

Comparison of Outcomes between Endoscopic Retrograde Cholangiopancreatography and Open Surgical Management for Common Bile Duct Stones

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Author's Contribution

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ABSTRACT

Objectives: To identify stone clearance rates and complications related to procedures, particularly post-procedural pancreatitis, in patients with common bile duct (CBD) stones who underwent Endoscopic Retrograde Cholangiopancreatography (ERCP) versus open surgical exploration.

Methodology: This comparative study from (June 2025-Dec 2025), included patients diagnosed with CBD stones who underwent either ERCP or open surgical exploration. The demographic details, rates of stone clearance, complications associated with the procedure, duration of hospitalization, and occurrence of pancreatitis following the procedure were documented and analyzed for comparison between the two treatment groups.

Results: In this study, we included a total of 144 patients; 72 patients underwent ERCP, and 72 underwent open surgical treatment. We found that the ERCP group had higher stone clearance rates compared to the open surgical group. We did not observe procedure-related complications, e.g. post-procedural pancreatitis (12.5 % following ERCP compared with 4.2 % in the surgical group), and even shorter hospital stay duration in the ERCP group compared to the open surgical group. Hypertension and hyperglycemia were among the other complications, with no marked differences noted between the groups.

Conclusion: We concluded that both treatment options are reliable for the management or treatment of CBD stones. ERCP is comparatively better due to its minimally invasive nature and reduced hospital stay duration, though it carries a slight risk of pancreatitis following the procedure. Selecting suitable patients is key to maximizing stone removal success and minimizing complications.

Keywords: Choledocholithiasis, ERCP, surgical exploration, stone removal, pancreatitis, and common bile duct stones.

Introduction

Common bile duct (CBD) stones represent a common biliary disease that can cause pancreatitis, cholangitis, and obstructive jaundice if not addressed. Beyond conventional methods for treatment, Endoscopic Retrograde Cholangiopancreatography (ERCP), a non-surgical option, evolved dramatically and is considered the first choice of treatment for CBD stones.^{1, 2} This method combines both endoscopy and fluoroscopic guidance for better clinical outcomes. Open surgical method is widely used to remove CBD stones.^{3, 4} Both ways of treatment are important and have some limitations³, and choosing either option mainly depends on many factors.³⁻⁶ Despite the widespread use of both methods, there is debate going to assess superior efficacy in terms of stone clearance, their complications, and outbreak. A recent study by Wang et al., reported 93.6% success rate of ERCP method for CBD stones stone clearance compared to those who had laparoscopic

common bile duct exploration (LCBDE). They also showed that ERCP group had shorter time than open surgical exploration (52.0±15.8 versus 102.9±40.1 min, p<0.001). There were no differences in postoperative hospital stays, complication rates, and outbreaks, suggesting that ERCP might be a better option for CBD stones.

Another report showed that during COVID19 pandemic, number of open surgical exploration of CBD stones were increased, while use of T-tube drainage procedures were decreases (p<0.001).⁸ During follow-up, among the patients underwent T-tube drainage, two patients developed bile duct cancer, and also showed higher rate of stone recurrence, indicating that persistent difficulties in choosing the best treatment method for CBD stones. It is still unknown comparative efficacy and safety of both methods, especially in environments where treatment choices are depending on local expertise and

facilities availability. In current study, we focused on evaluating stone clearance rates, hospital stay duration, postoperative complications, and recurrence rates to ascertain the comparative efficacy and safety of these methods. The findings of this study may provide clinically relevant evidence to support decision-making and contribute to the optimization of management strategies for patients with CBD stones.

Methodology

This Longitudinal observational study conducted at in-patient Department of Surgery Bahawal Victoria Hospital Bahawalpur during the period of 6 months (June 2025-Dec 2025). The sample size was calculated using the WHO sample size calculator. A single-proportion hypothesis testing formula was applied, assuming an expected stone clearance rate of 93.6% among patients undergoing common bile duct exploration, as reported in previous literature⁷. In this study, we included all those patients with confirmed CBD stones requiring intervention, adults aged 20 - 60 years, both male and female, symptomatic patients (jaundice, cholangitis, biliary colic), fit for either ERCP or open surgery as per anesthetic evaluation and those agreed to give informed consent whereas those having malignant biliary CBD obstruction, previous biliary surgery and those with coagulopathy or severe cardiopulmonary disease were excluded from this trial. Following approval from the Ethical Review Committee (ERC), a total of 144 patients diagnosed with common bile duct (CBD) stones and admitted to the Department of Surgery, Bahawal Victoria Hospital, Bahawalpur. Baseline data, including age, sex, BMI, diabetes, hypertension, obesity were systematically recorded. All Patients undergoing were CBD exploration either through ERCP or Open surgery based on their clinical status and surgeon's preference. All patients received standardized preoperative preparation and postoperative care according to institutional protocols. Postoperatively all patients had MRCP done within 7 days to document the stone clearance. In our study, common

bile duct (CBD) stones were assessed through a combination of clinical evaluation, laboratory tests, and imaging techniques.

