0%, 15.2%, and 11.8%, respectively. Of these, EVs and isolated gastric varices more frequently occurred in cirrhotic and noncirrhotic patients, respectively. However, no difference was detected in the grades of EVs between the 2 groups. The indications included common bile duct stones (64.4%), malignant biliary stricture (25.6%), benign or undetermined biliary stricture (14.8%), benign pancreatic

diseases (8.1%), and others (0.7%). Of these, the rate of common bile duct stones was significantly higher in the cirrhotic group, while the noncirrhotic group had a significantly higher rate of biliary stricture and benign pancreatic diseases (Table 1).

### 3.3. Etiology and Child-Pugh and MELD scores of the 226 cirrhotic cases

The etiology of cirrhosis included hepatitis B (36.7%), secondary biliary cirrhosis (33.6%), schistosomiasis (9.3%), primary biliary cirrhosis (1.8%), alcohol (1.3%), hepatitis C (0.9%), mixed etiologies (4.9%), and cryptogenic cirrhosis (11.5%) (Table 2). Child-Pugh classes A, B, and C accounted for 45 (19.9%), 78 (34.5%), and 103 (45.6%) cases, respectively. Sixty-seven cases (29.6%) had MELD scores  $<12$ , and 159 cases (70.4%) had MELD scores  $\geq 12$  (Table 2).

### 3.4. Etiology of the 44 noncirrhotic cases

The etiologies of the noncirrhotic cases included malignant pancreatic diseases (31.8%), benign pancreatic disease (20.5%), hilar cholangiocarcinoma (9.1%), duodenal cancer (4.5%), gastric cancer (4.5%), gastric stromal tumor (4.5%), colorectal carcinoma (2.3%), biliary leakage (2.3%), and others (20.5%) (data not shown).

### 3.5. ERCP procedures in the 270 cases

The common bile duct and pancreatic duct were targeted in 262 and 8 cases, respectively, and the rates of targeting of the

**Table 1**  
**Clinical characteristics of the 270 cases (n, %).**

Parameters	n = 270	Cirrhosis n = 226	Non-cirrhosis n = 44	F/ $\chi^2$	OR (95% CI)	P
Gender						
Male	185 (68.5)	151 (66.8)	34 (77.3)	1.868	0.592 (0.278–1.263)	.172
Female	85 (31.5)	75 (33.2)	10 (22.7)			
Age (yr)	58.4 ± 12.5	58.2 ± 12.6	59.4 ± 12.1	0.088		.767
Platelet count <50/ $\mu$ L	48 (17.8)	47 (20.8)	1 (2.3)	8.645	11.291 (1.515–84.137)	.002
Gastroesophageal varices						
EV	197 (73.0)	176 (77.9)	21 (47.7)	16.970	3.855 (1.973–7.532)	.000
Mild	74 (37.6)	65 (36.9)	9 (42.8)	0.281	0.781 (0.312–1.953)	.596
Moderate	101 (51.2)	90 (51.1)	11 (52.4)	0.012	0.951 (0.385–2.354)	.914
Severe	22 (11.2)	21 (11.9)	1 (4.8)	0.972	2.710 (0.346–21.248)	.478
IGV	41 (15.2)	22 (9.7)	19 (43.2)	31.991	0.142 (0.068–0.298)	.000
Concomitant gastric and esophageal varices	32 (11.8)	28 (12.4)	4 (9.1)	0.384	1.414 (0.470–4.254)	.798
Indications						
Common bile duct stone	174 (64.4)	163 (72.1)	11 (25.0)	35.693	7.762 (3.697–16.297)	.000
Biliary stricture	109 (40.4)	80 (35.4)	29 (65.9)	14.242	0.283 (0.144–0.560)	.000
Malignant	69 (25.6)	44 (19.5)	25 (56.8)	27.005	0.184 (0.093–0.363)	.000
Benign or undetermined	40 (14.8)	36 (15.9)	4 (9.1)	1.365	1.895 (0.638–5.623)	.353
Benign pancreatic diseases	22 (8.1)	12 (5.3)	10 (22.7)	14.929	0.191 (0.076–0.475)	.001
Others	2 (0.7)	2 (0.9)	0	0.392	0.991 (0.979–1.003)	1.000
Periampullary diverticula	35 (13.0)	32 (14.2)	3 (6.8)	1.759	2.254 (0.659–7.716)	.227
Billroth II	3 (1.1)	2 (0.9)	1 (2.3)	0.646	0.384 (0.034–4.329)	.415

