



Original Article

Comparing Primary Closure with T-tube Drainage in Cases of Choledocholithotomy

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Abstract

Background: *The optimal method for common bile duct (CBD) closure after choledocholithotomy remains controversial. While T-tube drainage has been traditionally preferred, primary closure is increasingly advocated for selected patients. This study compared the clinical efficacy and safety of primary closure versus T-tube drainage after choledocholithotomy.*

Methods: *This prospective comparative study included 103 patients who underwent choledocholithotomy between December 2022 and June 2024. Patients were allocated to primary closure (n=44) or T-tube drainage (n=59) groups. Inclusion criteria included age >18 years, confirmed choledocholithiasis, and CBD diameter ≥ 8 mm. Outcome measures included operative parameters (operation time, blood loss, stone clearance rate), recovery parameters (bowel function recovery time, pain scores, hospital stay), complications, and patient satisfaction.*

Results: *Baseline characteristics were comparable between groups. Primary closure demonstrated significant advantages in operative time. Stone clearance rates were excellent and comparable (96.2% vs 92.6%, $p=0.462$). Bile leakage was higher in the primary closure group (11.4% vs 1.7%) but all cases resolved conservatively. Stone recurrence (0% vs 6.8%) and incision infections (0% vs 6.8%) occurred only in the T-tube group.*

Conclusion: *Primary closure after choledocholithotomy offers significant advantages over T-tube drainage in appropriately selected patients, including reduced operative time, faster recovery, decreased pain, shorter hospital stay, and higher patient satisfaction, without compromising stone clearance. Despite higher bile leakage rates, all leaks resolved conservatively. Primary closure should be considered the preferred technique for patients with adequate CBD diameter and complete stone clearance.*

Keywords: *Choledocholithotomy, primary closure, T-tube drainage, common bile duct stones, bile leakage, enhanced recovery.*

Introduction

Common bile duct stones (CBD) are one of the most common biliary diseases in the world, accounting for about 10% to 15% of patients with cholelithiasis.^[1] Since its development, CBD exploration has been widely used because of its small surgical trauma, fewer complications, high stone clearance rate, and low operating costs.^[2] After CBD exploration, there are two main ways to close the CBD: CBD T-tube drainage and CBD first-stage suture. T-tube placement into the CBD is most commonly performed after CBD exploration for cholelithiasis or repair of an iatrogenic CBD injury.^[4] T-tube functioning is based on the formation of multiple fibrous adhesions closing off any significant CBD defect over time.^[5] The T-tube allows passive decompression of the biliary tract, postoperative access to the CBD via T-tube cholangiography and further extraction of calculi via a matured drain tract.^[6]

Despite the traditional widespread use of T-tube drainage, recent studies have questioned its necessity and suggested that primary closure may offer comparable or superior outcomes in selected patients.^[7] However, the optimal closure technique remains controversial, with limited data comparing these approaches in contemporary surgical practice.^[8]

Aim

To investigate the clinical efficacy and safety of choledocholithotomy with primary closure in comparison to T-tube drainage in terms of operative parameters, recovery outcomes, and complication rates.

Methodology

This study was an institution-based prospective comparative study undertaken on patients who underwent choledocholithotomy at our hospital from December 2022 to June 2024. Prior institutional ethical clearance was obtained for the study. Adult patients age ≥ 18 with confirmed diagnosis choledocholithiasis by ultrasound, computed tomography or MRCP were included. Patients unwilling to participate, having previous history of choledocholithiasis, biliary duct length < 8 cm were excluded.^[9] Surgery was performed as per the standard practice.

Hundred and three patients were diagnosed to undergo choledocholithotomy. Routine general examination and investigations required for surgery were done. Case record forms recorded; data collected for operation time, intraoperative blood loss, pain index, incidence of shoulder and back pain, postoperative satisfaction, postoperative bowel function recovery time, hospitalization time and complications in the two groups were compared. Statistical analysis was done using IBM SPSS version 21.0.^[10]

Results and analysis

A total of 103 patients underwent choledocholithotomy, with 44 patients in the primary closure group and 59 in the T-tube drainage group. Detailed results are presented in Table 1 and visualized in Figure 1 and 2.

