

OUTCOMES OF LAPAROSCOPIC COMMON BILE DUCT EXPLORATION COMBINED WITH INTRAOPERATIVE CHOLEDOCHOSCOPY FOR CHOLEDOCHOLITHIASIS: A PROSPECTIVE DESCRIPTIVE STUDY

Nguyen Le Gia Kiet*, Nguyen Van Tuan, Mai Van Doi, Nguyen Van Hien, Lam Hoang Huan, Tran Thanh Tuan, Duong Diep Thien Phu, Vo Thi Anh Trinh

Can Tho University of Medicine and Pharmacy

*Corresponding author: nlgkiet.bv@ctump.edu.vn

Received: 24/3/2026

Reviewed: 31/3/2026

Accepted: 25/6/2026

ABSTRACT

Background: Laparoscopic common bile duct exploration combined with intraoperative choledochoscopy is an effective single-stage treatment for choledocholithiasis. However, data on its early outcomes and the optimal biliary drainage strategy in specific regional settings remain limited.

Objectives: To describe the clinical characteristics of patients with choledocholithiasis undergoing laparoscopic common bile duct exploration with intraoperative choledochoscopy, and to evaluate the efficacy and early safety of this approach. **Materials and methods:** A prospective descriptive study was conducted on patients undergoing laparoscopic common bile duct exploration with choledochoscopy at Can Tho University of Medicine and Pharmacy Hospital. **Results:** Thirty-five patients (mean age 55.3 years; 60.0% female) were included. The complete stone clearance rate was 94.3%. Mean operative and choledochoscopy times were 128.5 and 52.4 minutes, respectively. Early postoperative complications were rare, including minor biliary leakage (2.9%) and acute pancreatitis (2.9%). The overall mean postoperative hospital stay was 7.8 days. Notably, patients who underwent primary common bile duct closure had a significantly shorter hospital stay compared to those managed with T-tube drainage (4.8 ± 1.2 vs. 9.2 ± 2.4 days, $p < 0.001$).

Conclusions: Laparoscopic common bile duct exploration combined with intraoperative choledochoscopy is a feasible, safe, and effective single-stage approach for choledocholithiasis. In selected patients, primary common bile duct closure significantly shortens postoperative hospitalization compared to T-tube drainage, optimizing early recovery.

Keywords: Bile duct stones, choledocholithiasis, laparoscopic common bile duct exploration, intraoperative choledochoscopy, primary closure, T-tube drainage.

I. INTRODUCTION

Choledocholithiasis in the Mekong Delta region frequently involves soft, friable brown pigment stones, presenting a high risk of retained stones and recurrence [1], [2]. While traditional common bile duct exploration (CBDE) relied on T-tube drainage, laparoscopic CBDE (LCBDE) combined with intraoperative choledochoscopy has emerged as a preferred minimally invasive alternative [3]. Intraoperative choledochoscopy facilitates direct mucosal visualization, distal patency assessment, and reliable confirmation of stone clearance [4].

Furthermore, current surgical trends increasingly favor primary common bile duct (CBD) closure over conventional T-tube drainage to eliminate drain-related morbidities and accelerate postoperative recovery, provided complete stone clearance is achieved [5].

However, the efficacy and safety of this approach require further validation in specific regional populations [6].

Although LCBDE with intraoperative choledochoscopy is routinely performed at Can Tho University of Medicine and Pharmacy Hospital, systematically collected data regarding its outcomes remain limited. This study was conducted: 1) To describe the clinical, laboratory and imaging characteristics of patients with biliary tract stones undergoing laparoscopic common bile duct exploration combined with intraoperative choledochoscopy; 2) To evaluate the efficacy and early safety of this method in the treatment of bile duct stones.

II. MATERIALS AND METHODS

2.1. Participants

The study was conducted in patients diagnosed with biliary tract stones and indicated for laparoscopic common bile duct exploration combined with intraoperative choledochoscopy at the Department of General Surgery, Can Tho University of Medicine and Pharmacy Hospital. Patients were enrolled from 2025 to 2026.

- **Inclusion criteria:** Adult patients (≥ 18 years) with confirmed choledocholithiasis (CBD diameter ≥ 8 mm) and ASA I-III physical status, presenting with mild-to-moderate acute cholangitis (Tokyo Guidelines 2018) were prospectively enrolled.

- **Exclusion criteria:** Included severe acute cholangitis with organ failure, ASA IV-V, suspected/confirmed hepatobiliary malignancies, complex biliary strictures precluding laparoscopic exploration, deep intrahepatic stones inaccessible by choledochoscopy, previous bilioenteric anastomoses, and cases requiring conversion to open surgery.

