

# Application of Pancreatic Duct Stenting in ERCP for Choledocholithiasis

Yuan Zhang<sup>1</sup>, Jidong Cao<sup>2</sup>, Yulei Guo<sup>1</sup>, Yan Zhang<sup>1</sup>, Saili Liu<sup>1</sup>, Jianjun Jia<sup>1,\*</sup>

<sup>1</sup>Department of Gastroenterology, The Second Affiliated Hospital of Xingtai Medical College, Xingtai, China

<sup>2</sup>Department of Hepatobiliary Surgery, The Second Affiliated Hospital of Xingtai Medical College, Xingtai, China

\*Correspondence Author: 13932972835@163.com

**Abstract:** **Objective:** To analyze the application effect of pancreatic duct stenting in patients with common bile duct stones undergoing endoscopic retrograde cholangiopancreatography (ERCP). **Methods:** Clinical data of 215 patients with common bile duct stones treated in the hospital from January 2020 to December 2024 were retrospectively analyzed. Based on the biliary drainage method, patients were divided into a nasobiliary drainage group (n=110) and a pancreatic duct stent group (n=105). Levels of aspartate aminotransferase (AST), alanine aminotransferase (ALT), total bilirubin (TBIL), C-reactive protein (CRP), white blood cell (WBC) count, and serum amylase were compared between the two groups before and after the procedure. The incidence of post-ERCP pancreatitis (PEP) and hyperamylasemia, as well as postoperative recovery parameters, were also assessed. **Results:** Preoperatively, no significant differences were observed between the two groups in ALT, AST, TBIL, WBC, CRP, or serum amylase levels ( $P>0.05$ ). Postoperatively, levels of ALT, AST, TBIL, WBC, and CRP in both groups were significantly lower than their respective preoperative levels ( $P<0.05$ ), while serum amylase levels were significantly higher ( $P<0.05$ ). Furthermore, all these postoperative indicators in the pancreatic duct stent group were significantly lower than those in the nasobiliary drainage group ( $P<0.05$ ). The incidence of PEP in the pancreatic duct stent group was 5.71% (6/105), which was significantly lower than the 24.55% (27/110) in the nasobiliary drainage group ( $P<0.05$ ). Postoperative Visual Analog Scale (VAS) pain scores, time to first oral intake, and hospital stay in the pancreatic duct stent group were (3.51±0.69) points, (14.15±3.63) hours, and (5.71±1.03) days, respectively. These values were all significantly lower or shorter than those in the nasobiliary drainage group: (4.55±0.77) points, (24.71±3.97) hours, and (8.15±1.34) days ( $P<0.05$ ). **Conclusion:** In patients with common bile duct stones undergoing ERCP, placement of a pancreatic duct stent can ameliorate systemic inflammatory response and improve liver function, reduce the incidence of PEP, and promote postoperative recovery.

**Keywords:** Common Bile Duct Calculi, Endoscopic Retrograde Cholangiopancreatography, Pancreatic Duct Stent, Nasobiliary Drainage, Complications.

## 1. Introduction

Choledocholithiasis is a common condition in gastroenterology and is associated with a certain mortality rate. Endoscopic retrograde cholangiopancreatography (ERCP) has become an important tool for the diagnosis and treatment of pancreaticobiliary diseases, as it can clearly visualize the biliary system and offers advantages such as minimal invasiveness and rapid recovery [1]. However, complications may occur after ERCP, among which hyperamylasemia and post-ERCP pancreatitis (PEP) are relatively common and can be life-threatening in severe cases. Previously, clinical prevention of post-ERCP complications has primarily relied on pharmacological approaches, but reports on their efficacy have not reached a consensus [2]. In recent years, certain progress has been made in the prevention and management of post-ERCP complications. Some studies have indicated that intraoperative pancreatic duct stent placement during ERCP in patients with choledocholithiasis can reduce the risk of PEP and facilitate patient recovery [3]. Nevertheless, the role of pancreatic duct stent placement during ERCP in patients with bile duct stones remains controversial. Through retrospective statistical analysis, this study aims to investigate the efficacy of pancreatic duct stent placement during ERCP in patients with bile duct stones, in order to provide a reference for clinical management.