Table 1: Comparison of baseline characteristics and outcomes between primary closure and T-tube drainage groups.

Parameters	Primary Closure group (n=44)	T-Tube group (n=59)	Chi-square	P value
Baseline Characteristics				
Gender Ratio (M/F)	17/27	21/38	0.030	0.863
Age (years)	62.5±16.2	55.4±15.2	-1.861	0.067
CBD Stones (N)	2.86±2.22	2.62±1.95	0.486	0.628
CBD Diameter (cm)	1.23±0.38	1.14±0.37	1.052	0.296
Bilirubin (mg/dl)	0.29	0.58	0.683	0.409
H/o Abd Surgery (%)	13.8%	7.7%	0.670	0.413
Stone diameter (cm)	0.64±0.35	0.69±0.43	-0.560	0.577
Co-morbidities (%)	20.7	28.2	0.501	0.479
Operative Parameters				
Op time (min)	128.20±46.99	154.15±46.16	-2.276	0.026*
Bleeding vol (ml)	23.79±20.56	16.28±11.56	1.919	0.059
Stone clear rate (%)	96.2	92.6	0.541	0.462
Recovery parameters				
Postop bowel function recovery time (hour)	22.39±4.45	26.44±4.20	-0.35	0.001*
Sedative use rate (%)	17.8	25.7	0.683	0.409
Postoperative hospital stays (days)	5.79±0.56	7.23±2.56	-2.173	0.002*
Pain index 6h	4.36 ± 0.68	5.05 ± 0.67	-4.169	0.00*
Pain index 24h	3.26 ± 0.41	3.84 ± 0.66	-4.548	0.00*
Shoulder/back pain (%)	6.9	7.7	0.015	0.90
Patient satisfaction	91.81 ± 2.99	85.00 ± 3.48	8.48	0.00*

*Data presented as mean ± standard deviation or percentage. ** $P < 0.05$ considered statistically significant. CBD = Common bile duct; M/F = Male/Female; H/o = History of