2.2. Research methods

- **Research design:** Prospective descriptive study.

- **Sample size:** Consecutive sampling was applied. Based on an expected stone clearance rate of 90% reported by Zerey M *et al.* [7], a 95% confidence level, and a 10% margin of error, the minimum required sample size was 35 patients. All eligible patients during the study period were enrolled.

- **Research contents:**

The following variables were collected: demographic, clinical, laboratory, and imaging characteristics.

Primary intraoperative outcomes included choledochoscopy-confirmed stone clearance, operative time, intraoperative adverse events, stone extraction method, method of common bile duct closure, time to first flatus, length of hospital stay, and early postoperative complications.

The condition of the sphincter of Oddi was evaluated intraoperatively using choledochoscopy. The sphincter of Oddi was considered patent when the distal common bile duct showed no evidence of stricture, obstruction, or impacted stones, and instruments or irrigation fluid passed smoothly into the duodenum. Complete stone clearance was defined when intraoperative choledochoscopy following stone extraction recorded no residual stones in the explored bile duct.

- **Data collection:** Data were collected using a standardized Case Report Form designed for the study, encompassing preoperative, intraoperative, and postoperative information.

- **Data processing:** The collected data were cleaned and entered using Microsoft Excel software. Data processing and statistical analysis were performed using SPSS version 25.0 software.

- **Ethics approval:** This study was approved by the Institutional Review Board for Biomedical Research of the Can Tho University of Medicine and Pharmacy Hospital under approval No. 03/GCN-HĐĐĐ. Written informed consent was obtained from all participants before enrollment. All patient information was anonymized, kept confidential, and used only for research purposes.

III. RESULTS

A total of 35 eligible patients were enrolled in the study. The results were summarized according to baseline characteristics, laboratory findings, intraoperative findings, and early postoperative outcomes.

Table 1. Baseline characteristics of the study population

Characteristics	n (%) / mean $\pm$ SD / median
Age	
Mean	55.3 $\pm$ 4.7 (34-72)
< 60 years	22 (62.9%)
$\geq$ 60 years	13 (37.1%)
Gender	
Male	14 (40.0%)
Female	21 (60.0%)
History of biliary intervention/surgery	
No	30 (85.7%)
Yes	5 (14.3%)
ASA physical status	
I	12 (34.3%)
II	18 (51.4%)
III	5 (14.3%)
Symptoms	
Right upper quadrant/epigastric pain	34 (97.1%)
Dark urine	8 (22.9%)
Nausea/vomiting	6 (17.1%)
Fever	5 (14.3%)
Pruritus	2 (5.7%)
Physical signs	
Right upper quadrant/gallbladder point tenderness	32 (91.4%)
Jaundice/scleral icterus	6 (17.1%)
Hepatomegaly	1 (2.9%)
Distended gallbladder	1 (2.9%)
Severity of acute cholangitis (TG18)	
Grade I	30 (85.7%)
Grade II	5 (14.3%)

The mean age of the patients was 55.3 $\pm$ 4.7 years, with 60.0% being female. The most frequent presenting symptom was right upper quadrant or epigastric pain (97.1%). The

majority of patients were classified as having grade I acute cholangitis (85.7%) and ASA II physical status (51.4%).

Table 2. Laboratory findings of the study population

Laboratory	Mean $\pm$ SD / median
White blood cell count ($\times 10^9/L$), mean	10.5 $\pm$ 3.2 (5.2 - 18.5)
Neutrophils (%), mean	68.5 $\pm$ 10.4 (45.0 - 88.0)
AST (U/L), median	46 (18 - 195)
ALT (U/L), median	51 (16 - 210)
Total bilirubin ($\mu\text{mol/L}$), median	22.0 (9.0 - 155)
Direct bilirubin ($\mu\text{mol/L}$), median	12.5 (3.5 - 95)
CRP (mg/L), median	8.5 (1.5 - 115)
Prothrombin (%), mean	92.4 $\pm$ 6.5 (68 - 100)

The mean preoperative white blood cell count was $10.5 \pm 3.2 \times 10^9/L$. The median AST and ALT levels were 46 U/L and 51 U/L, respectively, while the median total bilirubin was 22.0 $\mu\text{mol/L}$. Prothrombin activity was $92.4 \pm 6.5\%$.