EV = esophageal varices, IGV = isolated gastric varices.

common bile duct and pancreatic duct were significantly higher in the cirrhotic group than in the noncirrhotic group. Cannulation and endoscopic papillary balloon dilatation (EPBD) were successfully performed in 267 (98.9%) and 31 (11.5%) cases, respectively, and no difference was found between the 2 groups. Endoscopic sphincterotomy (EST) and bougienage of the bile duct stricture were conducted in 93 (34.4%) and 25 (9.3%) cases, respectively, both of which were more frequently adopted in noncirrhotic cases (54.5% versus 30.5%,  $P=.002$ ; and 22.7% versus 6.6%,  $P=.001$ , respectively) (Table 3).

ERCP was successfully performed in 266 cases with an overall technical success rate of 98.5%; no difference was found between cirrhotic and noncirrhotic patients, 98.7% vs 97.7%,  $P=.511$ .

**Table 2**  
**Etiology and Child-Pugh and model for end-stage liver disease scores of the 226 cirrhotic cases (n, %).**

Parameters	n = 226
Cirrhosis etiology	
Hepatitis B	83 (36.7)
Hepatitis C	2 (0.9)
Secondary biliary cirrhosis	76 (33.6)
Schistosomiasis	21 (9.3)
Primary biliary cirrhosis	4 (1.8)
Alcoholic	3 (1.3)
Mixed	11 (4.9)
Cryptogenic cirrhosis	26 (11.5)
Child-Pugh scores	
A	45 (19.9)
B	78 (34.5)
C	103 (45.6)
MELD scores	
<12	67 (29.6)
≥12	159 (70.4)

MELD = model for end-stage liver disease.

Specifically, ERBD, EMBE placement, ERPD, and stone extraction were conducted in 173/174 (99.4%), 27/27 (100%), 26/26 (100%), and 116/174 (66.7%) attempted cases (data not shown) and 173/270 (64.1%), 27/270 (10.0%), 26/270 (9.6%), and 116/270 (43.0%) overall cases, respectively. Of these, the rate of ERBD and stone extraction was significantly higher in cirrhotic cases than in noncirrhotic cases (67.7% versus 45.5%,  $P=.005$ ; 46.5% versus 25.0%,  $P=.009$ , respectively), while the non-cirrhotic group had a significantly higher rate of EMBE placement (31.8% versus 5.8%,  $P=.000$ ) and ERPD (18.2% versus 8.0%,  $P=.036$ ) than the cirrhotic group (Table 3).

### 3.6. Adverse events of the procedure

The overall rate of adverse events was 21.1%. Fever, PEP, hyperamylasemia, duodenal papilla bleeding, cardiac mucosal laceration and perforation occurred in 18 (6.7%), 8 (3.0%), 17 (6.3%), 9 (3.3%), 3 (1.1%), and 1 (0.4%) cases, respectively. No difference in any of the adverse events was observed between the 2 groups. The majority of adverse events were mild and alleviated by conventional therapies. Only 1 patient with grade III varices exhibited gastroesophageal variceal bleeding 7 days after ERCP and was successfully managed by somatostatin, esomeprazole, and endoscopic variceal ligation (Table 4).

### 3.7. Correlations of Child-Pugh scores and MELD scores with complications in cirrhotic patients

Fever occurred in 11.1%, 3.8%, and 5.3% of cases classified as Child-Pugh classes A, B, and C, respectively, and in 9.0% and 5.0% of cases with MELD scores <12 and ≥12, respectively. In addition, the rates of PEP were 4.4%, 3.8%, and 0.9% in Child-Pugh classes A, B, and C cases, respectively, and 4.4% and 1.9% in cases with MELD scores <12 and ≥12, respectively. The rates of duodenal papilla bleeding were 8.9%, 2.6%, and 2.7% in

