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Emergency Endoscopic Retrograde Cholangiopancreatography Did Not Increase the Incidence of Postprocedural Pancreatitis Compared With Elective Cases

A Prospective Multicenter Observational Study

Yoshitaka Nakai, MD,* Kiyonori Kusumoto, MD,* Yoshio Itokawa, MD,* Osamu Inatomi, MD, PhD,† Shigeki Bamba, MD, PhD,‡ Toshifumi Doi, MD, PhD,§ Takumi Kawakami, MD,§ Takahiro Suzuki, MD, PhD,§ Azumi Suzuki, MD,|| Bunji Endoh, MD,¶ Koki Chikugo, MD,¶ Yoshinori Mizumoto, MD, PhD,¶ and Kiyohito Tanaka, MD, PhD||

Objective: The aim of this study was to identify the incidence of and risk factors for post-endoscopic retrograde cholangiopancreatography pancreatitis (PEP) after emergency endoscopic retrograde cholangiopancreatography (ERCP).

Methods: We performed a prospective multicenter observational study of 3914 patients who underwent ERCP. We compared the incidence of PEP after emergency and elective ERCP.

Results: A total of 3410 patients were enrolled in this study. Post-ERCP pancreatitis occurred in 44 of 800 patients (5.5%) and in 190 of 2418 patients (7.9%) in the emergency and elective groups, respectively. No significant difference was noted between the groups (odds ratio [OR], 0.73; 95% confidence interval [CI], 0.52–1.03; $P = 0.07$). Multivariate analysis showed that the following factors increased the risk for PEP after emergency ERCP: contrast medium injection into the pancreatic duct (OR, 2.56; 95% CI, 1.30–5.03; $P = 0.005$), >4 cannulation attempts (OR, 5.72; 95% CI, 2.61–12.50; $P < 0.001$), and endoscopic papillary balloon dilatation (OR, 9.24; 95% CI, 2.13–40.10; $P < 0.001$).

Conclusions: No significant difference was noted in the incidence of PEP in patients after emergency and elective ERCP. We may prevent PEP even after emergency ERCP by avoiding contrast injection into the pancreatic duct, multiple cannulation attempts, and endoscopic papillary balloon dilatation.

Key Words: emergency endoscopic retrograde cholangiopancreatography, post-endoscopic retrograde cholangiopancreatography pancreatitis, endoscopic papillary balloon dilatation

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From the *Department of Gastroenterology and Hepatology, Kyoto Katsura Hospital, Kyoto; †Division of Gastroenterology, Department of Medicine, and ‡Division of Clinical Nutrition, Shiga University of Medical Science, Shiga; §Department of Gastroenterology, Kyoto First Red Cross Hospital; ||Department of Gastroenterology, Kyoto Second Red Cross Hospital; and ¶Department of Gastroenterology, National Hospital Organization Kyoto Medical Center, Kyoto, Japan.

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Address correspondence to: Yoshitaka Nakai, MD, Department of Gastroenterology and Hepatology, Kyoto Katsura Hospital, 17 Yamada-Hirao-cho, Nishikyo-Ku, Kyoto City 615-8256, Japan (e-mail: yoshi-nakai@katsura.com).

The authors declare no conflict of interest.

