

Challenges and outcomes of ERCP in patients with periampullary duodenal diverticulum: Insights from a single-center retrospective study in Vietnam

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Summary

Background: The relationship between periampullary duodenal diverticulum (PAD) and ERCP outcomes remains unclear. This study aims to assess the effects of PAD on cannulation success, complications, and treatment efficacy in patients with bile duct stones. **Subject and method:** A retrospective study was conducted among 587 patients with native papilla who underwent ERCP from January 2021 to December 2022 at 108 Military Central Hospital, categorized into two groups: those with PAD (n = 143) and those without (NPAD, n = 444). We analyzed cannulation success, procedural difficulties, and complications. **Result:** PAD was identified in 22.9% of the cohort. Both groups had comparable successful cannulation rates (PAD: 98.6%, NPAD: 95.9%, $p=0.2$), yet PAD patients faced more significant challenges (35% vs. 23.4%, $p=0.009$). The necessity for biliary stenting was notably higher in the PAD group (16.3% vs. 9.6%, $p=0.04$). Although post-ERCP complications did not differ significantly, the hospital stay was longer for PAD patients (7 days vs. 6 days, $p=0.0002$). **Conclusion:** PAD may complicate the ERCP procedure; however, treatment outcomes remain primarily consistent across both groups. Enhanced management approaches are essential for improving patient care in those with PAD.

Keywords: Endoscopic retrograde cholangiopancreatography, periampullary diverticulum, difficult cannulation, biliary cannulation, cannulation techniques.

I. BACKGROUND

Periampullary duodenal diverticulum (PAD) is a common anatomical variation in the gastrointestinal tract, with an occurrence rate ranging from 10% to 32.3%^{1, 2}. Age is considered a confounding factor as diverticula and bile duct stones increase². Previous studies have demonstrated a correlation between PAD and the occurrence of bile duct stones^{1, 2}. However, the influence of PAD on ERCP for the treatment of biliary and pancreatic diseases remains

controversial. While some research indicates that PAD does not increase the risk of selective cannulation failure²⁻⁴, other studies have shown that it makes ERCP more difficult and raises the likelihood of complications⁵⁻⁸. Thus, further research is required to fully understand PAD's effects on ERCP outcomes. Specifically, PAD was found in 32.3% of Vietnamese patients undergoing ERCP¹, yet there is no conclusive evidence to confirm whether PAD impacts ERCP complications in Vietnam. This unresolved issue, due to conflicting findings in various studies, highlights the need for more research to determine the success rate and complications related to ERCP in patients with PAD. Therefore, this study aimed to investigate and

Received: 18 October 2024, *Accepted:* 25 November 2024

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compare the success rate, cannulation difficulty, and complications in patients with and without PAD at our ERCP center.

II. SUBJECT AND METHOD

2.1. Subject

From January 2021 to December 2022, a total of 785 patients with bile duct stones were recorded, including 587 patients with native papilla at the 108 Military Central Hospital. *Patient inclusion criteria:* Patients diagnosed with bile duct stones who underwent their first ERCP procedure (whether successful or unsuccessful). *Exclusion criteria:* Patients with gallstones who did not undergo ERCP or those who underwent ERCP for reasons unrelated to gallstones.

2.2. Method

Study design: A retrospective study.

Sample size: Convenient sampling, selecting 587 patients based on inclusion and exclusion criteria. The patients were divided into two groups: The periampullary duodenal diverticulum (PAD) group (n = 143) and the non-periampullary duodenal diverticulum (NPAD) group (n = 444).

Data collection method: Information was collected from medical records at three-time points: before the ERCP procedure, one day after the procedure, and three days post-procedure, comparing pre- and post-intervention results using the specified research indices. Data collected included hospital stay duration and evaluation of ERCP complications such as acute pancreatitis, bleeding, or perforation of hollow organs. Research tools: Complete blood count (CBC), biochemical tests, basic coagulation tests, blood typing, ultrasound, CT scan, electrocardiogram, C-arm system, side-viewing endoscope for ERCP, and various intervention tools such as knives, baskets, balloons, biliary stents, contrast agents, and study-specific patient records. Procedure: Preparation of the patient and instruments, conducting the ERCP stone extraction procedure, and post-ERCP treatment.

Statistical analysis: Statistical analysis was performed using GraphPad Prism version 9.1 (<https://www.graphpad.com/>) and SPSS version 25.0. The research results are presented as percentages, while the length of hospital stay is expressed as the median with the interquartile range (Q1-Q3). A p-value of less than 0.05 was considered statistically significant.