**Table 3**  
Endoscopic retrograde cholangiopancreatography procedure (n, %).

Parameters	n=270	Cirrhosis n=226	Non-cirrhosis n=44	F/ $\chi^2$	OR (95% CI)	P
Targeted duct						
Common bile duct	262 (97.0)	224 (99.1)	38 (86.4)	20.828	17.684 (3.441–90.877)	.000
Pancreatic duct	8 (3.0)	2 (0.9)	6 (13.6)			
Success rate of cannulation	267 (98.9)	224 (99.1)	43 (97.7)	0.646	2.605 (0.231–29.366)	.415
EST	93 (34.4)	69 (30.5)	24 (54.5)	9.406	0.366 (0.190–0.707)	.002
EPBD	31 (11.5)	27 (11.9)	4 (9.1)	0.296	1.357 (0.450–4.091)	.797
Bougienage of the bile duct stricture	25 (9.3)	15 (6.6)	10 (22.7)	11.348	0.242 (0.100–0.582)	.001
Technical success rate <sup>a</sup>	266 (98.5)	223 (98.7)	43 (97.7)	0.225	1.729 (0.176–17.013)	.511
ERBD	173 (64.1)	153 (67.7)	20 (45.5)	7.917	2.515 (1.306–4.845)	.005
EMBE	27 (10.0)	13 (5.8)	14 (31.8)	27.804	0.131 (0.056–0.305)	.000
ERPD	26 (9.6)	18 (8.0)	8 (18.2)	4.418	0.389 (0.158–0.962)	.036
Stone extraction	116 (43.0)	105 (46.5)	11 (25.0)	6.922	2.603 (1.254–5.406)	.009

<sup>a</sup> 3 and 1 patients experienced failed cannulation and ERBD, respectively. EST = endoscopic sphincterotomy, EPBD = endoscopic papillary balloon dilatation, ERBD = endoscopic retrograde biliary drainage, EMBE = endoscopic metal biliary endoprosthesis placement, ERPD = endoscopic retrograde pancreatic drainage.

Child-Pugh classes A, B and C cases, respectively, and 4.5% and 3.8% in patients with MELD scores <12 and ≥12, respectively. The overall prevalence of complications was higher in patients with Child-Pugh class A and MELD scores <12, but the difference was not significant (Table 5).

**4. Discussion**

The present study demonstrated that the technical success rate of ERCP was 98.5%; no difference was found between cirrhotic and noncirrhotic patients, 98.7% vs 97.7%. ERBD, EMBE, ERPD, and stone extraction were conducted in 173/270 (64.1%), 27/270 (10.0%), 26/270 (9.6%), and 116/270 (43.0%) of the overall cases, respectively. Adverse events occurred in 21.1% of the overall cases, including fever (6.7%), PEP (3.0%), hyperamylasemia (6.3%), duodenal papilla bleeding (3.3%), cardiac mucosal laceration (1.1%), and perforation (0.4%), most of which were mild and transient, and the rate of adverse events was comparable between the 2 groups. Thus, ERCP is effective and safe for patients with gastroesophageal varices.

ERCP has been widely used to address diseases of the biliary tract and the pancreas relying on its superior efficacy and safety.<sup>[9,23–26]</sup> In addition, ERCP has been confirmed to be an effective manipulation in a large series of patients with

cirrhosis.<sup>[12,27]</sup> However, its efficacy in decompensated cirrhotic patients with gastroesophageal varices has not been well verified. Our study showed that the technical success rate was 98.7%. Furthermore, we also determined the high efficacy (97.7%) of ERCP in noncirrhotic cases with gastroesophageal varices, which was comparable to that in cirrhotic cases.

EST has been verified as a standard procedure for bile duct stones and for various endoscopic diagnoses and other therapies of the bile duct. However, coagulopathies, which often exist in liver cirrhosis, may be a contraindication for EST.<sup>[28]</sup> In addition, the risk of bleeding increases after EST in both compensated and decompensated cirrhosis.<sup>[11]</sup> Furthermore, EST has been certified as an independent risk factor for bleeding in cirrhotic patients.<sup>[29]</sup> For these reasons, EST was less frequently performed in cirrhotic cases than in noncirrhotic cases in this study.

