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The Isfahan ERCP Registry: A 5-Year Comprehensive Report of Demographics, Indications, and Outcomes in Central Iran

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Abstract

Background and Aims: Comprehensive, large-scale registries for Endoscopic Retrograde Cholangiopancreatography (ERCP) are scarce in the Middle East. This study aims to evaluate the efficacy, safety, and patient outcomes of ERCP utilizing a highly complete data registry from a major referral center in this region.

Methods: A retrospective registry-based study was conducted at a tertiary care center, including adult patients who underwent ERCP between January 2019 and January 2024. Patient demographics, procedural indications, success rates, and adverse events were extracted. A comprehensive sex-stratified analysis was performed to evaluate differences in clinical outcomes.

Results: A total of 1,511 ERCP procedures performed on 1,361 unique patients were analyzed. The cohort had a mean age of 62.5 ± 17.6 years, with a male predominance (60.7%). The technical success rate was high at 96.0%. Adverse events occurred in 7.4% of cases, with post-ERCP pancreatitis (PEP) being the most common (6.1%). While primary procedural indications did not significantly differ between sexes ($p = 0.140$), females exhibited a significantly higher rate of PEP compared to males (9.9% vs. 3.7%, $p < 0.0001$). Data quality was exceptional, with a 0% missing data rate for core procedural variables.

Conclusion: This large-scale Middle Eastern registry demonstrates that ERCP can be performed with high success rates and acceptable complication profiles, comparable to global benchmarks. The markedly higher risk of PEP in females, independent of baseline indications, suggests a strong intrinsic physiological or anatomical susceptibility, highlighting the necessity for targeted prophylactic measures in this subgroup.

1. Introduction

Endoscopic retrograde cholangiopancreatography (ERCP) has fundamentally transformed the management of pancreatobiliary diseases. Originally developed as a diagnostic imaging technique, it has evolved into a predominantly therapeutic procedure, replacing many traditional surgical interventions and offering a minimally invasive approach with lower morbidity and faster recovery times. Today, it stands as the gold standard for treating a wide array of conditions affecting the biliary tree and pancreatic ducts (1, 2).

The clinical applications of ERCP are vast and varied. Choledocholithiasis remains the most frequent indication globally, where ERCP allows for effective stone extraction using techniques such as endoscopic sphincterotomy (EST), balloon clearance, and mechanical lithotripsy (3). Furthermore, ERCP is the cornerstone for managing both benign and malignant biliary strictures—such as those arising from cholangiocarcinoma, pancreatic head tumors, or post-surgical complications (4). In these scenarios, it enables vital biliary decompression and palliation through

the deployment of plastic or self-expandable metal stents (SEMS) (5). Other critical therapeutic maneuvers routinely performed include stricture dilation, sphincter of Oddi manometry, and the management of bile leaks (6).

Despite its immense clinical value and high success rates, ERCP is widely considered one of the most technically demanding endoscopic procedures and is associated with a distinct profile of adverse events (7). Post-ERCP pancreatitis (PEP) is the most common and widely studied complication, with its incidence and severity varying significantly based on a complex interplay of patient-related and procedure-related risk factors (8, 9). Other potentially severe, albeit less frequent, complications include post-sphincterotomy bleeding, duodenal or biliary perforation, and cholangitis (10). Given these inherent risks, a continuous and meticulous evaluation of procedural outcomes and safety profiles is essential in daily clinical practice.

Globally, the epidemiological landscape of ERCP is highly diverse. In Western and high-income countries, the widespread adoption of advanced non-invasive imaging modalities, such as magnetic resonance cholangiopancreatography (MRCP) and endoscopic ultrasound (EUS), has largely restricted ERCP to strictly therapeutic roles (11). In these regions, the demographic shift toward an aging population also heavily influences the prevalence of specific indications, such as malignant strictures. Conversely, in developing nations and specific regions of Asia or the Middle East, different etiological patterns—such as delayed presentations of complicated choledocholithiasis, varying rates of specific malignancies, or even endemic infectious biliary conditions—distinctly shape clinical practice (12, 13). Furthermore, profound variations in healthcare infrastructure, specialized endoscopist training, and equipment accessibility significantly impact procedural volume, technical success rates, and the incidence of complications across different geographic areas (14-16).