2.3. Ethics approval and consent to participate

The study protocol was performed according to the 1975 Declaration of Helsinki principles. The Institutional Review Board and the Scientific Ethics Review Committee of 108 Military Central Hospital approved the study. Informed consent was obtained from all participants after a detailed explanation of the treatment. All patients were discussed by the hospital's multidisciplinary team and approved for ERCP's performance in treating CBD stones. All data were analyzed following the guidelines and regulations related to data security.

III. RESULT

3.1. Baseline characteristics of subjects

From January 2021 to December 2022, 785 patients with bile duct stones were recorded. One hundred eighty of them were found to have PAD (a rate of 22.9%), including 134 with a native papilla. The baseline characteristics of these 180 patients are shown in Table 1.

Table 1. The baseline characteristics of 180 patients with periampullary duodenal diverticulum

Characteristics		PAD (n = 180)
Male, n %		97 (53.9)
Age	Mean (years) ± SD	72.5 ± 13.1
	>60 years, n %	149 (82.8)
Abdominal pains, n %		156 (86.7)
Fever, n %		115 (63.9)
Jaundice, n %		80 (44.4)
Severe acute cholangitis, n %		41 (22.8)
Septicemia, n %		28 (15.6)
Acute pancreatitis, n %		20 (11.1)

Comments: The average age of PAD patients was 72.5 years, primarily consisting of patients over 60 years old (82.8%). Nearly one-quarter of PAD patients had severe cholangitis, including 28 out of 180 patients with bacteremia (15.6%).

3.2. ERCP outcomes and adverse events

Table 2. ERCP results among patients with native papilla

ERCP results	PAD (n = 143)	NPAD (n = 444)	p-value
Successful cannulation, n (%)	141 (98.6)	426 (95.9)	0.2
Difficult cannulation, n (%)	50 (35.0)	104 (23.4)	0.009
Precut papillotomy, n (%)	14 (9.8)	55 (12.4)	0.5
Patients with PD cannulation, n (%)	28 (19.6)	76 (17.1)	0.6
Patients with PD injection, n (%)	9 (6.3)	22 (5)	0.7
CBD diameter (mm), median [Q1-Q3]	12 [10 - 15]	12 [10 - 17]	0.5
Multiple stones, n (%)	136 (95.1)	394 (88.7)	0.04
Size of stone (mm), median [Q1-Q3]	10 [6 - 15]	10 [6 - 15]	0.9

PAD: Periapillary Duodenal Diverticulum; NPAD: Non-Periapillary Duodenal Diverticulum; CBD: Common bile duct; PD, Pancreatic duct

Comments: Based on the grading of cannulation difficulty, group PAD exhibited a significantly higher rate of difficult cannulation (35% compared to 23.4%, $p=0.009$). However, both groups had comparable procedures precut papillotomy, and there was no significant difference in the ERCP cannulation success rates (98.6% vs. 95.9%, $p=0.2$). Moreover, the rate of multiple stones in PAD patients was significantly higher compared to NPAD patients (95.1% vs. 88.7%, $p=0.04$). Still, the median diameter of the bile ducts and bile stones did not differ between the two groups.

Table 3. Endoscopic treatment after successful cannulation

Endoscopic treatment	PAD (n = 141)	NPAD (n = 426)	p value
Complete biliary stone extraction, n (%)	103 (73.0)	331 (77.7)	0.3
A partly removed stone and an additional biliary stent, n (%)	15 (10.6)	53 (12.4)	0.7
Only biliary stent insertion, n (%)	23 (16.3)	41 (9.6)	0.04
Balloon dilation	73 (51.8)	217 (50.9)	0.9
CBD clearance by basket, n (%)	36 (25.5)	114 (26.8)	0.9
CBD clearance by ballon, n (%)	108 (76.6)	337 (79.1)	0.6

PAD: Periapillary Duodenal Diverticulum; NPAD: Non-Periapillary Duodenal Diverticulum; CBD: Common bile duct.

Comments: Both groups' treatment outcomes for bile duct stones were almost identical, including complete or partial stone removal. In contrast, the rates of failure to remove stones and bile duct stenting were significantly higher in PAD patients compared to NPAD patients (16.3% vs. 9.6%, $p=0.04$). Additionally, the use of stone intervention tools such as biliary dilation balloons, stone baskets, or extraction balloons was similar between the two groups.