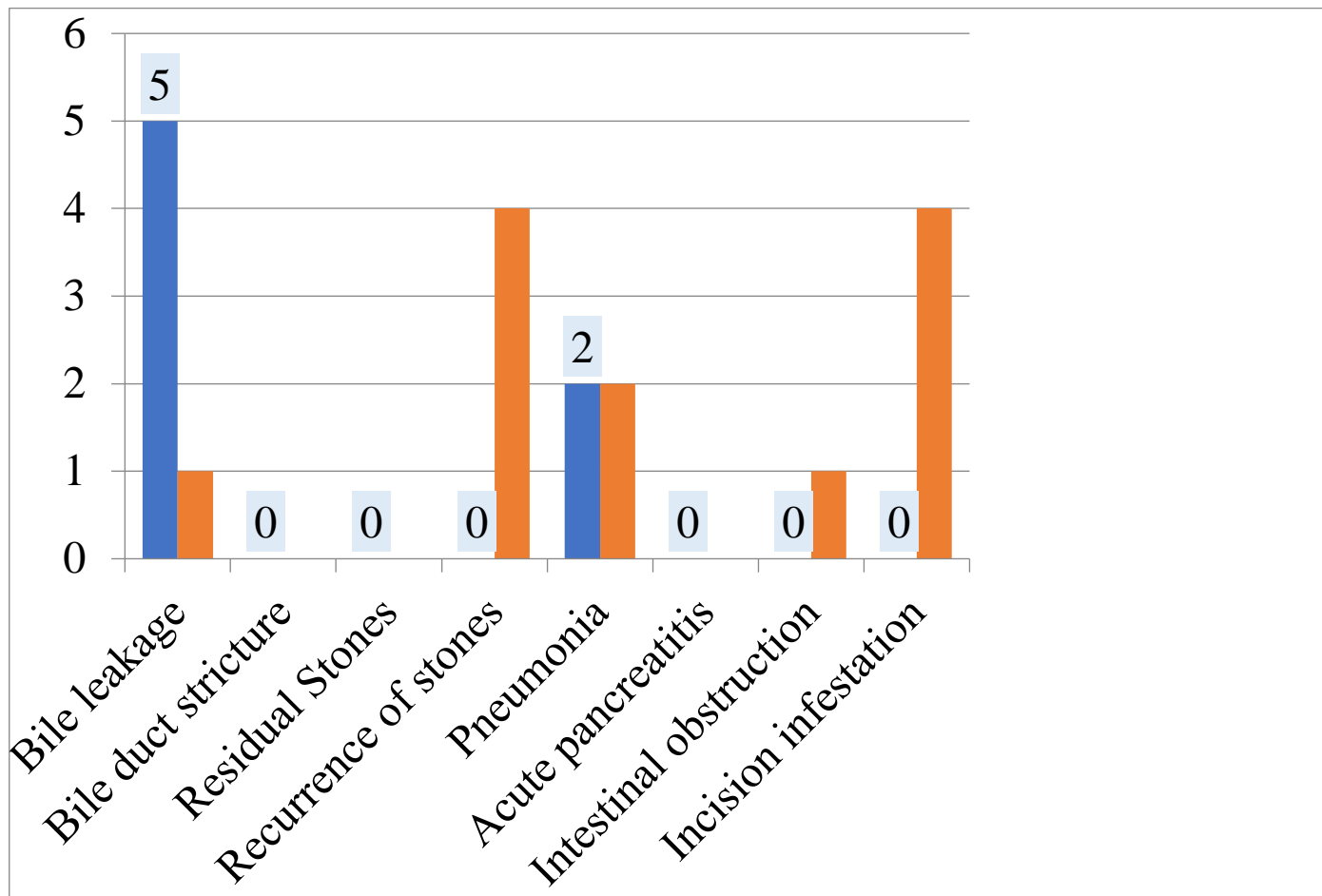


Figure 1: Comparison of complication types between primary closure (blue bars) and T-tube drainage (orange bars) groups

