



ORIGINAL RESEARCH ARTICLE

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# Predicting acute complications in endoscopic retrograde cholangiopancreatography based on the severity and onset of post-procedural pain

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## Abstract

**Background** Endoscopic retrograde cholangiopancreatography (ERCP), a standard procedure used for diagnosing and treating pancreaticobiliary disorders, has the highest rate of complications among endoscopic procedures. We aimed to evaluate the association of post-ERCP pain onset and its severity with the development of acute complications.

**Methods** This cross-sectional study included 172 candidates for ERCP who were referred to Namazi Hospital, Shiraz, from January 21, 2021, to January 21, 2022. Demographic features of the participants, including age and gender, were recorded. ERCP indications, complications during and after ERCP, and narcotic requirements were also noted. Post-ERCP pain severity was evaluated using a 10-point visual analogue scale (VAS), with 0 indicating no pain and 10 indicating the worst pain. Pain severity was evaluated twice: once by the physician and once by the patient. The interval between the procedure and the onset of pain was also recorded.

**Results** Out of the 172 participants of this study with a mean age of  $53.77 \pm 20.20$  years, 98 (57%) were male. The most typical indication of ERCP was common bile duct stone (36%). Complications during and after ERCP occurred in 2.3% and 2.9%, respectively, with retroperitoneal/sphincterotomy perforation (1.2%) being the most common post-ERCP complication. Post-ERCP pain score (both by patient and physician) was significantly higher in patients with complications compared to those without complications ( $P < 0.001$ ). The interval between the ERCP procedure and the onset of pain was significantly shorter in patients with post-ERCP complications ( $P = 0.003$ ). Also, a significantly higher percentage of patients with complications required narcotics (40% vs 1.2%,  $P = 0.004$ ).

**Conclusions** Although the presence of post-ERCP pain may not necessarily be indicative of complications, post-ERCP pain severity and onset, as well as narcotic requirement, appear to be associated with the development of post-ERCP complications.

**Keywords** ERCP, Post-ERCP complications, Risk factors, Post-ERCP pancreatitis

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## Introduction

Endoscopic retrograde cholangiopancreatography (ERCP) was introduced in 1986 as a diagnostic modality and later evolved into a therapeutic procedure [1]. It remains the standard procedure for managing pancreaticobiliary disorders, including sphincterotomy, stricture dilatation, lithotripsy, calculi extraction, biliary drainage, and stent placement/replacement [2, 3].

As reported in multiple retrospective studies, ERCP is generally considered safe even in the elderly who may have comorbidities that put them at higher risk of procedural complications; however, among endoscopic procedures, ERCP appears to have the highest risk of procedural complications [4, 5]. Moreover, despite advances in safety protocols, endoscopic technology, and endoscopist skills, the risk of ERCP-related complications constantly remains in the range of 10–12% and mortality in the range of 0.4–1.4% [6, 7]. The most common post-ERCP complication is pancreatitis, with an incidence rate of 3–10% [8, 9]. Other post-ERCP complications include cholangitis occurring in 0.5–3% of cases, hemorrhage in 0.3–2%, and duodenal perforation in 0.08–0.6%. Air embolism, colonic diverticula perforation, splenic injury, and pneumothorax have also been reported as rare post-ERCP complications, while mortality is often associated with surgical procedures, accounting for 0.3 to 1% of ERCPs [3, 10–13].

Most post-ERCP complications occur within a few hours of the procedure [14]. Post-ERCP pain can occur in the setting of pancreatitis, cholangitis, and intestinal perforation [8]. Therefore, the presence of abdominal pain after ERCP can lead the clinician towards the diagnosis of post-ERCP complications [15]. Nevertheless, limited studies have been performed to evaluate the association of post-ERCP pain with ERCP complications.

In this study, we aimed to evaluate post-ERCP complications and their frequency and associated factors, specifically the correlation of pain, its severity, and onset with these complications.

## Methods

### Participants

This cross-sectional study included 172 consecutive patients referred for ERCP to Namazi Hospital (a tertiary ERCP referral center), Shiraz, Iran, from January 21, 2021, to January 21, 2022. Patients with coagulation disorders, contraindications of general anesthesia due to a high risk of cardiovascular, respiratory, or cerebral complications, and those who did not consent to ERCP were excluded from the study.

### Study design

Demographic features of the participants, including age and gender, were recorded. ERCP indications, complications during and after ERCP, and narcotic requirements were also noted. Post-ERCP pain severity was evaluated using a 10-point visual analogue scale (VAS), with 0 indicating no pain and 10 indicating the worst pain. Pain severity was evaluated twice: once by the physician and once by the patient. The interval between the procedure and the onset of pain was also recorded.

### Data analysis

The Statistical Package for the Social Sciences (SPSS) software (version SPSS, Chicago, IL, USA; release 16.0 for Windows) was used for data analysis. Mean, standard deviation, frequency, and percentages were used to describe the results. Chi-squared and Fisher's exact tests were used to determine the correlation of pain with qualitative variables. An independent *t*-test was used to compare pain severity scores (VAS) between groups. *P* values equal to or less than 0.05 were regarded as statistically significant.