## 2. Materials and Methods

### 2.1 Baseline Data

This study was approved by the Medical Ethics Committee of

the Second Affiliated Hospital of Xingtai Medical College. Clinical data from 215 patients with choledocholithiasis treated at our hospital between January 2020 and December 2024 were selected. The inclusion criteria were as follows: 1) a definitive clinical diagnosis of choledocholithiasis and subsequent endoscopic retrograde cholangiopancreatography (ERCP) treatment; 2) selection of biliary drainage following ERCP; and 3) no residual stones observed on postoperative imaging review. The exclusion criteria were as follows: 1) a history of pancreatitis or acute/chronic pancreatitis; 2) a history of upper gastrointestinal surgery or upper gastrointestinal stricture; 3) biliary or pancreatic tumors; 4) contrast agent allergy; 5) pregnancy or lactation; 6) pancreatobiliary maljunction; and 7) inability to tolerate the ERCP procedure. All patients were divided into two groups based on the biliary drainage method: the nasobiliary drainage group (NBD, n=110) and the pancreatic duct stent group (PDS, n=105). No statistically significant differences were found in the baseline characteristics between the two groups ( $P>0.05$ ), indicating comparability, as shown in Table 1.

### 2.2 Treatment Methods

All patients routinely fasted for 8–12 hours preoperatively and received an intramuscular injection of 40 mg phloroglucinol injection half an hour before the procedure. Iohexol injection was selected as the contrast agent. Conventional endoscopic retrograde cholangiopancreatography (ERCP) diagnosis and treatment were performed. During the procedure, sphincterotomy and balloon dilation were conducted according to the stone condition, followed by stone extraction. In the pancreatic duct stent group, a pancreatic duct guidewire

was placed into the main pancreatic duct, and a plastic pancreatic duct stent (5Fr, 6cm, Cook, Ireland Ltd.) was inserted. Biliary drainage was performed using the double-guidewire technique. In the nasobiliary drainage group, a nasobiliary drainage tube was inserted into the common bile duct over a guidewire. After successful cannulation, the endoscope was withdrawn to complete the procedure. All patients received postoperative supportive treatments including fluid infusion, enzyme inhibition, acid suppression, and anti-infection therapy. Postoperative drainage was maintained for approximately 3 days in both groups and was discontinued after relevant examinations showed no abnormalities.

### 2.3 Observation Indicators

Fasting venous blood samples were collected from patients preoperatively and 24 hours postoperatively. Serum levels of aspartate aminotransferase (AST), alanine aminotransferase (ALT), total bilirubin (TBIL), C-reactive protein (CRP), white blood cell (WBC) count, and serum amylase were determined using a fully automated biochemical analyzer. The incidence of post-ERCP pancreatitis (PEP), defined according to established diagnostic criteria [3], was observed. Postoperative abdominal pain at 24 hours was assessed using a visual analog scale (VAS), with a total score of 10 indicating a positive correlation between pain intensity and score. The time to first oral fluid intake, time to first solid food intake, and total hospital stay were recorded.

### 2.4 Statistical Methods

Statistical analysis was conducted with SPSS software (version 26.0). Continuous data are expressed as mean  $\pm$  standard deviation ( $\bar{x} \pm s$ ) and were compared using the t-test. Categorical data are presented as number of cases (percentage) [n (%)] and were compared using the chi-square test. A

P-value of  $<0.05$  was considered statistically significant.