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Post-endoscopic retrograde cholangiopancreatography pancreatitis (PEP) is a potentially serious complication. Endoscopic retrograde cholangiopancreatography (ERCP) is often performed urgently, but the difference in risk factors for PEP after elective and emergency ERCP is unclear. Emergency ERCP does not have a clear definition and is often defined as a procedure performed within 24 to 48 hours.^{1,2} It can also be defined as emergency ERCP performed outside of work hours.³ Most emergency ERCP procedures are performed in patients with acute cholangitis associated with biliary stones, benign or malignant biliary strictures, and stent obstruction.^{4,5} Moreover, the pain caused by biliary obstruction and acute gallstone pancreatitis with cholangitis is an indication for emergency ERCP.^{6,7} Although ERCP usually improves symptoms dramatically, it can also worsen symptoms and cause serious complications.^{8,9} Patients with severe acute cholangitis can be critically ill due to dehydration, septic shock, renal dysfunction, coagulopathy, and respiratory failure.¹⁰ A systematic review and meta-analysis reported that emergency ERCP performed within 24 to 48 hours in patients with acute cholangitis is associated with lower in-hospital mortality and organ failure.^{1,2} It has been reported that there was no significant difference between weekend and weekday ERCP groups regarding length of stay and mortality in patients admitted to a tertiary care center with acute cholangitis.³ Elective ERCP can be performed with adequate staff and resources, whereas emergency ERCP may have insufficient staff and resources. Hence, emergency ERCP increases the difficulty of the procedure, and because the procedure is often performed in patients with poor health, there is concern about an increased incidence of adverse events including PEP.¹¹ Post-ERCP pancreatitis is a common and serious complication of ERCP.⁹ The incidence of PEP reportedly occurs in 3% to 6% in most large clinical trials.^{9,11–15} Results from a recent meta-analysis of 108 randomized controlled trial showed an overall incidence of 9.7%, with an incidence of 14.7% in high-risk patients.¹⁴ Furthermore, many meta-analyses have reported that some risk factors for PEP are related to the patient, operator, and procedure. Patient-related risk factors are thought to be female sex, younger age, previous history of pancreatitis, sphincter of Oddi dysfunction, and normal serum bilirubin levels.^{15–18} In contrast, operator- and procedure-related risk factors are thought to be difficult cannulation, contrast injection into the pancreatic duct (PD), precut sphincterotomy, biliary balloon sphincter dilatation, trainee involvement, and lack of experience.^{15–18} However, to our knowledge, whether emergency ERCP increases the risk for PEP, and what these risk factors are have not been reported. This multicenter prospective study was conducted to determine the incidence of PEP and its risk factors in emergency ERCP.

MATERIALS AND METHODS

Ethical Considerations

All patients received an explanation of the procedures and possible risks of the study and gave written informed consent. This study was performed in compliance with Declaration of Helsinki protocols and was approved by our ethical committee and published in the University Hospital Medical Information Network clinical trial registration system (UMIN000024814).

Study Design

This prospective multicenter observational study was conducted in Japan at Kyoto Katsura Hospital (Kyoto, Japan), National Hospital Organization Kyoto Medical (Kyoto, Japan), Kyoto Second Red Cross Hospital (Kyoto, Japan), Japanese Red Cross Kyoto Daiichi Hospital (Kyoto, Japan), and Shiga University of Medical Science (Shiga, Japan). More than 300 diagnostic and therapeutic ERCP procedures per year were performed at four institutions, and <300 procedures per year were performed at 1 institution. The study included only adults aged 20 years or older, who agreed to participate, among patients who required ERCP for the treatment and diagnosis of biliary and pancreatic diseases. A total of 3914 ERCP procedures were performed between June 2015 and May 2017. Exclusion criteria included active pancreatitis, choledochojejunostomy, inability to approach a papilla, and inspection of only the PD. Data for patients were collected from an electronic medical chart before ERCP was performed. Detailed procedure data were recorded at the time of ERCP. Serum amylase levels were assessed 2 hours after ERCP and the next morning (at least within 24 hours after ERCP).

ERCP Procedures and Postprocedure Management

All ERCP procedures were performed by an operator with at least 1 year of experience in the upper and lower gastrointestinal endoscopy and at least 50 cases of assistant experience with ERCP. The procedures were primarily performed under conscious sedation induced by an intravenous injection of midazolam, propofol, pentazocine, pethidine hydrochloride, or dexmedetomidine hydrochloride administered in the endoscopic x-ray room rather than in the operating room. Each procedure was performed by 3 to 4 persons, including doctors, nurses, and/or radiology technicians. For standard deep biliary cannulation, the wire-guided cannulation (WGC) or wire-loaded cannulation technique was used at 3

institutions, and the conventional contrast cannulation technique was used at two institutions. When cannulation was difficult, we chose another method such as WGC with contrast injection, pancreatic guide-wire (GW)-assisted cannulation, and/or precut sphincterotomy. Depending on the patient's general conditions and ERC images, an endoscopic biliary stent (EBS) or endoscopic nasal biliary drainage tube was placed, and if the patient's general condition was good, endoscopic sphincterotomy (EST), endoscopic papillary balloon dilatation (EPBD), intraductal ultrasonography (IDUS), and bile duct stone removal were performed at the operator's discretion. The decision to place a prophylactic PD stent was made by each endoscopist depending on the global patient's risk. For the prophylactic treatment of PEP, rectal nonsteroidal anti-inflammatory drugs (NSAIDs) and aggressive intravenous hydration were administered based on the discretion of each institution. Specific criteria have not been established in this study.