Patients typically present with symptoms such as jaundice, abdominal pain, or signs of cholangitis. Blood tests, including liver function tests, help identify biliary obstruction. As per Hospital policy transabdominal ultrasound, and MRCP (Magnetic Resonance Cholangiopancreatography), was used to confirm the size, and location of CBD stones. Postoperative MRCP was done within 1 week to confirm the Stone clearance. Within 6 weeks postoperatively, patients presenting with epigastric pain (VAS>6) and radiating to back, vomiting and serum lipase level >150U/L were labeled as acute pancreatitis. Known hypertensive patients for ≥1 year on antihypertensive treatment was deemed positive for hypertension. Known diabetic patients for ≥1 year on hypoglycemic treatment were deemed as diabetics. Obesity was assessed through body mass index using formula: BMI=weight in kg/height in m². Weight was measured on weighting scale and height on stadiometer. All the patients were followed fortnightly for 6 weeks to document the development of pancreatitis as per operational definition. All the data was recorded on the study performa.

The computed data was analyzed by using SPSS version 26.0. Age, BMI, and stone size were presented as mean and standard deviation. Gender, obesity, diabetes mellitus, stone location (proximal / distal CBD), type of procedure performed, stone clearance, and pancreatitis was presented as frequency and percentages. Data was stratified on age, obesity, diabetes, hypertension, stone size, stone location, and type of procedure performed to determine the effect on distribution of stone clearance and pancreatitis. Post stratification chi Square test was applied and P value <0.05 was considered as significant.

Results

The baseline demographic and clinical characteristics of

Table I: Patient Characteristics at Baseline. (n=144)					
Variable		ERCP (n=72)	Open Surgery (n=72)	Total (n=144)	P-value
Age (years)	Mean ± SD	40.3 ± 11.8	41.0 ± 12.1	40.7 ± 11.9	0.741
BMI (kg/m ²)	Mean ± SD	28.9 ± 3.8	28.9 ± 3.7	28.9 ± 3.8	0.982
Stone size (mm)	Mean ± SD	11.0 ± 3.1	11.1 ± 3.0	11.1 ± 3.1	0.864
Age group	20–40 years	35 (48.6%)	39 (54.2%)	74 (51.4%)	0.505
	41–60 years	37 (51.4%)	33 (45.8%)	70 (48.6%)	
Gender	Male	44 (61.1%)	35 (48.6%)	79 (54.9%)	0.219
	Female	28 (38.9%)	37 (51.4%)	65 (45.1%)	
Obesity	Yes	24 (33.3%)	30 (41.7%)	54 (37.5%)	0.317
	No	48 (66.7%)	42 (58.3%)	90 (62.5%)	
Diabetes	Yes	18 (25.0%)	11 (15.3%)	29 (20.1%)	0.183
	No	54 (75.0%)	61 (84.7%)	115 (79.9%)	
Hypertension	Yes	22 (30.6%)	12 (16.7%)	34 (23.6%)	0.067
	No	50 (69.4%)	60 (83.3%)	110 (76.4%)	
Stone location	Proximal CBD	38 (52.8%)	30 (41.7%)	68 (47.2%)	0.182
	Distal CBD	34 (47.2%)	42 (58.3%)	76 (52.8%)	

the study participants are summarized in Table I. A total of 144 patients were equally allocated to the ERCP and open surgery groups (72 each). The two groups were comparable with respect to age, BMI, stone size, gender, obesity, diabetes, hypertension, and stone location, with no statistically significant differences between them (all $p>0.05$).

As shown in Figure 1, ERCP achieved a significantly higher stone clearance rate than open surgery. Although post-procedural pancreatitis occurred more frequently in the ERCP group (12.5% vs. 8.3%), the difference was not statistically significant ($p=0.07$).

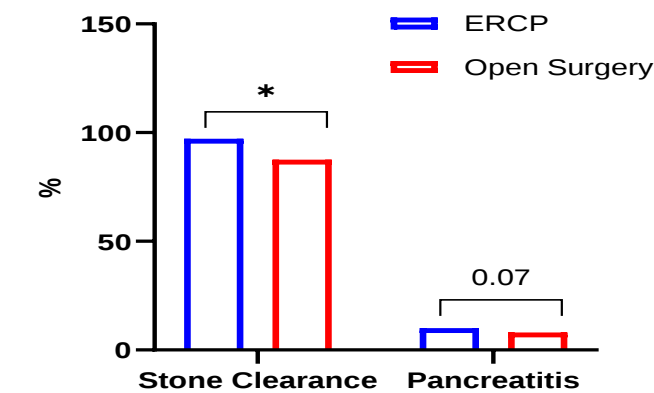


Figure 1. Stone Clearance: ERCP versus Open Surgery.

The stratified analysis of stone clearance is presented in Table II. ERCP consistently demonstrated higher stone clearance rates across most patient subgroups. The advantage was statistically significant among patients aged 41–60 years, females, obese patients, and non-diabetic patients (all $p<0.05$), whereas no significant

differences were observed among younger patients, males, diabetic patients, or those with hypertension.