## 3. Results

### 3.1 Comparison of ALT, AST, TBIL, WBC, CRP, and Serum Amylase Levels Between the Two Groups Before and After ERCP.

Preoperatively, there were no significant differences in the levels of alanine aminotransferase (ALT), aspartate aminotransferase (AST), total bilirubin (TBIL), white blood cell count (WBC), C-reactive protein (CRP), and serum amylase between the two groups ( $P > 0.05$ ), Table 1. Postoperatively, the levels of ALT, AST, TBIL, WBC, and CRP in both groups were significantly lower than their respective preoperative levels ( $P < 0.05$ ), while the serum amylase levels were significantly higher than their respective preoperative levels ( $P < 0.05$ ). Furthermore, the aforementioned indices in the pancreatic duct stent group were significantly lower than those in the nasobiliary drainage group ( $P < 0.05$ ), as shown in Table 2.

### 3.2 Comparison of Postoperative PEP Incidence Between the Two Groups

The incidence of postoperative pancreatitis (PEP) in the pancreatic duct stent group was lower than that in the nasobiliary drainage group ( $P < 0.05$ ), as shown in Table 2.

### 3.3 Comparison of Postoperative Outcomes Between the Two Groups

The postoperative Visual Analogue Scale (VAS) score, time to first oral intake, and length of hospital stay in the pancreatic duct stent group were all lower or shorter than those in the nasobiliary drainage group ( $P < 0.05$ ), as detailed in Table 2.

**Table 1:** Comparison of Baseline Characteristics Between the Two Groups

Variables	Total (n = 215)	NBD (n = 110)	PDS (n = 105)	Statistic	P
Age, Mean $\pm$ SD	61.97 $\pm$ 8.23	61.17 $\pm$ 8.06	62.81 $\pm$ 8.36	t=-1.46	0.145
Pre AST, Mean $\pm$ SD	85.79 $\pm$ 11.64	86.29 $\pm$ 10.77	85.26 $\pm$ 12.51	t=0.65	0.519
Pre ALT, Mean $\pm$ SD	90.72 $\pm$ 15.07	91.76 $\pm$ 14.77	89.63 $\pm$ 15.38	t=1.04	0.301
Pre CRP, Mean $\pm$ SD	12.84 $\pm$ 3.18	12.85 $\pm$ 3.62	12.83 $\pm$ 2.65	t=0.05	0.963
Pre Amylase, Mean $\pm$ SD	88.96 $\pm$ 10.06	89.18 $\pm$ 8.93	88.74 $\pm$ 11.16	t=0.31	0.754
Stone Diameter, Mean $\pm$ SD	9.51 $\pm$ 2.45	9.24 $\pm$ 2.52	9.79 $\pm$ 2.35	t=-1.64	0.103
CBD Diameter, Mean $\pm$ SD	12.62 $\pm$ 2.53	12.54 $\pm$ 2.52	12.71 $\pm$ 2.54	t=-0.48	0.634
Stone Number, Mean $\pm$ SD	2.00 $\pm$ 1.17	2.04 $\pm$ 1.20	1.95 $\pm$ 1.15	t=0.52	0.601
Gender, n(%)				$\chi^2=0.76$	0.384
Female	113 (52.56)	61 (55.45)	52 (49.52)		
Male	102 (47.44)	49 (44.55)	53 (50.48)		

t: t-test,  $\chi^2$ : Chi-square test  
SD: standard deviation

**Table 2:** Comparative Analysis

Variables	Total (n = 215)	NBD (n = 110)	PDS (n = 105)	Statistic	P
Post AST, Mean $\pm$ SD	39.98 $\pm$ 4.97	43.27 $\pm$ 3.89	36.54 $\pm$ 3.40	t=13.47	<.001
Post ALT, Mean $\pm$ SD	53.68 $\pm$ 7.40	57.77 $\pm$ 6.63	49.41 $\pm$ 5.53	t=10.02	<.001
Post CRP, Mean $\pm$ SD	21.38 $\pm$ 6.04	26.36 $\pm$ 3.75	16.17 $\pm$ 2.58	t=23.27	<.001
Post Amylase, Mean $\pm$ SD	141.05 $\pm$ 37.88	174.07 $\pm$ 19.79	106.46 $\pm$ 13.47	t=29.41	<.001
Hospital Stay, Mean $\pm$ SD	6.98 $\pm$ 1.59	8.00 $\pm$ 1.36	5.91 $\pm$ 1.00	t=12.89	<.001
VAS Score, Mean $\pm$ SD	4.07 $\pm$ 0.91	4.65 $\pm$ 0.70	3.47 $\pm$ 0.68	t=12.50	<.001
Feeding Time, Mean $\pm$ SD	19.84 $\pm$ 6.77	25.13 $\pm$ 4.84	14.30 $\pm$ 3.03	t=19.79	<.001
PEP, n(%)	33(15.35)	27(24.55)	6(5.71)	$\chi^2=14.66$	<.001