While extensive literature and large multi-center registries have comprehensively described the epidemiology and outcomes of ERCP in Western cohorts, there is a notable paucity of robust, large-scale data in Iran (17-19). Regional disparities in population demographics and the prevalence of underlying diseases mean that international guidelines and statistics may not fully reflect our local realities. Understanding these local dynamics is crucial for optimizing patient care and allocating healthcare resources effectively.

Therefore, the primary objective of this study is to report on a large, single-center ERCP registry. By analyzing a comprehensive cohort of 1361 patients over a 5-year period, we aim to delineate the patient demographics, the spectrum of clinical indications, endoscopic techniques, and subsequent outcomes—including therapeutic success rates and procedure-related complications. This descriptive epidemiological analysis will provide valuable real-world data, helping to establish regional benchmarks and identify targeted areas for enhancing the quality of pancreatobiliary care.

2. Methods

2.1 Study Design and Setting

This retrospective, descriptive-analytical study was based on a comprehensive patient registry at Al-Zahra Educational and Medical Center, a major tertiary referral hospital. The study evaluated data from all patients who underwent Endoscopic Retrograde Cholangiopancreatography (ERCP) over a five-year period, from January 2019 to January 2024.

2.2 Patient Population

All patients referred for ERCP during the specified timeframe were eligible for inclusion. Patients were excluded from the final analysis if they met any of the following criteria: (1) incomplete medical records where more than 20%of essential variables were missing; or (2) cases where the ERCP procedure was documented as "not performed" or abandoned prior to initiation. After systematically cleaning the initial pool to remove duplicates and ineligible records, the final study cohort comprised 1361 unique patients who underwent a total of 1511 ERCP procedures (including single and multiple-session cases).

2.3 Data Collection and Variables

Data were retrospectively extracted from the hospital's electronic and paper-based medical records by trained personnel using a standardized data collection form. To ensure high data quality, variables were meticulously recorded, achieving a 0%missing data rate for core clinical metrics. The collected variables included:

- **Demographics:** Age and sex.
- **Clinical and Procedural Data:** Primary diagnosis and indications for ERCP, history of prior ERCPs, cannulation success or failure, and detailed procedural interventions (e.g., standard or partial sphincterotomy, biliary and pancreatic duct stent insertion/removal, and TTS balloon dilation).
- **Laboratory Findings:** Relevant pre-procedural tests (e.g., hemoglobin levels) and post-procedural markers, primarily serum amylase and lipase levels measured approximately 24hours after the procedure.
- **Clinical Outcomes and Adverse Events:** The presence of pre- and post-procedure symptoms (such as new or worsened abdominal pain and vomiting), hospitalization duration, and procedure-related adverse events (specifically post-ERCP pancreatitis [PEP], hemorrhage, and perforation).

Outcome Definitions and Adjudication of Adverse Events

All procedure-related adverse events were meticulously recorded, defined, and graded in accordance with standard consensus guidelines to ensure robust data adjudication.

- **Post-ERCP Pancreatitis (PEP):** PEP was defined based on the consensus criteria established by Cotton et al., characterized by new-onset, pancreatic-type abdominal pain associated with an elevation in serum amylase or lipase levels to at least 3times the upper limit of normal at 24hours post-procedure, which necessitated unplanned hospital admission or prolongation of a planned admission.
- **Post-ERCP Bleeding:** Bleeding events were defined and adjudicated utilizing the American Society for Gastrointestinal Endoscopy (ASGE) lexicon. This was identified by clinical evidence of gastrointestinal bleeding (e.g., melena, hematemesis) accompanied by a decrease in hemoglobin concentration of ≥ 2 g/dL, or any bleeding that required endoscopic hemostasis, angiographic intervention, surgery, or blood transfusion (20).
- **Technical Success:** Technical success was defined as the successful completion of the intended therapeutic or diagnostic interventions during the ERCP procedure, such as successful deep cannulation, sphincterotomy, or stent placement/extraction as initially planned.

2.4 Statistical Analysis

All collected data were analyzed using SPSS statistical software (Version 26). Descriptive statistics were employed to summarize patient demographics and procedural characteristics. Categorical variables were reported as frequencies and percentages (n, %), while continuous variables were presented as mean $\pm$ standard deviation (SD) or median and interquartile range (IQR), depending on the normality of the data distribution. To analyze sex-stratified differences in baseline characteristics, indications, and complications, inferential statistics were applied. The independent samples t-test or Mann-Whitney U test was used for continuous variables, and the Chi-square test or Fisher's exact test was utilized for categorical variables. A p-value of $<0.05$was considered statistically significant.