Definitions and Study Outcomes

Emergency ERCP was defined as unscheduled procedures performed during and after regular work hours in this study. A diagnosis of PEP was made when 2 of the following 3 conditions were met: (1) serum amylase levels >3 times the upper limit of the normal range at each institution; (2) persistent abdominal pain for >24 hours; and (3) evidence of pancreatitis on computed tomography, according to the criteria of Cotton et al.¹⁹ Difficulty of cannulation was defined as >4 cannulation attempts on the papillae. Endoscopists with >5 years of ERCP experience were defined as trainers, and endoscopists with <5 years of experience were defined as trainees. The primary aim of this study was to compare the incidence and characteristics of PEP between emergency and elective ERCP. The secondary aim was to determine the predictive risk factors for PEP in emergency ERCP.

Statistical Analysis

The incidence and characteristics of PEP between emergency and elective ERCP were compared using the χ^2 test and the Mann-Whitney *U* test, as appropriate. The predictive risk factors for PEP in emergency ERCP were shown using univariate and multivariate logistic regression analyses. The factors of analyses were selected based on previous reports.^{15–18} $P \leq 0.05$ was considered statistically significant. All statistical analyses were carried out with EZR (Saitama Medical Center, Jichi Medical University, Saitama, Japan) and a graphical user interface for R 2.13.0 (R Foundation for Statistical Computing, Vienna, Austria).

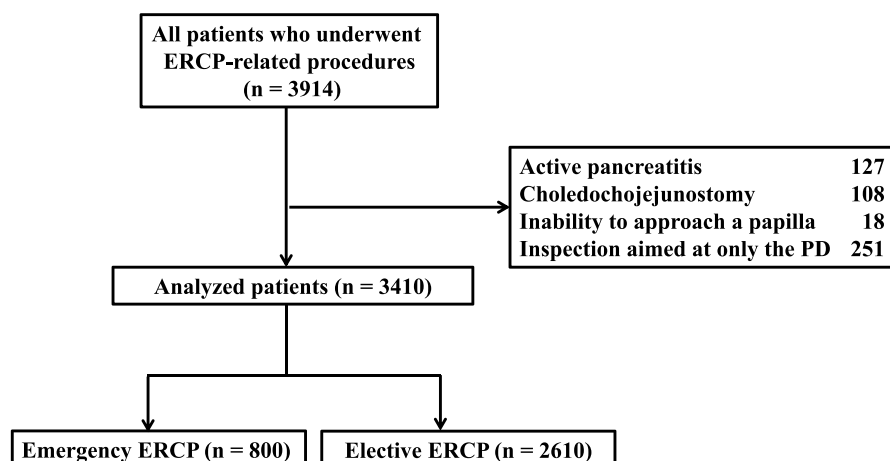


FIGURE 1. Flowchart of patients enrollment.

TABLE 1. Patient Characteristics of the Emergency and Elective ERCP Groups

	Emergency ERCP Group, n = 800	Elective ERCP Group, n = 2610	P
Age, median (range), y	75.9 (21–110)	73.2 (15–106)	<0.05*
Sex, n (%)			0.62 [†]
Male	481 (61.8)	1068 (56.9)	
Female	319 (38.2)	1542 (43.1)	
Etiology, n (%)			0.87 [†]
Benign	536 (63.6)	1685 (63.2)	
Malignancy	264 (36.4)	925 (36.8)	
ASA score ≥class 3, n (%)	223 (27.9)	34.5 (15.2)	<0.001 [†]
Acute cholangitis, n (%)	625 (78.1)	532 (20.4)	<0.001 [†]
History of pancreatitis, n (%)	61 (7.6)	293 (12.6)	0.03 [†]
Serum bilirubin level <2 mg/dL, n (%)	250 (31.2)	1870 (71.6)	<0.001 [†]
Naive papilla, n (%)	450 (56.3)	1231 (47.2)	<0.001 [†]

*Independent *t* test.
[†] χ^2 test.