EPBD is widely performed during ERCP as an option for bile duct stone extraction, especially when patients tend to bleed.<sup>[30]</sup> A previous study has demonstrated that EPBD is successfully performed in 42 (7.8%) cirrhotic patients for biliary drainage, stone removal, or stent placement.<sup>[12]</sup> Indeed, EPBD has been certified as a preferred procedure for cirrhotic patients to decrease the risk of post-ERCP hemorrhage, especially for those who have renal dysfunction or are receiving antiplatelet or anticoagulant therapy.<sup>[29]</sup> EPBD was conducted in 31 (11.5%) cases in the

**Table 4**  
Adverse events (n, %).

Adverse events	n=270	Cirrhosis n=226	Non-cirrhosis n=44	F/ $\chi^2$	OR (95% CI)	P
Fever	18 (6.7)	14 (6.2)	4 (9.1)	0.496	0.660 (0.207–2.110)	.507
Biliary infection	16 (5.9)	12 (5.3)	4 (9.1)			
Lung infection	1 (0.4)	1 (0.4)	0			
Hematosepsis	1 (0.4)	1 (0.4)	0			
PEP <sup>a</sup>	8 (3.0)	6 (2.7)	2 (4.5)	0.458	0.573 (0.112–2.935)	.621
Hyperamylasemia	17 (6.3)	14 (6.2)	3 (6.8)	0.024	0.903 (0.248–3.282)	.745
Duodenal papilla bleeding	9 (3.3)	9 (4.0)	0	1.813	0.960 (0.935–0.986)	.363
Cardiac mucosal laceration	3 (1.1)	3 (1.3)	0	0.618	0.986 (0.971–1.002)	1.000
Perforation	1 (0.4)	1 (0.4)	0	0.195	0.996 (0.987–1.004)	1.000
EVB <sup>b</sup>	1 (0.4)	1 (0.4)	0	0.195	0.996 (0.987–1.004)	1.000
Total	57 (21.1)	48 (21.2)	9 (20.5)	0.014	1.049 (0.472–2.331)	.907

<sup>a</sup> all PEP cases were mild.

<sup>b</sup> Seven days after ERCP. EVB = gastroesophageal variceal bleeding.

**Table 5**  
**Correlations of Child-Pugh and MELD scores with complications in patients with cirrhosis (n, %).**

	Child-Pugh scores			P	MELD scores		P
	A	B	C		<12	≥12	
	n=45	n=78	n=113		n=67	n=159	
Fever	5 (11.1)	3 (3.8)	6 (5.3)	.250	6 (9.0)	8 (5.0)	.264
PEP	2 (4.4)	3 (3.8)	1 (0.9)	.243	3 (4.5)	3 (1.9)	.365
Bleeding	4 (8.9)	2 (2.6)	3 (2.7)	.147	3 (4.5)	6 (3.8)	.727
Total	11 (24.4)	8 (10.2)	10 (8.9)	.021	12 (18.0)	17 (10.7)	.138

present study, and duodenal papilla bleeding occurred only in 1 case underwent combined EPBD and EST. Thus, EPBD may be a suitable option for cirrhotic patients.

Bougienage is one of the most commonly adopted strategies to dilate biliary stenosis before implantation of a biliary stent.<sup>[31]</sup> In the present study, bougienage of the bile duct stricture was more frequently adopted in noncirrhotic cases due to its significantly high prevalence of stenosis.

Endoscopic biliary stent implantation is technically successful in over 90% of attempted cases. ERBD with a plastic stent and EMBE placement is preferred in benign and malignant biliary stenosis, respectively. Overall, the efficacy of the 2 methods is comparable for short-term (1-month) treatment of biliary obstruction, while EMBE placement demonstrates a lower recurrence rate than a single plastic stent for long-term palliation of malignant biliary obstruction.<sup>[32]</sup> Furthermore, it is probable that ERBD will be the only method to address biliary obstruction in cirrhotic patients with a low platelet count, poor coagulation, and gastroesophageal varices. In this study, ERBD was conducted in 173 cases (64.1% in overall cases and 99.4% in attempted cases), mainly including those with bile duct strictures and common bile duct stones unable to be extracted. In addition, ERBD was more frequently used for cirrhotic patients, predominately as a result of the significantly higher rate of common bile duct stones in these patients, some of which could not be extracted due to a low platelet count and poor coagulation. EMBE placement was conducted in 27 cases (10% in overall cases and 100% in attempted cases) with malignant bile duct strictures; noncirrhotic patients had a significantly higher rate of EMBE placement due to a higher rate of malignant bile duct strictures. Overall, both ERBD and EMBE placement were successfully performed in patients with gastroesophageal varices.