## Results

From the 172 participants who were enrolled in this study with a mean age of  $53.77 \pm 20.20$  years, 98 (57%) were male (mean age:  $53.39 \pm 20.52$  years), and 74 (43%) were female (mean age:  $54.28 \pm 19.89$  years). The most typical indication of ERCP was a common bile duct (CBD) stone (36%), followed by distal and proximal CBD obstruction (22.1% and 11.6%, respectively) (Table 1). Complications during ERCP occurred in 4 patients (2.3%), including sphincterotomy perforation (1.2%), hemorrhage (0.6%), and CBD perforation (0.6%). Post-ERCP complications occurred in 5 patients (2.9%), including retroperitoneal/sphincterotomy perforation (1.2%), pancreatitis (0.6%), hemorrhage (0.6%), and CBD perforation (0.6%).

Table 2 demonstrates the frequency of post-ERCP complications and pain and the diagnostic or therapeutic procedure performed during ERCP by gender. Post-ERCP complications occurred in 3 men (2.7%) and two women (3.1%) ( $P=1.000$ ). Of the five patients with post-ERCP complications, only one required surgery and the others recovered completely. No mortality was reported. Post-ERCP pain was observed in 19 (11%) patients: 10 men (10.2%) and nine women (12.2%) ( $P=0.685$ ).

Post-ERCP pain intensity score (both by patient and physician) was significantly higher in patients with complications compared to those without complications ( $P<0.001$ ). The interval between the ERCP

**Table 1** Indications of ERCP, complications during ERCP, and post-ERCP complications in the study population

Indications of ERCP	N (%)	Complications during ERCP	N (%)	Post-ERCP complications	N (%)
CBD stone	62 (36.0)	None	168 (97.7)	None	167 (97.1)
Distal CBD obstruction	38 (22.1)	Sphincterotomy perforation	2 (1.2)	Retroperitoneal/sphincterotomy perforation	2 (1.2)
Proximal CBD obstruction	20 (11.6)	Hemorrhage	1 (0.6)	Pancreatitis	1 (0.6)
Stent removal/replacement	17 (9.9)	CBD perforation	1 (0.6)	Hemorrhage	1 (0.6)
Acute cholangitis	7 (4.1)			CBD perforation	1 (0.6)
The biliary complication of a transplant	7 (4.1)				
Biliary surgery complication	7 (4.1)				
PSC	7 (4.1)				
Pancreatitis and impacted stone	5 (2.9)				
PD leakage	1 (0.6)				
Other indications	1 (0.6)				

Abbreviations: N number, ERCP endoscopic retrograde cholangiopancreatography, CBD common bile duct, PSC primary sclerosing cholangitis, PD pancreatic duct

**Table 2** Post-ERCP pain, post-ERCP complications, and ERCP diagnostic and therapeutic procedures by gender

Variables	Total (n = 172) N (%)	Male (n = 98) N (%)	Female (n = 74) N (%)	P value*
Post-ERCP complications	5 (2.9)	3 (3.1)	2 (2.7)	1.000†
Post-ERCP pain	19 (11.0)	10 (10.2)	9 (12.2)	0.685
Therapeutic procedures				
Sphincterotomy	101 (58.7)	52 (53.1)	49 (66.2)	0.083
Precut fistulotomy	26 (15.1)	15 (15.3)	11 (14.9)	0.936
Stone extraction by basket	30 (17.4)	16 (16.3)	14 (18.9)	0.657
Lithotripsy	13 (7.6)	7 (7.1)	6 (8.1)	0.813
Balloon dilatation	100 (58.1)	50 (51.0)	50 (67.6)	0.029
Papilla dilatation	4 (2.3)	2 (2.0)	2 (2.7)	1.000†
Savary dilatation	9 (5.2)	8 (8.2)	1 (1.4)	0.080†
TTS dilatation	11 (6.4)	9 (9.2)	2 (2.7)	0.118†
CBD plastic stent	66 (38.4)	41 (41.8)	25 (33.8)	0.282
Metal stent	6 (3.5)	2 (2.0)	4 (5.4)	0.404†
Removal of biliary stent	44 (25.6)	26 (26.5)	18 (24.3)	0.743
PD stent	13 (7.6)	7 (7.1)	6 (8.1)	0.813
Removal of PD stent	4 (2.3)	0 (0.0)	4 (5.4)	0.033†
PD contrast injection	6 (3.5)	3 (3.1)	3 (4.1)	1.000†
PD cannulation	24 (14.0)	17 (17.3)	7 (9.5)	0.139
Once	13 (7.6)	10 (10.2)	3 (4.1)	0.448†
Twice	7 (4.1)	4 (4.1)	3 (4.1)	
Three times	4 (2.3)	3 (3.1)	1 (1.4)	

Abbreviations: N number, ERCP endoscopic retrograde cholangiopancreatography, CBD common bile duct, PD pancreatic duct, TTS through-the-scope

\* Analyzed by chi-squared test

† Analyzed by Fisher's exact test

procedure and the onset of pain was significantly shorter in patients with post-ERCP complications ( $P=0.003$ ). Also, a significantly higher percentage of patients with complications required narcotics (40% vs 1.2%,  $P=0.004$ ) (Table 3).