2.5 Ethical Considerations

The study protocol was reviewed and approved by the Institutional Review Board (IRB) and the Ethics Committee of Al-Zahra Educational and Medical Center. (Ethics Code: IR.MUI.MED.REC.1402.004). Given the retrospective registry-based design of the study, the requirement for informed consent from individual patients was waived. All data were de-identified and patient identifiers were removed from the final dataset to strictly ensure anonymity and confidentiality.

3. Results

3.1 Patient Characteristics

Between January 2019 and January 2024, a total of 1511 ERCP procedures were performed on 1361 unique patients (**Figure 1**). The mean age of the patients was 62.5 ± 17.6 years (range: 8–99 years). There was a male predominance in the cohort, with males comprising 60.7% ($n = 826$) of the patients, reflecting a female-to-male ratio of approximately $1{:}\,1.5$. The majority of the cohort, comprising 1257 patients, underwent a single ERCP session. Multiple ERCP sessions were

recorded for 104 patients. Detailed background conditions and risk factors of the individual patients are summarized in **Table 1**.

Table 1 – Individual patients' background conditions and risk factors (n=1,361)

Comorbidity/habit	Frequency (%)
Hypertension	463 (34.0%)
Diabetes mellitus	288 (21.2%)
Ischemic heart disease	205 (15.1%)
Hyperlipidemia	184 (13.5%)
Alcohol use	24 (1.8%)
Opium use	126 (9.3%)

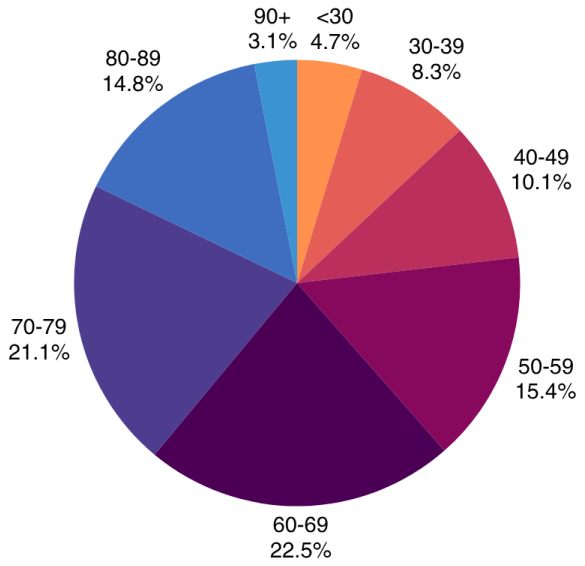


Figure 1 – Age group distribution; percentage of patients in each age category

3.2 Indications and Procedural Details

The primary indications for ERCP included choledocholithiasis, malignancy, primary sclerosing cholangitis (PSC), post-surgical indications, stent management, pancreatitis, biliary stricture, and portal hypertension biliopathy. During the procedures, sphincterotomy was performed in 1322 cases, consisting of 1125 standard and 197 partial sphincterotomies. Through-the-scope (TTS) balloon dilatation was utilized in 430 cases. Regarding stenting, biliary stents were inserted in 172 sessions and removed in 43 sessions, while pancreatic duct stents were placed in 117 cases. The comprehensive characteristics of the cases undergoing ERCP are detailed in **Table 2**.

Table 2 – Characteristics of cases undergoing ERCP

Characteristic	Median (IQR)/Frequency (%)
Age (years)	65 (50–76)

Sex	
male	927 (61%)
female	584 (39%)
Sphincterotomy type	
standard	1,125 (74%)
partial	197 (13%)
none	189 (13%)
Pancreatic duct stent	117 (7.7%)
Biliary stent action	
extraction	43 (2.8%)
insertion	172 (11%)
none	1,296 (86%)
TTS balloon dilation	430 (28%)
Procedure category	
Neither	189 (13%)
Sphincterotomy alone	892 (59%)
Sphincterotomy + balloon dilation	430 (28%)
Indication for ERCP	
Choledocholithiasis	1,070 (71%)
Malignancy	202 (13%)
Biliary stricture	14 (0.9%)
Primary sclerosing cholangitis	50 (3.3%)
Stent management	33 (2.2%)
Post-surgical	38 (2.5%)
Pancreatitis	18 (1.2%)
Portal hypertension biliopathy	11 (0.7%)
Other	75 (5.0%)

3.3 Technical Success and Failure

The overall technical success rate of the ERCP procedures was 96.0%, with 1451 successful cases and 60 unsuccessful cases. Unsuccessful procedures primarily failed at the stage of biliary cannulation. Among the failed cases, 3 patients underwent pancreatic duct stent placement without any biliary cannulation maneuvers. None of the unsuccessful cases involved sphincterotomy, biliary stenting, or TTS balloon dilation. A summary of the reasons for unsuccessful ERCP procedures is provided in **Table 3**.