ERCP is effective for managing choledocholithiasis in patients with cirrhosis and can therefore be an alternative to surgery in patients with Child-Pugh classes A and B. Furthermore, this procedure may be the only method for Child-Pugh class C patients with life-threatening biliary adverse events.<sup>[27]</sup> However, it has not been evaluated in patients with gastroesophageal varices caused by cirrhosis or other etiologies. The present study revealed that stone extraction was conducted in 116 cases (43.0% in overall cases and 66.7% in attempted cases) and that ERBD was performed as an alternative for the remaining cases due to a low platelet count and poor coagulation.

ERPD is recommended for preventing PEP in high-risk patients due to repeated pancreatic duct cannulation.<sup>[26]</sup> In addition, it is considered a preferred regimen for the treatment of main pancreatic duct stricture.<sup>[33]</sup> In the present study, ERPD was more frequently performed in noncirrhotic cases, possibly due to its significantly higher rate of targeting the pancreatic duct.

Few studies have examined the safety of ERCP for cirrhotic patients. Cirrhotic patients have a comparable rate of adverse events of ERCP to noncirrhotic patients.<sup>[34]</sup> Overall, ERCP can be conducted safely in cirrhotic patients, and the risk of postprocedural bleeding may be improved in large and medium-sized endoscopy centers that regularly perform ERCP.<sup>[11,18]</sup> In addition, the overall rate of complications was 9.1% in patients with cirrhosis, and the 30-day procedure-related complications included PEP (4.6%), cholangitis (2.8%), bleeding (1.1%), aspiration pneumonia (0.9%), perforation (0.4%), and bile leak (0.2%).<sup>[12]</sup> However, the safety of ERCP has not been assessed and compared in patients with gastroesophageal varices due to liver cirrhosis or other etiologies. The present study was conducted in a large center that routinely performs ERCP (approximately 2500 cases per year) and demonstrated that the overall adverse event rate was 21.1% (21.2% and 20.5% in cirrhotic and noncirrhotic patients, respectively) and included fever (6.7%), PEP (3.0%), hyperamylasemia (6.3%), duodenal papilla bleeding (3.3%), cardiac mucosal laceration (1.1%), and perforation (0.4%); additionally, no difference was found in any of these adverse events between the cirrhotic and noncirrhotic groups. Furthermore, the majority of the adverse events were mild, transient, and alleviated by conventional therapies. However, gastroesophageal variceal bleeding occurred in 1 cirrhotic patient with Child-Pugh Class C and grade III varices 7 days after ERCP, which may not have been associated with the ERCP procedure and was successfully managed by somatostatin, esomeprazole, and endoscopic variceal ligation.

The association of MELD and Child-Pugh scores with adverse events after ERCP has not been clearly determined. As mentioned previously, the rate of multiple adverse events increases in cirrhotic patients with a MELD score above 11.5, and intraoperative hemorrhage frequently arises with a MELD score greater than 11.5. However, adverse events occur comparably among cirrhotic patients with different Child-Pugh classifications.<sup>[18]</sup> Our study demonstrated that the overall prevalence of complications was not significantly higher in patients with Child-Pugh class A and MELD scores <12, mainly due to the low rate of EST and EPBD in Child-Pugh class B and C patients and those with a high MELD score.

The strength of the present study derives from its evaluation and confirmation of the efficacy and safety of the initial ERCP procedures in cirrhotic and noncirrhotic patients with gastroesophageal varices in a large-sized center that routinely performs ERCP.

Certain limitations are present in this study. First, comparisons of the efficacy and safety of ERCP did not include patients with cirrhosis or pancreatic portal hypertension without gastroesoph-

ageal varices. Second, the influencing factors for complications were not verified due to limited size.

In conclusion, ERCP may be effective and safe for patients with gastroesophageal varices, whether caused by liver cirrhosis or other etiologies. Prospective studies with large populations are needed to test these results.

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