Specifically, EZR is a modified version of R commander (version 1.6-3) designed to add statistical functions frequently used in biostatistics.²⁰

RESULTS

Clinical and Procedure Characteristics

In total, 3410 patients were analyzed in the study. Among them, 800 patients were in the emergency ERCP group and 2610 patients were in the elective ERCP group (Fig. 1). The success rate of deep cannulation into the common bile duct (CBD) was 99.1% for all procedures. Patient characteristics of the emergency and elective ERCP groups are shown in Table 1. There were no significant differences in sex and etiology as patient factors between the groups. Patients in the emergency group were older (75.9 vs 73.2 years; $P < 0.05$) than in the elective group. The proportion of naive papilla (56.3% vs 47.2%; $P < 0.001$), an American Society of Anesthesiology (ASA) score of class 3 or higher (27.9% vs 15.2%; $P < 0.001$), and acute cholangitis (78.1% vs 20.4%; $P < 0.001$) in the emergency group was much higher than in the elective group. The proportion of patients with jaundice with serum bilirubin level of <2.0 mg/dL (31.2% vs 71.6%; $P < 0.001$) and patients with a history of PEP (7.6% vs 12.6%;

$P = 0.03$) in the emergency group was much lower than in the elective group. Procedures performed in the emergency and elective ERCP groups are shown in Table 2. A shorter procedure time (30.8 vs 40.2 minutes; $P < 0.001$) and a higher number of inexperienced operators with <5 years of experience (68.5% vs 63.0%; $P = 0.02$) were noted in the emergency group than in the elective group. In addition, EBS placement was significantly more common in the emergency group (88.3% vs 56.3%; $P < 0.001$), although invasive procedures such as EST (18.9% vs 31.0%; $P < 0.001$), stone removal (13.3% vs 36.3%; $P < 0.001$), EPBD (1.7% vs 8.3%; $P < 0.001$), and IDUS (4.9% vs 15.0%; $P < 0.001$) were more frequently performed in the elective group compared with the emergency group. Regarding prevention of PEP, the proportion of prophylactic PD stenting (5.3% vs 7.5%; $P = 0.03$) and administration of rectal NSAIDs (4.5% vs 11.3%; $P < 0.001$) were lower in the emergency group than in the elective group.

Incidence of Post-Endoscopic Retrograde Cholangiopancreatography Pancreatitis

Our analysis showed that PEP occurred in 44 of 800 patients (5.5%) and in 190 of 2418 patients (7.9%) in the emergency and elective groups, respectively. No statistically significant difference

TABLE 2. Procedural Characteristics of the Emergency and Elective ERCP Groups

	Emergency ERCP Group, n = 800	Elective ERCP Group, n = 2610	P
Procedure time, min	30.8	40.2	<0.001*
Experience of the operator <5 y, n (%)	511 (68.5)	1542 (63.0)	0.02 [†]
EST, n (%)	151 (18.9)	785 (31.0)	<0.001 [†]
Stone removal, n (%)	109 (13.3)	1044 (36.3)	<0.001 [†]
Papillary balloon dilatation, n (%)	16 (1.7)	251 (8.3)	<0.001 [†]
IDUS, n (%)	31 (4.9)	335 (15.0)	<0.001 [†]
EBS, n (%)	696 (88.3)	1455 (56.3)	<0.001 [†]
Contrast injection into PD, n (%)	161 (20.1)	637 (24.4)	0.01 [†]
≥4 cannulation attempts, n (%)	278 (34.8)	887 (34.0)	0.70 [†]

*Independent *t* test.
[†] χ^2 test.

TABLE 3. The Incidence of PEP Between the Emergency and Elective ERCP Groups

	Emergency ERCP Group, n = 800	Elective ERCP Group, n = 2610	OR (95% CI)	P
PEP, n (%)	44 (5.5)	192 (7.4)	0.73 (0.52–1.03)	0.07*

* χ^2 test.

was noted in the incidence of PEP between the groups (odds ratio [OR], 0.73; 95% confidence interval [CI], 0.52–1.03; $P = 0.07$) (Table 3). The severity of PEP according to Cotton's criteria in emergency ERCP was mild in 26 patients (3.3%), moderate in 15 patients (1.9%), and severe in 3 patients (0.3%).