The subgroup analysis of post-procedural pancreatitis is summarized in Table III. Although pancreatitis occurred more frequently after ERCP across several subgroups, no statistically significant differences were observed between ERCP and open surgery according to age, sex, obesity, diabetes, or hypertension (all $p>0.05$), indicating a comparable safety profile between the two treatment modalities.

Discussion

The current research evaluated the efficacy and safety of ERCP versus open surgical exploration in treating CBD stones. We also show higher stone clearance rates in ERCP group compared to open surgery, while maintaining a similar level of complications, supporting that ERCP as a primary treatment option for choledocholithiasis, especially in facilities with established endoscopic proficiency. Consistent with this, previous report also shows successful ductal clearance in 97.7% of patients treated with ERCP, in contrast to 87.0% for those undergoing laparoscopic CBD exploration.⁷ Likewise, recent evaluations and global guidelines have emphasized that ERCP is the primary treatment method for the majority of patients with choledocholithiasis due to its high success rate and minimally invasive characteristics.^{9, 10} The higher stone clearance rate achieved with ERCP may be attributed to direct endoscopic visualization of the biliary tree and the ability to perform stone extraction during the same procedure. An important observation in our study was the absence of a statistically significant difference in post-procedural pancreatitis between ERCP and open

Table II: Stratification of Stone Clearance between ERCP and Open Surgery						
Variable	Group	Stone Clearance	ERCP n (%)	Open Surgery n (%)	Total n (%)	P-value
Age Group	20–40 years	Yes	35 (100.0%)	37 (94.9%)	72 (97.3%)	0.174*
		No	0 (0.0%)	2 (5.1%)	2 (2.7%)	
	41–60 years	Yes	35 (94.6%)	26 (78.8%)	61 (87.1%)	0.049*
		No	2 (5.4%)	7 (21.2%)	9 (12.9%)	
Gender	Male	Yes	42 (95.5%)	32 (91.4%)	74 (93.7%)	0.465*
		No	2 (4.5%)	3 (8.6%)	5 (6.3%)	
	Female	Yes	28 (100.0%)	31 (83.8%)	59 (90.8%)	0.025*
		No	0 (0.0%)	6 (16.2%)	6 (9.2%)	
Obesity	Yes	Yes	24 (100.0%)	25 (83.3%)	49 (90.7%)	0.036*
		No	0 (0.0%)	5 (16.7%)	5 (9.3%)	
	No	Yes	46 (95.8%)	38 (90.5%)	84 (93.3%)	0.309*
		No	2 (4.2%)	4 (9.5%)	6 (6.7%)	
Diabetes	Yes	Yes	17 (94.4%)	10 (90.9%)	27 (93.1%)	0.715*
		No	1 (5.6%)	1 (9.1%)	2 (6.9%)	
	No	Yes	53 (98.1%)	53 (86.9%)	106 (92.2%)	0.025*
		No	1 (1.9%)	8 (13.1%)	9 (7.8%)	
Hypertension	Yes	Yes	21 (95.5%)	9 (75.0%)	30 (88.2%)	0.077*
		No	1 (4.5%)	3 (25.0%)	4 (11.8%)	
	No	Yes	49 (98.0%)	54 (90.0%)	103 (93.6%)	0.087*
		No	1 (2.0%)	6 (10.0%)	7 (6.4%)	

surgery. Although pancreatitis occurred numerically more frequently among patients undergoing ERCP, the difference did not reach statistical significance.

Post-ERCP pancreatitis remains the most common adverse event associated with endoscopic intervention, with reported incidences ranging from 3% to 15% in the literature.^{11, 12} However, advances in endoscopic techniques, guidewire-assisted cannulation, pancreatic duct stenting, and prophylactic administration of rectal nonsteroidal anti-inflammatory drugs have substantially reduced the incidence and severity of this complication.^{11, 13} The comparable pancreatitis rates observed in our cohort suggest that the benefits of improved stone clearance can be achieved without a significant increase in procedure-related morbidity. The subgroup analyses further demonstrated that ERCP maintained favorable stone clearance outcomes across most demographic and clinical categories. Interestingly, a significant advantage of ERCP was observed among patients aged 41–60 years and among female patients. In contrast, obesity, diabetes mellitus, and hypertension did not significantly affect treatment outcomes. These findings suggest that ERCP remains an effective treatment option across a broad spectrum of patients and support its use as a first-line intervention in appropriately selected cases.^{9, 14}

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This study has several limitations. The single-center design and relatively small sample size may have limited the ability to detect differences in less frequent complications and long-term outcomes. Furthermore, data regarding stone recurrence and long-term quality of life were not available. Nevertheless, the comparable baseline characteristics between groups and the consistency of findings across subgroup analyses strengthen the validity of our observations. There is a need for future multicenter prospective research to more thoroughly assess the long-term results and cost-effectiveness of ERCP and surgical treatment for CBD stones.

Conclusion

In conclusion, we show that ERCP achieved a notably higher stone clearance than open surgical, while the complication rates remained unchanged. Although there was a higher incidence of post-procedural pancreatitis after ERCP, this increase was not statistically significant. These results endorse ERCP as a safe and effective treatment for CBD stones, potentially guiding clinicians in choosing the best treatment approach based on patient-specific factors and available expertise.

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