t: t-test,  $\chi^2$ : Chi-square test  
SD: standard deviation

#### 4. Discussion

Currently, endoscopic retrograde cholangiopancreatography (ERCP) has been widely used for the treatment of common bile duct stones. However, complications still occur after ERCP, among which post-ERCP pancreatitis (PEP) is one of the most common. PEP not only prolongs the patient's hospital stay and increases the economic burden but can also be life-threatening in severe cases. The prevention of post-ERCP complications plays a crucial role in improving patient prognosis, although the reported efficacy of pharmacological prophylaxis for PEP remains inconsistent. Relevant studies indicate that timely drainage after ERCP is one of the effective methods for preventing postoperative complications in ERCP patients [4]. Nasobiliary drainage can effectively drain pancreatic juice and bile, reduce the reflux of bile and contrast agent, and prevent infection. However, as an external drainage method, nasobiliary drainage may cause postoperative discomfort in the nasopharynx, and tube removal can lead to choking, nausea, and affect postoperative comfort [5]. Additionally, patients intolerant of nasobiliary drainage may experience self-removal or accidental dislodgement of the tube.

In recent years, the application of pancreatic duct stents has been increasing. As an internal drainage method, they prevent the loss of water, electrolytes, and bile, aligning more closely with physiological characteristics. Pancreatic duct stents can prevent inadequate pancreatic duct drainage caused by ERCP procedures, thereby potentially contributing to the prevention of post-ERCP pancreatitis (PEP) [6]. Furthermore, studies have indicated that pancreatic duct stents can reduce the risk of PEP [7]. Following the occurrence of common bile duct stones, some bile may reflux into the pancreatic duct, increasing intraductal pressure, damaging pancreatic acinar cells, and leading to excessive production of trypsin, lipase, and amylase, which subsequently causes hepatocyte injury. Additionally, common bile duct stones can result in bile stasis within the biliary tract, stimulating an inflammatory response characterized by elevated levels of C-reactive protein (CRP) and white blood cells (WBC). This study found that the levels of alanine aminotransferase (ALT), aspartate aminotransferase (AST), total bilirubin (TBIL), CRP, and WBC at 24 hours postoperatively were lower in the pancreatic duct stent group compared to the nasobiliary drainage group. This suggests that intraoperative placement of a pancreatic duct stent during ERCP can more effectively reduce systemic inflammation and promote postoperative recovery of liver function. The underlying mechanism may be that pancreatic duct stent placement alleviates biliary tract compression and pancreatic edema, improves bile stasis within the biliary tract, and exerts a hepatoprotective effect. Furthermore, stent placement can prevent the cascade inflammatory response caused by inadequate pancreatic duct drainage, thereby mitigating the systemic inflammatory state and reducing CRP and WBC levels. Concurrently, this study observed that the pancreatic duct stent group had relatively lower serum amylase levels at 24 hours postoperatively, along with a lower incidence of hyperamylasemia and PEP. All cases improved after active conservative treatment, confirming that pancreatic duct stent placement plays a role in preventing post-ERCP complications. The reason may be that stent placement facilitates pancreatic duct drainage, reduces pancreatic duct

hypertension and autodigestion by pancreatic enzymes, and effectively ameliorates the inflammatory response, thereby alleviating postoperative stress and lowering the risk of complications. These findings are consistent with the results reported by Li Yunhong et al [8]. Moreover, early placement of a pancreatic duct stent during ERCP in patients with common bile duct stones can assist in common bile duct cannulation and avoid pancreatic duct orifice injury, thereby further reducing the risk of PEP.