Table 3 – summary of reason for unsuccessful ERCP

Suspected cause of ERCP failure	No.
Anatomical challenges	

Periampullary diverticulum	1
Post-surgical anatomy	2
Juxtapapillary or periampullary neoplasms	10
Malignant distal bile duct stricture or tumor occlusion	
Pancreatic head mass	8
Cholangiocarcinoma	3
Metastatic cancer	4
Large or impacted CBD stone	22
PSC or benign strictures	3
Other anatomical or technical challenges	7

Abbreviations: CBD, common bile duct; ERCP, endoscopic retrograde cholangiopancreatography; PSC, primary sclerosing cholangitis

3.4 Adverse Events and Post-Procedure Symptoms

Adverse events occurred in 112 cases, representing an overall complication rate of 7.4%. The most frequent complication was post-ERCP pancreatitis (PEP), observed in 92 cases (6.1%). Hemorrhage was noted in 16 cases, and perforation occurred in 1 case. Combined complications, such as pancreatitis concurrent with bleeding, were also documented. Regarding clinical symptoms, pre-ERCP abdominal pain was reported in 517 cases (35%). Following the procedure, post-ERCP abdominal pain was observed in 196 cases (13%), of which 107 cases were new-onset pain. Post-ERCP vomiting was documented in 49 cases (3.3%).

3.5 Sex-Stratified Analysis

A sex-stratified comparison revealed significant differences in certain patient demographics and clinical outcomes (**Table 4**). Female patients were significantly younger than male patients (mean age 63 vs. 66 years, $p = 0.015$). While the technical success rates and the distribution of primary indications showed no significant differences between the sexes ($p = 0.140$ for indications), the incidence of PEP was significantly higher in females compared to males (9.9% vs. 3.7%, $p < 0.0001$).

Table 4 – Sex-stratified comparison of patient characteristics, ERCP outcomes, and primary indications

Characteristic	Male (N=927)	Female (N=584)	P-value
Age (years)	66 (54-75)	63 (45-76)	**0.0146**[*]
Successful ERCP	890 (96.0%)	560 (95.9%)	1.0[**]
Post-ERCP pancreatitis	34 (3.7%)	58 (9.9%)	**<0.0001**[**]
Primary indication for ERCP			0.140[**]
Choledocholithiasis	634 (68.4%)	436 (74.7%)	0.096[**]

Malignancy	138 (14.9%)	64 (11.0%)	0.316**
Biliary stricture	11 (1.2%)	3 (0.5%)	1.0**
Primary sclerosing cholangitis	28 (3.0%)	22 (3.8%)	1.0**
Stent management	21 (2.3%)	12 (2.1%)	1.0**
Post-surgical	26 (2.8%)	12 (2.1%)	1.0**
Pancreatitis	13 (1.4%)	5 (0.9%)	1.0**
Portal hypertension biliopathy	9 (1.0%)	2 (0.3%)	1.0**
Other	47 (5.1%)	28 (4.8%)	1.0**

Footnotes: *: Mann-Whitney-U test; ****:** chi-squared test with Bonferroni correction for multiple comparisons

3.6 Data Completeness and Entry Rates

The registry demonstrated exceptionally high data completeness. A 0% missing data rate was achieved for several critical variables, including gender, ERCP success or failure, sphincterotomy type, pancreatic duct stent placement, biliary stent placement, removal, and replacement, biliary stent type, TTS balloon dilatation utilization and size, primary indication, pre-ERCP hemoglobin levels, and complications. The entry rates for all other registered variables are comprehensively outlined in **Table 5**.