Risk Factors for Post-Endoscopic Retrograde Cholangiopancreatography Pancreatitis After Emergency Endoscopic Retrograde Cholangiopancreatography

Table 4 shows the predictive risk factors for PEP in emergency ERCP using univariate and multivariate analyses. Univariate analysis showed that naive papilla (OR, 36.8; 95% CI, 5.04–269.0; $P = 0.004$), procedure time >30 minutes (OR, 3.83; 95% CI, 1.88–8.29; $P < 0.0001$), contrast injection into the PD (OR, 4.20; 95% CI, 1.64–10.8; $P = 0.003$), >4 cannulation attempts (OR, 7.12; 95% CI, 3.37–16.4; $P < 0.001$), GW insertion into the PD (OR, 3.72; 95% CI, 1.84–7.37; $P < 0.0001$), catheter insertion into

the PD (OR, 3.33; 95% CI, 1.65–6.57; $P = 0.0006$), and balloon dilatation (OR, 4.16; 95% CI, 0.73–16.0; $P = 0.05$) were risk factors for PEP. Multivariate logistic regression analysis showed that contrast injection into the PD (OR, 2.56; 95% CI, 1.30–5.03; $P = 0.007$), >4 cannulation attempts (OR, 5.72; 95% CI, 2.61–12.5; $P < 0.001$), and balloon dilatation (OR, 9.24; 95% CI, 2.13–40.1; $P = 0.03$) were independent predictive risk factors.

DISCUSSION

Several reports of PEP incidence have been published, but it should be noted that many of these studies included both emergency and elective groups. Some studies report the incidence of PEP in emergency ERCP as between 2.0% and 6.3% (Table 5).^{21–26} However, most of these studies used small sample sizes and either single-center^{23,24,26} or multicenter²² retrospective study or single-center prospective study designs.²⁵ Moreover, none of the studies directly compared the incidence of PEP in elective ERCP. Furthermore, in an ERCP case-control study conducted according to the

TABLE 4. The Predictive Risk Factors for PEP in Emergency ERCP Using Univariate and Multivariate Analyses

	PEP, n (%) (n = 44)	Non-PEP, n (%) (n = 756)	Univariate Logistic Regression		Multivariate Logistic Regression	
			OR (95% CI)	P	OR (95% CI)	P
Age <50 y	4 (9.1)	25 (3.3)	2.92 (0.97–8.81)	0.06	1.91 (0.60–6.15)	0.28
Sex, n (%)			0.53 (0.27–1.03)	0.06	1.82 (0.96–3.47)	0.07
Male	20 (45.0)	461 (61.0)				
Female	24 (55.0)	295 (39.9)				
ASA score \geq class 3	11 (25.0)	212 (28.0)	0.88 (0.43–1.81)	0.18	—	—
Naive papilla	43 (97.7)	407 (53.8)	36.8 (5.04–269.0)	0.004	—	—
History of pancreatitis	1 (2.3)	60 (7.9)	0.27 (0.04–1.98)	0.20	—	—
Serum bilirubin level <2 mg/dL	29 (65.9)	521 (68.9)	0.87 (0.44–1.79)	0.74	—	—
Etiology			1.98 (0.91–4.75)	0.07	—	—
Benign	35 (79.5)	501 (66.3)				
Malignancy	9 (20.5)	255 (33.7)				
Experience of the operator <5 y	33 (80.0)	478 (74.1)	1.74 (0.84–3.89)	0.15	—	—
Procedure time \geq 30 min	32 (72.7)	309 (40.9)	3.83 (1.88–8.29)	<0.001	—	—
Contrast injection into PD	22 (50.0)	139 (18.4)	4.20 (1.64–10.8)	0.003	2.42 (1.22–4.80)	0.01
\geq 4 cannulation attempts	34 (75.0)	244 (51.3)	7.12 (3.37–16.4)	<0.001	5.40 (2.44–12.0)	<0.001
GW insertion into PD	17 (38.6)	109 (14.4)	3.72 (1.84–7.37)	<0.001	—	—
Catheter insertion into PD	17 (38.6)	120 (15.9)	3.33 (1.65–6.57)	<0.001	—	—
Precut	1 (2.3)	8 (1.1)	3.95 (0.39–39.8)	0.40	—	—
EST	11 (25.0)	140 (18.5)	1.46 (0.65–3.06)	1.47	—	—
Balloon dilatation	3 (6.8)	13 (1.7)	4.16 (0.73–16.0)	0.05	8.78 (2.08–37.1)	0.003
Placement of EBS	35 (79.5)	661 (87.4)	0.56 (0.25–1.37)	0.16	—	—
Placement of PS	3 (6.8)	41 (5.4)	1.34 (0.26–4.52)	0.50	—	—
IDUS	4 (9.1)	27 (3.6)	2.69 (0.65–8.29)	0.08	—	—
Stone removal	8 (18.2)	101 (13.4)	1.44 (0.56–3.27)	0.37	—	—

PS indicates pancreatic stent.

