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General surgery

CONTINUOUS VERSUS INTERRUPTED SUTURING FOR PRIMARY CLOSURE OF COMMON BILE DUCT AFTER EXPLORATION: A PROSPECTIVE COMPARATIVE STUDY

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ABSTRACT Hepatobiliary diseases, particularly gallstone disease, are increasingly prevalent and impose a substantial burden on healthcare systems worldwide. Choledocholithiasis occurs in a significant proportion of patients with gallbladder stones and often necessitates surgical intervention. With the growing adoption of laparoscopic common bile duct exploration (LCBDE), primary closure of the common bile duct has largely replaced traditional T-tube drainage. However, the optimal suturing technique for primary CBD closure remains a matter of debate.**Aim:** To compare continuous versus interrupted suturing techniques for primary closure of the common bile duct following open or laparoscopic CBD exploration.**Materials and Methods:** A prospective comparative study was conducted on 60 patients with choledocholithiasis, allocated into two groups: continuous suturing (Group A) and interrupted suturing (Group B). Operative parameters, suturing time, postoperative pain, bile leak, drain output, postoperative CBD diameter, complications, and duration of hospital stay were evaluated and analysed.**Results:** Operative time and CBD suturing time were significantly shorter in the continuous suturing group. Postoperative pain scores and hospital stay were comparable between the two groups. Although overall postoperative complications did not differ significantly, bile leak and postoperative jaundice were observed more frequently in the continuous suturing group. **Conclusion:**Continuous suturing for primary CBD closure offers advantages in terms of operative efficiency and reduced suturing time, while interrupted suturing appears to be associated with a lower incidence of bile-related complications. Both techniques are safe and effective when applied with appropriate patient selection and meticulous surgical technique.

KEYWORDS : Choledocholithiasis; Common bile duct exploration; Primary duct closure; Continuous suturing; Interrupted suturing; Laparoscopic surgery.

INTRODUCTION

Gallstone disease represents one of the most prevalent disorders of the hepatobiliary system and continues to impose a significant clinical and health care burden worldwide. While the majority of gallstones remain confined to the gallbladder, a clinically important subset migrates into the biliary tree, resulting in choledocholithiasis with potential consequences ranging from obstructive jaundice to life-threatening cholangitis. Common bile duct stones are a prevalent biliary disease, accounting for approximately 10–15% of all bile duct stone cases, with an incidence rate second only to gallstones [1,2]. Early diagnosis and timely intervention are therefore critical to prevent morbidity and mortality associated with common bile duct stones.

The diagnosis of common bile duct (CBD) stones relies on an integrated assessment of clinical presentation, biochemical abnormalities, and targeted imaging rather than a single definitive test. Transabdominal ultrasonography is usually the first-line investigation, primarily identifying biliary dilatation rather than the stones themselves. In patients with persistent clinical suspicion, non-invasive imaging such as magnetic resonance cholangiopancreatography (MRCP) or endoscopic ultrasound (EUS) provides high diagnostic accuracy. Endoscopic retrograde cholangiopancreatography (ERCP) is now reserved mainly for therapeutic purposes due to its invasive nature and associated risks such as stone removal failure, pancreatitis, and bleeding [3]. In addition, bile duct stones often recur after treatment, significantly impacting quality of life and health.

Currently, CBD stones are treated through endoscopic retrograde cholangiopancreatography (ERCP), CBD exploration surgery both by laparoscopic and open technique, percutaneous transhepatic biliary drainage (PTBD), and sinus tract stone removal [4]. PTBD provides temporary biliary decompression in patients with obstructive jaundice but does not constitute a definitive curative treatment [5].

Choledocholithiasis remains a common clinical problem encountered in hepatobiliary surgery, frequently necessitating surgical exploration of the common bile duct (CBD) when endoscopic clearance fails or is not feasible. Conventional common bile duct exploration and duct stone removal can lead to decreased quality of life, T-tube displacement, bile loss, electrolyte imbalance, and delayed recovery, all of which are related to T-tube complications [3]. laparoscopic common bile duct exploration (LCBDE) is increasingly used to treat CBD stones, offering favorable therapeutic outcomes [6]. With this advances in surgical technique and perioperative care the primary closure of the CBD following choledochotomy has increasingly replaced traditional T-tube drainage due to its association with reduced morbidity, shorter hospital stay, and avoidance of tube-related complications. . Consequently, for suitable patients, more physicians are inclined toward primary closure of the CBD.[7,8]

Surgical exploration of the common bile duct can be performed via several approaches, each selected based on stone location, ductal anatomy, and surgeon experience. Traditionally, choledochotomy can be accomplished through an open or laparoscopic approach, with the latter gaining preference due to its minimally invasive nature, reduced postoperative pain, and faster recovery. Within these approaches, the choledochotomy may be performed through a transductal incision directly over the stone, or less commonly via a transcystic route as it may be limited by cystic duct anatomy and stone characteristics. [9]. Following stone extraction, restoration of ductal continuity is critical to prevent bile leak and stricture formation.