Table 5 – Entry rates of registered variables

Variable	Entry rate (%; 100 – missing rate)
Age	99.9
Primary indication for ERCP	99.9
Abdominal pain before ERCP	97.4
Vomiting after ERCP	97.0
Abdominal pain after ERCP	96.9
Diabetes mellitus	96.8
Alcohol consumption	96.8
Opium use	96.7
Ischemic heart disease	96.6
Hyperlipidemia	96.5
Hypertension	96.3
WBC	93.5
Hemoglobin	93.5
Platelet counts	93.5
AST	91.2
ALT	91.0
ALP	89.9
Direct bilirubin	89.4

Total bilirubin	89.0
Amylase level (pre-ERCP)	61.1
Lipase level (pre-ERCP)	61.1
INR (Pre-ERCP)	50.1
Amylase level (post-ERCP)	44.8
Lipase level (post-ERCP)	44.8

4. Discussion

This five-year single-center registry represents one of the largest prospective ERCP datasets reported from Iran and, to our knowledge, among the most comprehensive from the Middle East. Across 1,511 procedures in 1,361 patients, we demonstrate a technical success rate of 96.0%, an overall adverse event rate of 7.4%, and a PEP rate of 6.1% — findings that are largely consistent with published international benchmarks while offering unique insight into regional practice patterns. While comprehensive ERCP registries and national databases are well-established in Western and Scandinavian countries, robust and large-scale data remain notably scarce in Iran and the broader Middle East. In this context, the establishment of this registry—highlighted by a 0% missing data rate for several critical procedural and outcome variables—provides a highly reliable reflection of real-world clinical practice.

The predominance of choledocholithiasis as the primary indication (71%) reflects both the high regional burden of gallstone disease and the tertiary referral role of our center, which receives a substantial proportion of patients following failed primary-level biliary imaging or management. Our procedural data reflects a high burden of therapeutic interventions, with biliary sphincterotomy performed in the vast majority of cases (1322 procedures) and balloon dilation in a significant subset (430 procedures). This aligns with the global paradigm shift in which ERCP has evolved from a diagnostic modality—largely replaced by magnetic resonance cholangiopancreatography (MRCP) and endoscopic ultrasound (EUS)—to an almost exclusively therapeutic intervention (21). The high volume of sphincterotomies and dilations confirms the center's role as a tertiary referral hub managing complex biliary obstructions.

In terms of efficacy, our cohort demonstrated a remarkable technical success rate of 96.0%. According to the performance metrics established by the American Society for Gastrointestinal Endoscopy (ASGE) and the European Society of Gastrointestinal Endoscopy (ESGE), the standard benchmark for successful biliary cannulation and intended therapeutic intervention is $> 90\%$for standard anatomies (22, 23). Our findings comfortably exceed this minimum threshold and are closely comparable to success rates reported by high-volume international centers. The small proportion of clinical failures was largely attributed to complex anatomical variations or advanced malignancies, which is consistent with global literature.

Regarding safety, the overall adverse event rate in our registry was 7.4%, with post-ERCP pancreatitis (PEP) accounting for the majority of these events at 6.1%. International guidelines

and large multicenter cohorts typically report PEP incidences ranging from 3.5% to 9.7% in unselected patient populations (24). Our complication rates fall squarely within these accepted global standards, demonstrating that therapeutic ERCP can be performed with optimal safety profiles in a regional tertiary setting. Malignant biliary obstruction accounted for 13% of cases, and post-surgical biliary complications, PSC, and portal hypertension biliopathy together represented a clinically meaningful minority, underscoring the procedural breadth expected of a high-volume academic center.

A notable scientific contribution of our registry is the robust sex-stratified analysis. Interestingly, our analysis revealed no significant difference in the primary indications for ERCP between male and female patients ($p = 0.140$), indicating that the overall spectrum of pancreatobiliary diseases requiring advanced endoscopic intervention is epidemiologically similar across both sexes in our cohort. Despite having comparable baseline indications, female patients underwent ERCP at a significantly younger age (mean 63 vs. 66 years, $p = 0.015$) and experienced a substantially higher incidence of PEP (9.9% vs. 3.7%, $p < 0.0001$). Because the primary reasons for the procedure did not differ between the groups, the elevated PEP rate in females cannot be attributed to a higher frequency of more complex or inherently high-risk baseline diseases. Instead, this parity in indications strongly reinforces the hypothesis that the increased PEP risk in females is driven by intrinsic anatomical and physiological factors. This finding aligns with international literature, which often attributes this vulnerability to a higher prevalence of sphincter of Oddi dysfunction (SOD) (25). Our regional data confirms that these predispositions hold true within the Iranian population, further reinforcing the need for aggressive pharmacological prophylaxis (e.g., rectal indomethacin) in this high-risk subgroup.