Furthermore, patients in the pancreatic duct stent group exhibited lower Visual Analogue Scale (VAS) scores at 24 hours postoperatively and had shorter times to first oral intake of liquids and solids. These findings indicate that pancreatic duct stent placement can alleviate postoperative discomfort, reduce intestinal stress responses, and promote the recovery of gastrointestinal function. Some studies have suggested that pancreatic duct stent placement carries a risk of failed cannulation and may theoretically increase the incidence of pancreatic pseudocysts, pancreatic necrosis, and cholangitis. In this study, the rates of failed stent placement and stent dislodgement were both zero, and no related complications occurred. This may be attributed to factors such as the operator's high technical proficiency and the short duration of stent placement. However, the advantages and disadvantages of pancreatic duct stent placement should be comprehensively evaluated in clinical practice, and the decision should be made based on a combination of patient-specific factors and the surgeon's experience. Additionally, the sample size in this study was relatively small, which may introduce some bias into the results. Further large-scale prospective studies are warranted.

In summary, the placement of a pancreatic duct stent during ERCP in patients with common bile duct stones can reduce the incidence of post-ERCP hyperamylasemia and post-ERCP pancreatitis, thereby accelerating postoperative recovery.

#### Fund

Self-financed project of Xingtai Science and Technology Plan (2025ZC378).

#### References

- [1] Elmunzer B J, Foster L D, Serrano J, et al. Indomethacin with or without prophylactic pancreatic stent placement to prevent pancreatitis after ERCP: a randomised non-inferiority trial [J]. *The Lancet*, 2024, 403(10425): 450-458.
- [2] Mutneja H R, Vohra I, Go A, et al. Temporal trends and mortality of post-ERCP pancreatitis in the United States: a nationwide analysis [J]. *Endoscopy*, 2021, 53(04): 357-366.
- [3] Mazaki T, Mado K, Masuda H, et al. Prophylactic pancreatic stent placement and post-ERCP pancreatitis: an updated meta-analysis [J]. *Journal of gastroenterology*, 2014,49(2):343-355.
- [4] Avila P, Holmes I, Kouanda A, et al. Practice patterns of post-ERCP pancreatitis prophylaxis techniques in the United States: a survey of advanced endoscopists [J]. *Gastrointestinal endoscopy*, 2020,91(3):568-573.

- [5] Keswani R N, Qumseya B J, O Dwyer L C, et al. Association between endoscopist and center endoscopic retrograde cholangiopancreatography volume with procedure success and adverse outcomes: a systematic review and meta-analysis [J]. *Clinical Gastroenterology and Hepatology*, 2017,15(12):1866-1875.
- [6] Akshintala V S, Weiland C J S, Bhullar F A, et al. Non-steroidal anti-inflammatory drugs, intravenous fluids, pancreatic stents, or their combinations for the prevention of post-endoscopic retrograde cholangiopancreatography pancreatitis: a systematic review and network meta-analysis [J]. *The Lancet Gastroenterology & Hepatology*, 2021,6(9):733-742.
- [7] Borrelli De Andreis F, Mascagni P, Schepis T, et al. Prevention of post-ERCP pancreatitis: current strategies and novel perspectives [J]. *Therapeutic advances in gastroenterology*, 2023,16:1108338960.
- [8] Li Yunhong, Wang Yun, Liu Jianing, et al. Preliminary study on the prevention of acute pancreatitis after endoscopic retrograde cholangiopancreatography using double guidewire technique combined with pancreatic stent [J]. *Chinese Journal of Digestive Endoscopy*, 2021, 38(9): 740-743.