Table 4. The endpoints of ERCP and post-ERCP between patients in the group of PAD (n = 143) and the group of NPAD (n = 444)

Variable		PAD (n = 143)	NPAD (n = 444)	p value
Procedure time (min), median [Q1 - Q3]		35 [30 - 45]	30 [30 - 45]	0.3
Duration of hospitalization (days), median [Q1 - Q3]		7 [5 - 11]	6 [5 - 8]	0.0002
Post-ERCP complications (n, %)	Acute pancreatitis	4 (2.8)	3 (0.7)	0.6
	Gastrointestinal bleeding	4 (2.8)	3 (0.7)	0.1
	Perforation	1 (0.7)	2 (0.5)	0.8

Comments: The ERCP procedure time did not differ between the two groups. In contrast, the hospital stay for PAD patients was longer compared to NPAD patients (7 days vs. 6 days, $p=0.002$). Moreover, the rate of post-ERCP complications was not different between the two groups.

IV. DISCUSSION

This study examines the association between different types of periarterial diverticula (PAD) and the success rate of ERCP catheterization while assessing the difficulty and safety of papillary cannulation in patients with PAD. We found PAD in 22.9% of participants, a rate consistent with earlier studies (ranging from 10% to 30%)¹⁻⁴. Previous research has suggested PAD as a significant risk factor for biliary stones. A potential mechanism for this relationship could involve dysfunction of the sphincter of Oddi, caused by the presence of the diverticulum, which increases biliary pressure and leads to the reflux of intestinal contents, promoting gallstone formation. Additionally, the diverticulum may exert mechanical pressure on the distal bile duct, resulting in bile stasis, which can trigger cholangitis and its complications. Our findings further support the notion that severe cholangitis and sepsis are highly observed in individuals with PAD (Table 1).

Previous research has shown varying outcomes in the success rates of ERCP procedures and the visualization of primary biliary structures in patients with PAD. The discrepancies in these findings may be influenced by factors such as the experience level of the endoscopists, differences in catheterization

techniques, patient-specific characteristics, and variations in study design¹⁻⁴. In this study, we analyzed the impact of PAD on ERCP outcomes in 587 Vietnamese patients with native papilla, categorizing them into two groups: those with PAD (n = 143) and those without PAD (NPAD, n = 444).

Periampullary duodenal diverticula (PAD) are considered an obstacle to ERCP techniques. While some studies have reported higher success rates of ERCP procedures in patients without diverticula than those with diverticula, other reports indicate that the success rates are nearly the same between patients with and without PAD^{2, 3, 9}. In our study, we found no significant difference in successful papilla cannulation rates (98.6% vs. 95.9%, $p=0.2$), although the PAD group was more likely to experience difficulty during cannulation (35% vs. 23.4%, PAD vs. NPAD, respectively, Table 2). This may be related to the challenging location of the papilla when PAD is present, particularly when it is deeply situated within the diverticulum. These findings align with those of other authors, who also reported higher rates of difficult papilla cannulation in patients with PAD compared to those without^{2, 3}. When initial cannulation attempts fail, additional cannulation techniques are often required¹⁰. In the literature, several retrospective studies have described various cannulation techniques used in the presence of PAD. The most frequently mentioned techniques include pancreatic duct stenting, followed by needle-knife precut sphincterotomy¹⁰. However, the use rate of these techniques was comparable between the two groups in our study (Table 2).

PAD can be a cause of difficulty during papilla cannulation, but after successful biliary access, the

treatment outcomes of ERCP intervention between patients with and without PAD are reported to be similar in previous studies^{2, 4-8}. In line with this, our study found no difference in the complete or partial stone removal rates between the two groups. However, the rate of biliary stent placement was significantly higher in the PAD group compared to the NPAD group (16.3% vs. 9.6%, $p=0.04$). This may be due to the higher incidence of severe cholangitis in PAD patients, who often require emergency intervention with the primary goal of early biliary decompression rather than immediate stone extraction. Finally, although we did not find a significant difference in post-ERCP complications between the two groups (Table 4), consistent with some other authors^{2, 3}, our analysis revealed that PAD patients had a significantly more extended hospital stay compared to the NPAD group (7 days vs 6 days, $p=0.0002$). This may be explained by the higher proportion of patients in the PAD group suffering from severe cholangitis (22.8%) and sepsis (15.6%).

V. CONCLUSION

These findings suggest that while PAD may complicate the initial stages of ERCP, the overall efficacy of the procedure remains intact. Clinicians should be aware of the increased likelihood of complications in PAD patients and consider tailored approaches to enhance patient outcomes.

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