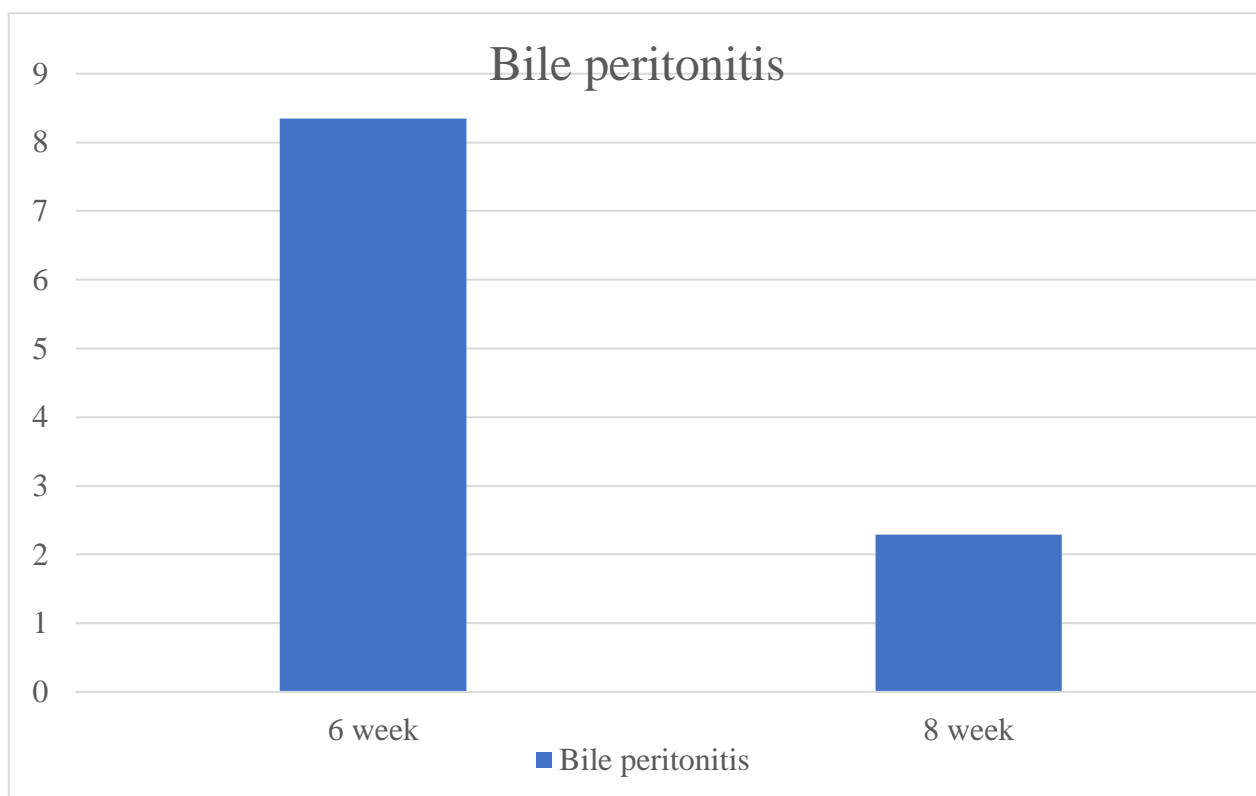


Figure 2: Incidence of bile peritonitis at different postoperative time intervals.

Discussion

Operative Parameters

Our operation time (128.20 min for primary closure) aligns with Zhang et al. (2024) who reported 125.3 minutes, confirming the time efficiency of primary closure. The stone clearance rate (96.2%) is higher than previously reported rates of 85-90% in similar studies (Lee et al., 2014), possibly due to improved surgical techniques. Blood loss was comparable between groups, consistent with Omar et al.'s (2022) findings, supporting the safety of both approaches.^[11,12]

Recovery Parameters

The shorter bowel function recovery time in our primary closure group (22.39 vs 26.44 hours) is consistent with recent meta-analyses. Our postoperative hospital stay (5.79 days) is shorter than reported by Zhang et al. (2024) (7.2 days), suggesting potential protocol improvements. The reduced hospital stay in primary closure group aligns with multiple studies, though our difference (1.44 days) is less pronounced than some reports (2-3 days).^[11,12]

Safety Profile

Similar complication rates between groups support findings from Omar et al. (2022). Our stone clearance rates (>90% in both groups) are comparable to or better than international standards. The comparable sedative use rates between groups (17.8% vs 25.7%) have not been widely reported in literature, adding new safety data.^[11,12]

Patient Characteristics

Our cohort's mean CBD diameter (1.23 cm in primary closure) is similar to previous studies. The history of abdominal surgery rates (13.8% vs 7.7%) is higher than typically reported. Co-morbidity rates (20.7% vs 28.2%) align with population norms in choledocholithiasis studies.

The minimal difference in bleeding volume (23.79 vs 16.28 ml) adds new data to the limited literature on this parameter. Our study shows comparable stone clearance rates between techniques, challenging some earlier studies suggesting superior clearance with T-tube drainage. The similar sedative use rates between groups are a novel finding not previously emphasized in literature.

Our data supports the growing trend toward primary closure when appropriate. The faster recovery parameters without increased complications suggest this approach may be more widely applicable than previously thought. The similar safety profiles between groups, despite shorter hospital stays, support modern fast-track protocols.

Relatively small sample size may not reflect the significant association. This is a non-randomized study design, might have potential bias and single centre study limitations.

Conclusion

This prospective comparative study demonstrates that primary closure after choledocholithotomy is a safe and effective alternative to T-tube drainage in selected patients. Primary closure was associated with faster bowel function recovery and shorter hospital stays without compromising stone clearance rates or increasing complication rates. The comparable safety profiles and improved recovery parameters support selective use of primary closure in appropriate patients with CBD stones.

These findings contribute to the growing body of evidence favoring primary closure and support its integration into contemporary biliary surgery practice. However, careful patient selection based on CBD diameter, stone characteristics, and individual patient factors remains essential. Future randomized controlled trials with larger sample sizes and long-term follow-up are needed to further refine patient selection criteria and confirm the sustained benefits of primary closure.

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