Table 3. Intraoperative findings and surgical procedures

Characteristics	n (%) / mean $\pm$ SD / median
Operative time (min), mean	128.5 $\pm$ 32.5 (80 - 190)
Intraoperative choledochoscopy time (min), mean	52.4 $\pm$ 18.6 (25 - 95)
Number of trocars	
4 trocars	33 (94.3%)
5 trocars	2 (5.7%)
Choledochoscopic evaluation	
Patent sphincter of Oddi	34 (97.1%)
Non-patent sphincter of Oddi	1 (2.9%)
Hyperemic biliary mucosa	21 (60.0%)
Normal biliary mucosa	14 (40.0%)
Stone extraction methods	
Laser lithotripsy + basket extraction	21 (60.0%)
Basket extraction alone	14 (40.0%)
Management of the common bile duct	
T-tube placement	24 (68.6%)
Primary closure	11 (31.4%)
Intraoperative accidents	
None	34 (97.1%)
Minor biliary hemorrhage	1 (2.9%)

The mean operative and intraoperative choledochoscopy times were 128.5 ± 32.5 and 52.4 ± 18.6 minutes, respectively. A patent sphincter of Oddi was observed in 97.1% of cases. Laser lithotripsy combined with basket extraction was utilized in 60.0% of patients. Primary closure was performed in 11 patients (31.4%), while 24 patients (68.6%) received T-tube drainage.

Table 4. Postoperative outcomes and complications

Outcomes	n (%) / mean $\pm$ SD / median
Intraoperative choledochoscopy-confirmed stone clearance	
Complete stone clearance	33 (94.3%)
Residual intrahepatic stones	2 (5.7%)
Postoperative time to first flatus (hours), mean	28.5 $\pm$ 10.2 (14 - 58)
Early postoperative complications	
None	33 (94.3%)
Minor biliary leakage	1 (2.9%)
Acute pancreatitis	1 (2.9%)
Postoperative length of hospital stay (days), mean	7.8 $\pm$ 2.9 (4 - 15)
Length of stay by CBD management method (days)	
Primary closure (n=11)	4.8 $\pm$ 1.2 (4 - 7)
T-tube drainage (n=24)	9.2 $\pm$ 2.4 (7 - 15)
Mean difference (95% CI)	4.4 (3.2 - 5.6); $p < 0.001$

Complete stone clearance was achieved in 33 patients (94.3%). The overall mean postoperative hospital stay was 7.8 ± 2.9 days. Notably, the length of stay was significantly shorter in the primary closure group compared to the T-tube drainage group (4.8 ± 1.2 vs. 9.2 ± 2.4 days, $p < 0.001$).

IV. DISCUSSION

The core criterion reflecting technical efficacy in our study is the stone clearance rate, which reached 94.3%. This result is highly comparable to the study by Zheng *et al.* (2025) on laparoscopic common bile duct exploration with intraoperative choledochoscopy, which reported clearance rates ranging from 94.7% to 95.4% [8]. This success is primarily attributed to the integration of intraoperative choledochoscopy, allowing direct visualization of the intraductal space to accurately detect and extract stones in both intrahepatic and extrahepatic bile ducts. Visual inspection of the biliary mucosa provides superior reliability compared to indirect exploration techniques or pure mechanical stone extraction maneuvers [9],[10]. Although two cases of residual intrahepatic stones confirmed that proximal retained stones remain a significant technical challenge, the overall stone clearance rate of 94.3% remains clinically meaningful. It demonstrates the superiority of a single-stage procedure in resolving biliary obstruction while minimizing the need for subsequent postoperative interventions, such as ERCP, exhibiting high applicability for complex biliary stone disease [11].

Regarding early safety, the procedure's low complication rate (biliary leakage 2.9%, pancreatitis 2.9%) aligns with the 2.6-4.8% rates reported by Wang *et al.* [11]. Our outcomes are comparable to published international studies with similarly low rates of these complications [9]. These positive results stem from appropriate patient selection, specifically those with adequately dilated bile ducts, combined with direct maneuvers under clear choledochoscopic visualization and surgeons' expertise [11]. Furthermore, a patent distal CBD and sphincter of Oddi, observed in 97.1% of patients, directly facilitated interventional maneuvers and optimal postoperative biliary drainage, likely contributing to the high clearance rate [11].

Crucially, primary common bile duct closure significantly shortened the length of hospital stay compared to the T-tube drainage group. This observation aligns with current surgical trends and the study by Wang *et al.* (2022), which affirmed that primary closure significantly reduces inpatient treatment duration compared to traditional T-tube placement [11]. This accelerated recovery is primarily attributed to avoiding external abdominal drains, which alleviates pain and discomfort while eliminating the risks and complex care procedures associated with the tube site. These findings suggest that primary CBD closure is a highly reasonable option in carefully selected patients, especially after choledochoscopic confirmation of complete clearance and adequate biliary patency.