Compared to registries from neighboring regions — including those from Turkey, Egypt, and South Asia — our success rates are comparable and our complication profile reflects a similarly complex referral caseload. The near-zero missing data rate across core procedural variables distinguishes this registry in terms of data integrity, a known limitation of retrospective ERCP studies in resource-limited settings (26, 27).

Our study has several limitations that should be acknowledged. First, as a single-center study, our findings may not be entirely generalizable to other institutions with varying levels of expertise, caseloads, or resources. Second, despite utilizing a meticulously maintained registry, the inherent biases associated with observational data cannot be completely excluded. However, these limitations are strongly counterbalanced by several notable strengths. To our knowledge, this is one of the largest and most comprehensive ERCP registries reported in the Middle East, encompassing 1511 procedures. The rigorous data collection framework is highlighted by a 0%missing data rate for critical variables, ensuring the high reliability and robustness of our outcomes. Furthermore, the detailed sex-stratified analysis provides valuable, context-specific insights into complication profiles, particularly the increased risk of post-ERCP pancreatitis in female patients, adding significant value to the current literature.

conclusion

In conclusion, this registry represents one of the most comprehensive and data-complete ERCP cohorts reported in the Middle East. It validates that high success rates (96.0%) and acceptable complication rates (7.4%), strictly in line with ASGE and ESGE global standards, are achievable in the region. Furthermore, it highlights the significantly elevated risk of PEP in female patients, underscoring the necessity for targeted prophylactic strategies. This registry lays a solid foundation for future multi-center, prospective studies to further optimize ERCP outcomes in the region.

References

1. Papaefthymiou A, Landi R, Arvanitakis M, Tringali A, Gkolfakis P. Endoscopic retrograde cholangiopancreatography: A comprehensive review as a single diagnostic tool. Best Practice & Research Clinical Gastroenterology. 2025;74:101976.
2. Han S, Chandrasekhara V. Endoscopic Retrograde Cholangiopancreatography: Pancreatic Endoscopy. Gastroenterol Clin North Am. 2024;53(4):643–61.
3. Manti M, Shah J, Papaefthymiou A, Facciorusso A, Ramai D, Tziatzios G, et al. Endoscopic Management of Difficult Biliary Stones: An Evergreen Issue. Medicina (Kaunas). 2024;60(2).
4. Almuhaidb A, Olson D, Aadam AA. Advancements in Endoscopic Biliary Interventions by Gastroenterology. Semin Intervent Radiol. 2021;38(3):280–90.
5. Kazami Y, Kawaguchi Y, Hasegawa K. Obstructive Biliary Tract Disease. In: Hackert T, Gulla A, editors. Rare Liver and Biliary Tract Diseases: Surgical Management. Cham: Springer Nature Switzerland; 2026. p. 281–97.
6. Hung K. Fundamentals of ERCP: Indications, Equipment, and Preparation. 2018. p. 1–11.
7. Forbes N, Leontiadis GI, Vaska M, Elmunzer BJ, Yuan Y, Bishay K, et al. Adverse events associated with endoscopic retrograde cholangiopancreatography: protocol for a systematic review and meta-analysis. BMJ Open. 2021;11(8):e053302.
8. Cahyadi O, Tehami N, de-Madaria E, Siau K. Post-ERCP Pancreatitis: Prevention, Diagnosis and Management. Medicina (Kaunas). 2022;58(9).
9. Nawacki Ł, Bociek A, Bielejewska A, Gorczyca-Głowacka I, Gluszek S. More Than Just a Complication: Post-ERCP Pancreatitis and Its Clinical Determinants in over 800 Procedures. Journal of Clinical Medicine. 2025;14.
10. Triki L, Tringali A, Arvanitakis M, Schepis T. Prevention of post-ERCP complications. Best Practice & Research Clinical Gastroenterology. 2024;69:101906.
11. Sirinawasatien A, Chanchairungcharoen J, Yaowmaneerat T, Jiratham-Opas J, Chanpiwat K, Chantarojanasiri T, et al. The use of endoscopic ultrasound in tandem with endoscopic retrograde cholangiopancreatography in the 2019 American Society for Gastrointestinal Endoscopy guideline for patients at high risk of choledocholithiasis can