## Discussion

The highest rate of complications among endoscopic procedures has been reported with ERCP. Nevertheless, it is generally considered safe [2]. Early detection and correction of risk factors for post-ERCP complications

**Table 3** Comparison of post-ERCP pain onset, pain severity, and narcotic requirement between patients with and without post-ERCP complications

Variables	With complications (n = 5)	Without complications (n = 167)	P value*
Pain severity by patient mean $\pm$ SD	7.40 $\pm$ 1.52	4.07 $\pm$ 1.33	< 0.001
Pain severity by physician mean $\pm$ SD	7.80 $\pm$ 0.84	3.64 $\pm$ 1.45	< 0.001
Patients requiring narcotics N (%)	2 (40.0)	2 (1.2)	0.004†
Pain onset after ERCP (min) mean $\pm$ SD	17.00 $\pm$ 7.58	63.57 $\pm$ 48.06	0.003

Abbreviations: N number, SD standard deviation, ERCP endoscopic retrograde cholangiopancreatography

\* Analyzed by independent t-test

† Analyzed by Fisher's exact test

such as pancreatitis, as well as improvement in ERCP techniques, decrease the complication rate generally, and early detection of complications has a significant impact on the management of the complications.

Pain is a common symptom among post-ERCP complications, including pancreatitis, cholangitis, cholecystitis, and intestinal perforation [8]. Post-ERCP pancreatitis is defined as worsening or new-onset abdominal pain along with more than three times the upper limit of standard increase in serum amylase within 24 h of the procedure [2]. Although rare, post-ERCP bleeding can occur due to biliary and/or pancreatic sphincterotomy and, more uncommonly, due to hepatic, splenic, and vascular injury or pseudoaneurysms [16, 17]. Since blood is an irritating material, pain can also be a symptom of intraperitoneal or retroperitoneal bleeding. Furthermore, abdominal pain is among the typical presentations of cholangitis [6, 18]. Patients with post-ERCP cholecystitis may also present with abdominal pain and fever potentially arising from cystic duct obstruction [19].

We evaluated patients who underwent ERCP in the tertiary referral center in the current study. Although the presence of post-ERCP pain was not indicative of complications, we found a statistically significant correlation between post-ERCP pain severity and the development of complications, in which the pain was significantly more severe in patients with post-ERCP complications compared with those without complications. Also, the narcotic requirement was higher in patients with complications. Moreover, patients who experienced post-ERCP pain shorter after the procedure were more likely to have complications.

Despite the association of post-ERCP pain severity and onset with the development of complications in our study, there are a few issues that might have influenced the results. To begin with, the overall rate of complications in the current study (2.9%) was lower compared to previous studies, as it was 11.6% in Glomsaker et al.'s study [7] and 12% in Katsinelos

et al.'s study [20]. Second, the skill and experience of the endoscopist can impact the development of complications, as complications occur less frequently with highly skilled endoscopists. Furthermore, it has been reported that the rate of complications is higher in patients who undergo ERCP for concomitant diagnostic and therapeutic purposes and that complications are higher with specific therapeutic procedures such as sphincterotomy, mainly when performed using the precut method [21, 22].

Of note, based on the current study's findings, the absence of pain is very likely to rule out post-ERCP severe complications. However, the presence of pain cannot predict the occurrence of complications since a percentage of patients did not develop complications despite having post-ERCP pain.

One limitation of this study was that some patients required multiple therapeutic procedures that might have increased the risk of post-ERCP complications and interfered with the results. Another limitation was that some patients had a history of prior ERCP and sphincterotomy, which could restrict the generalization of the study findings.

## Conclusions

Post-ERCP pain severity and onset, as well as narcotic requirement, appear to be associated with post-ERCP complications. Therefore, endoscopists are suggested to monitor patients' pain and narcotic intake after ERCP for the potential development of complications. Since this research is one of the primary studies evaluating post-ERCP pain as an indicator of probable post-ERCP complications, further studies with a larger sample size are required to confirm these findings.

## Abbreviations

ERCP	Endoscopic retrograde cholangiopancreatography
CBD	Common bile duct
PD	Pancreatic duct
VAS	Visual analogue scale

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### Human ethics

The study adheres to the Helsinki Declaration for medical research in humans.

### Authors' contributions

Conceptualization: F E, M KH B, GHR S; data curation: R N, M T; formal analysis: M T, SA T; investigation: I SH, GHR S, F E; visualization: M KH B, SA T; writing—original draft: F E, SA T, I SH; writing review and editing: all authors.

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### Availability of data and materials

The data are available upon reasonable request.

### Declarations

#### Ethics approval and consent to participate

The current study was approved by the Ethical Committee of Shiraz University of Medical Sciences (IR.SUMS.REC.1395.S815).

#### Consent for publication

The authors agreed to have their work published in this journal.

#### Competing interests

Regarding publishing this work, the authors state that they have no competing interest.

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