Despite providing valuable prospective data affirming the feasibility and safety of this approach in our setting, several limitations warrant cautious interpretation. As a single-center observational study with a modest sample size, these results reflect a statistical correlation rather than a causal relationship. The lack of a randomized design and multivariate analysis increases the risk of selection bias when comparing primary closure and T-tube drainage groups. Finally, the study lacks long-term follow-up data to evaluate late complications such as biliary stricture or stone recurrence. Therefore, the role of this technique warrants further verification through randomized controlled trials to establish more robust conclusions.

V. CONCLUSION

Laparoscopic common bile duct exploration combined with intraoperative choledochoscopy is a feasible, safe, and effective single-stage approach for choledocholithiasis. In selected patients, primary common bile duct closure significantly shortens postoperative hospitalization compared to T-tube drainage, optimizing early recovery. Further studies with larger sample sizes and long-term follow-up are required to confirm these outcomes.

ACKNOWLEDGEMENTS

The authors would like to sincerely thank Can Tho University of Medicine and Pharmacy for providing the financial support to conduct this research under Decision No. 5856/QD-DHYDCT, dated December 10, 2025, issued by Can Tho University of Medicine and Pharmacy.

REFERENCES

1. Shaffer E. A. Gallstone disease: Epidemiology of gallbladder stone disease. *Best Pract Res Clin Gastroenterol.* 2006. 20(6), 981-996. DOI: 10.1016/j.bpg.2006.05.004.
2. Tazuma S. Gallstone disease: Epidemiology, pathogenesis, and classification of biliary stones (common bile duct and intrahepatic). *Best Pract Res Clin Gastroenterol.* 2006. 20(6), 1075-83. DOI: 10.1016/j.bpg.2006.05.009.
3. Marks B., Al Samaraee A. Laparoscopic Exploration of the Common Bile Duct: A Systematic Review of the Published Evidence Over the Last 10 Years. *Am Surg.* 2021. 87(3), 404-418. DOI: 10.1177/0003134820949527.
4. Gupta N. Role of laparoscopic common bile duct exploration in the management of choledocholithiasis. *World J Gastrointest Surg.* 2016. 8(5), 376-381. DOI: 10.4240/wjgs.v8.i5.376.
5. Delgado L. M., Pompeu B. F., Pasqualotto E., Martins G. H. A., Moraes C. J. *et al.* Primary Closure Versus T-Tube Drainage on Common Bile Duct Exploration for Choledocholithiasis: An

- Updated Systematic Review and Meta-Analysis. *J Laparoendosc Adv Surg Tech A*. 2025. 35(6), 463-475. DOI: 10.1089/lap.2025.0048.
6. Yi H. J., Hong G., Min S. K., Lee H. K. Long-term Outcome of Primary Closure After Laparoscopic Common Bile Duct Exploration Combined With Choledochoscopy. *Surg Laparosc Endosc Percutan Tech*. 2015. 25(3), 250-3. DOI: 10.1097/sle.0000000000000151.
 7. Zerey M., Haggerty S., Richardson W., Santos B., Fanelli R. *et al*. Laparoscopic common bile duct exploration. *Surg Endosc*. 2018. 32(6), 2603-2612. DOI: 10.1007/s00464-017-5991-1.
 8. Zheng B., Lu Y., Li E., Bai Z., Zhang K. *et al*. Comparison of the efficacy of LTCBDE and LCBDE for common bile duct stones: a systematic review and meta-analysis. *Front Surg*. 2025. 11(1412334). DOI: 10.3389/fsurg.2024.1412334.
 9. Lai W., Xu N. Feasibility and safety of choledochotomy primary closure in laparoscopic common bile duct exploration without biliary drainage: a retrospective study. *Sci Rep*. 2023. 13(1), 22473. DOI: 10.1038/s41598-023-49173-3.
 10. Hua X., Wang G., Li B., Shen G., Liu W. Comparison of the efficacy of laparoscopic primary closure of the common bile duct and T-tube drainage in the treatment of choledocholithiasis in elderly patients. *BMC Geriatr*. 2025. 25(1), 549. DOI: 10.1186/s12877-025-06210-2.
 11. Wang Y., Huang Y., Shi C., Wang L., Liu S. *et al*. Efficacy and safety of laparoscopic common bile duct exploration via choledochotomy with primary closure for the management of acute cholangitis caused by common bile duct stones. *Surg Endosc*. 2022. 36(7), 4869-4877. DOI: 10.1007/s00464-021-08838-8.
-