TABLE 5. Incidence of PEP in the Cited Literature

Study, Year	Country	Study Design	Subject of the Study and Timing of ERCP	Incidence of PEP, %	OR (95% CI)	P
Swahn et al, 2013 ²¹	Sweden	Cohort nationwide database	Acute admission vs elective admission (including rendezvous cannulation technique)	3.0 vs 4.9 (263/8565 vs 189/3701)	1.3 (1.1–1.6)	0.0012*
Lee et al, 2015 ²²	United States	Retrospective multicenter	<48 + ≥48 h	3.0 (6/203)	—	—
Tohda et al, 2016 ²³	Japan	Retrospective single center	≥80 y vs <80 y within 24 h	1.0 vs 3.8 (1/102 vs 4/105)	—	<0.05 [†]
Park et al, 2016 ²⁴	Korea	Retrospective single center	Elderly (75–80 y) vs very elderly (≥80 y) within 48 h	5.3 vs 7.2 (3/132 vs 11/152)	—	0.628 [†]
Tan et al, 2018 ²⁵	Denmark	Prospective single center	<24 vs ≥24 h	2 vs 2 (1/48 vs 2/118)	—	1 [†]
Farina et al, 2020 ²⁶	United States	Retrospective single center	Critically ill patients admitted to an ICU	4.7 (12/258)	—	—
Shimamura et al, 2020 ²⁷	Japan	Retrospective single center	Off hours vs regular hours	11.4 vs 9.0 (20/175 vs 18/199)	1.3 (0.66–2.54)	0.448 [†]

*Multivariate logistic regression test.
[†]χ² test.
 ICU indicates intensive care unit.

Swedish national-level intraoperative rendezvous cannulation method, the incidence of PEP in emergency admissions was 3.0% compared with 4.5% in elective ERCP.²¹ This study reported the risk of PEP was higher among patients who were treated electively compared with those who were admitted as emergency cases (OR, 1.3; 95% CI, 1.1–1.6) in multivariate analysis. However, this report included the cannulation method assisted by laparoscopic antegrade GW rendezvous technique. Another single-center retrospective study that compared the incidence of PEP during work hours and off hours reported no significant difference (11.4% vs 9.0%; $P = 0.447$).²⁷ To our knowledge, this study was unique as a multicenter large-scale prospective investigation of the incidence of PEP and risk factors for PEP in emergency ERCP. Our prospective observational study shows that the incidence of PEP in emergency ERCP was 5.5%, and thus not significantly different from the incidence of 7.9% of PEP in elective ERCP. Previous studies have reported naive papillae, high ASA score, younger age, female sex, previous pancreatitis, and normal serum bilirubin levels in patient factors for the risk of PEP.^{11,15–18} In our study, the risk of PEP was not higher in the emergency ERCP group despite the higher proportion of naive papillae and higher ASA scores (III–IV). Continued study is needed to determine whether these are true risk factors. In contrast, a higher proportion of elderly patients and patients with jaundice and a lower history of pancreatitis may have influenced the lack of a higher incidence of PEP in emergency ERCP. Previous studies have reported endoscopist experience, difficult cannulation, precut sphincterotomy, EPBD, and contrast injection into the PD in procedure-related factors in the risk of PEP.^{13,15–18} In one large multicenter prospective study conducted in Korea, multivariate analysis showed that the risk of PEP was significantly higher for less experienced operators (<200 ERCPs performed) than for experienced operators (≥200 ERCPs performed) (12.0% vs 6.8%; OR, 1.630; $P = 0.004$).²⁸ In this study, the risk of PEP was not increased in the emergency ERCP group despite the large proportion of trainee operators. Furthermore, reported cases of difficult cannulation were significantly higher in patients with asymptomatic CBD stones than in those with symptomatic CBD stones.²⁹