help to avoid diagnostic endoscopic retrograde cholangiopancreatography in individuals without ascending cholangitis. DEN Open. 2025;5(1):e70058.
12. Hu LH, Xin L, Liao Z, Pan J, Qian W, Wang LW, et al. ERCP development in the largest developing country: a national survey from China in 2013. Gastrointest Endosc. 2016;84(4):659–66.
13. Yang HY, Wang D, Lin X, Han C, Lv YW, Huang RQ, et al. Global trends of ERCP research in the last 25 years: A bibliometrics study. Medicine (Baltimore). 2022;101(31):e29454.
14. Voiosu T, Bengus A, Voiosu A, Rimbas M, Zlate A, Haidar A, et al. Trainee caseload correlates with ERCP success rates but not with procedure-related complications: results from a prospective study (the QUASIE cohort). Endosc Int Open. 2016;4(4):E409–14.
15. Keswani R, Qumseya B, O'Dwyer L, Wani S. Association between Endoscopist and Center ERCP Volume with Procedure Success and Adverse Outcomes: A Systematic Review and Meta-Analysis. Clinical Gastroenterology and Hepatology. 2017;15.
16. Everett SM, Ahmed W, Dobson C, Haworth E, Jarvis M, Kluettgens B, et al. British Society of Gastroenterology Endoscopic Retrograde Cholangiopancreatography (ERCP) Quality Improvement Programme: minimum service standards and good practice statements. Frontline Gastroenterology. 2024;15(6):445.
17. Clark CJ, Fino NF, Clark N, Rosales A, Mishra G, Pawa R. Trends in the Use of Endoscopic Retrograde Cholangiopancreatography for the Management of Chronic Pancreatitis in the United States. J Clin Gastroenterol. 2016;50(5):417–22.
18. Thiruvengadam NR, Saumoy M, Schaubel DE, Cotton PB, Elmunzer BJ, Freeman ML, et al. Rise in First-Time ERCP for Benign Indications >1 Year After Cholecystectomy Is Associated With Worse Outcomes. Clinical Gastroenterology and Hepatology. 2024;22(8):1618–27.e4.
19. Forslund A, Haraldsson E, Holmberg E, Naredi P, Rizell M. Risks and use of ERCP during the diagnostic workup in a national cohort of biliary cancer. Surgical Endoscopy. 2025;39(2):991–1001.
20. Tenner S, Baillie J, DeWitt J, Vege SS. American College of Gastroenterology guideline: management of acute pancreatitis. Am J Gastroenterol. 2013;108(9):1400–15; 16.
21. Sanders D, Bomman S, Krishnamoorthi R, Kozarek R. Endoscopic retrograde cholangiopancreatography: Current practice and future research. World Journal of Gastrointestinal Endoscopy. 2021;13:260–74.
22. Domagk D, Oppong KW, Aabakken L, Czakó L, Gyökeres T, Manes G, et al. Performance measures for endoscopic retrograde cholangiopancreatography and endoscopic ultrasound: A European Society of Gastrointestinal Endoscopy (ESGE) Quality Improvement Initiative. United European Gastroenterol J. 2018;6(10):1448–60.
23. Chon HK, Kim KH, Song TJ, Ahn DW, Lee ES, Lee YN, et al. Quality Indicators of Endoscopic Retrograde Cholangiopancreatography in Korea. Gut Liver. 2024;18(4):564–77.
24. Suzuki A, Uno K, Nakase K, Mandai K, Endoh B, Chikugo K, et al. Post-endoscopic retrograde cholangiopancreatography pancreatitis assessed using criteria for acute pancreatitis. JGH Open. 2021;5(12):1391–7.
25. Afghani E, Lo SK, Covington PS, Cash BD, Pandol SJ. Sphincter of Oddi Function and Risk Factors for Dysfunction. Frontiers in Nutrition. 2017;Volume 4 - 2017.

26. Atamananalp SS, Yildirgan M, Kantarci A. Endoscopic retrograde cholangiopancreatography (ERCP): Outcomes of 3136 cases over 10 years. Turkish Journal of Medical Sciences. 2011;41:615–21.
27. Kato M, Tanaka K, Kida M, Ryozawa S, Matsuda K, Fujishiro M, et al. Multicenter database registry for endoscopic retrograde cholangiopancreatography: Japan Endoscopic Database Project. Digestive Endoscopy. 2020;32(4):494–502.