Although endoscopist experience was said to affect the risk of PEP, for noninvasive methods such as placement of EBS only, a procedure time <30 minutes^{21,30} may be acceptable even for trainees with <5 years of experience in emergency ERCP. The mechanisms and risk factors for pancreatitis caused by EST are unclear. However, the incidence of pancreatitis after EST is estimated to be 0.5% to 6.9%.³¹ The incidence of PEP for CBD stones is reportedly 4.7%.³² In this study, the frequency of EST, stone removal, and EPBD was lower in the emergency ERCP group. This may not have caused an increased risk of PEP. It has been reported that the incidence of PEP is significantly lower in patients with symptomatic CBD stones.³³ Furthermore, some studies have reported that for mild to moderate acute cholangitis with CBD stones, single-session endoscopic stone removal did not increase the incidence of complications including PEP.³⁴ However, in patients with severe cholangitis and multiple risks for PEP,^{14,30} consideration should be given to the incidence of complications caused by the increased procedure time associated with endoscopic stone removal. The attempt to simplify the procedure in emergency ERCP and the shorter duration of the procedure may have reduced the incidence of PEP. In this study, the low frequency of contrast injection into the PD in the emergency ERCP group may not have increased the risk of PEP. Contrast injection into PD, >4 cannulation attempts, and balloon dilation were significantly associated as risk factors for PEP in emergency ERCP in univariate and multivariate analyses in this study. The major differences from elective ERCP were considered to be poor patient general health,¹⁰ the condition of the duodenal papilla, and the small number of personnel involved in the examination. In particular, acute inflammatory changes such as hyperemic edema in the duodenal papillae due to cholangitis, obstructive jaundice, or mechanical irritation associated with biliary stones must be considered histologically and endoscopically.^{34,35} These risk factors trigger obstruction of pancreatic juice outflow due to edema of the orifice and papillary sphincter spasm.^{13,36} Hydrostatic injuries from overinjection of contrast into the PD³⁷ and chemical and allergic injuries from the contrast itself can lead to the development of PEP. As an initial step, we must avoid contrast medium injection into

the PD.³⁸ Multiple meta-analyses reported that the WGC method improved deep cannulation rates and reduced the incidence of PEP.^{39,40} Therefore, the WGC method may be the first choice for emergency ERCP. Several studies have reported that an increase in the number of cannulations is a risk factor for developing PEP, and the more frequent the cannulation, the higher the risk.^{41,42} If >4 cannulations are attempted, we need to consider switching to a more experienced operator or an alternative cannulation method such as precutting⁴³ or pancreatic GW-assisted cannulation.^{44,45} Among 13 studies that compared EPBD with EST, 10 concluded that PEP did not occur more frequently in the EPBD group.⁴⁶ However, in addition to mechanical injury in EPBD, we consider the possibility that edema of the orifice associated with cholangitis or impacted bile duct stones occurred in this study. In emergency ERCP, it is recommended that operators avoid EPBD and perform drainage only or EST. There are some limitations to this study. First, the definition of emergency ERCP is not consistent in each literature. In this study, most patients were considered to have undergone ERCP within at least 24 hours of onset or hospitalization, as defined as unscheduled tests performed during and beyond normal work hours. Second, although Japanese guidelines⁴⁷ and other guidelines^{48,49} recommend rectal administration of NSAID and aggressive fluid hydration before and after ERCP for the prevention of PEP, this study did not establish specific criteria for these measures. It was difficult to administer NSAIDs routinely, because they were not approved for insurance coverage in Japan at the time in emergency cases with a reduction in blood pressure and renal dysfunction. In the future, rectal administration of NSAIDs to applicable cases may reduce the incidence of PEP further. The volume of infusion had to be determined according to blood pressure levels and dehydration in each case in emergency ERCP, and thus a fixed amount of prophylactic aggressive hydration was not performed. In conclusion, the incidence of PEP in emergency ERCP was 5.5%. No significant difference was noted in the incidence between emergency and elective ERCP. Knowledge of the risk factors allowed us to understand what to look for and what to avoid in emergency ERCP. Our study results show that it is necessary to avoid injecting contrast medium into the PD, attempting >4 cannulations, and performing EPBD in emergency ERCP.

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