Primary closure following laparoscopic CBD exploration can avoid the limitations of an indwelling T-tube[10]; Retrospective studies have shown that primary closure following laparoscopic CBD exploration can shorten the hospital stay and reduce the development of postoperative complications [11, 12]. Two principal suturing techniques are commonly employed: continuous (running) sutures and interrupted sutures. Continuous suturing involves a single uninterrupted stitch along the incision, allowing rapid closure and uniform approximation of tissue edges, which may reduce operative time [13]. Interrupted sutures consist of individually tied stitches placed at separate points along the ductotomy, offering precise tension control at each site, potentially minimizing localized tissue stress,

though often requiring longer suturing time [14]. Retrospective studies comparing these techniques have demonstrated that continuous suturing can significantly shorten operative and suturing time without increasing complication rates such as bile leakage or stricture formation [15,16]. Despite their widespread use, high-quality prospective data remain limited, and no clear consensus exists regarding the optimal suturing pattern for primary CBD closure [14–16].

Given the frequency of CBD exploration in hepatobiliary surgery, establishing the optimal suturing method is clinically relevant to reduce operative time, minimize postoperative complications, and improve patient recovery. Consequently, the present study has been designed to compare continuous and interrupted suturing techniques for primary closure of the common bile duct, evaluating operative efficiency, postoperative outcomes, and complications.

Materials and Methods

Study Design and Setting

A prospective, comparative study was conducted , a total of 60 patients diagnosed with choledocholithiasis on ultrasonography (USG) were enrolled. After obtaining written informed consent, patients were equally allocated into two groups of 30 each:

- Group A (n = 30): Continuous suture closure of the common bile duct (CBD)
- Group B (n = 30): Interrupted suture closure of the CBD

Ethical Approval

- The study was approved by the Institutional Ethics Committee of _GMC Sangrur road, Patiala (IEC approval number: EC/NEW/INST/2023/PB/0383_). Written informed consent was obtained from all participants prior to enrollment. The study was conducted in accordance with the Declaration of Helsinki.

Inclusion and Exclusion Criteria

Inclusion Criteria:

- Patients aged >12 years with symptomatic CBD stones confirmed on USG.

Exclusion Criteria:

- Hemodynamically unstable patients
- Liver cirrhosis or severe cardiopulmonary comorbidities (e.g., COPD)
- Pregnancy
- Malignancy or suspected malignant biliary obstruction

Preoperative Evaluation

- All patients underwent a comprehensive preoperative workup, including detailed clinical evaluation, routine hematological and biochemical investigations, and imaging studies. Imaging included abdominal USG in all cases, with magnetic resonance cholangiopancreatography (MRCP) and contrast-enhanced CT (CECT) performed as indicated to delineate biliary anatomy, stone burden, and ductal morphology.

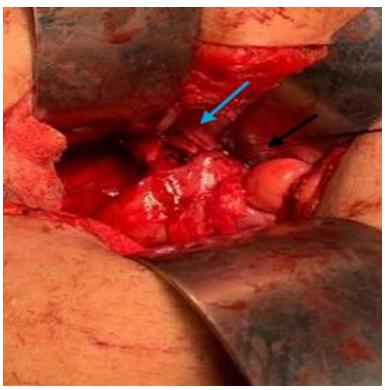


FIG 1

Operative Procedure (figure 1)

All procedures were performed under general anesthesia.

- Laparoscopic CBD exploration: Standard port placement was employed. Choledochotomy was performed by giving a long incision over anterior surface of CBD at the level of cystic duct and bile duct junction, followed by stone extraction under direct visualization using choledochoscopy to confirm complete clearance.
- Open CBD exploration: A paramedian incision was used to access the CBD. A longitudinal choledochotomy was made, and stones were extracted using similar techniques to the laparoscopic approach.

CBD Closure Techniques: figure 2

- Group A (Continuous suturing): The CBD was closed using absorbable 2-0 or 3-0 round-bodied Vicryl in a continuous, over-and-overlocking running fashion, ensuring uniform tension along the incision.
- Group B (Interrupted suturing): The CBD was closed using simple interrupted sutures with absorbable 2-0 or 3-0 Vicryl, evenly spaced to minimize risk of local ischemia.

Following closure, bile leakage was assessed intraoperatively, a subhepatic drain was placed in all patients, and the abdominal incision was closed in layers.

FIG 2

Outcome Measures

To evaluate the efficacy and safety of each suturing technique, the following parameters were recorded:

- Total operative time
- Time required for CBD suturing
- Postoperative pain (using a standard pain scale)
- Incidence of bile leak
- Subhepatic drain output
- Preoperative and postoperative CBD diameter
- Total hospital stay

Patients were monitored postoperatively at standardized intervals: 2nd day, 3rd day, 1 week, and 1 month and 6 months. Clinical examination, laboratory tests, and imaging were performed as indicated to assess for complications, particularly bile leak or stricture formation.

Data Collection and Statistical Analysis

All clinical and operative data were systematically recorded in a structured proforma. Statistical analysis was performed using Microsoft Excel and appropriate statistical tests including Student's t-test and chi-square test. A p-value <0.05 was considered statistically significant.

RESULTS

Age and gender

The majority of patients in both groups belonged to the middle-to-elderly age group.

A female predominance was observed in both groups, consistent with the known epidemiology of gallstone disease. The two groups were otherwise comparable with respect to age and sex distribution.

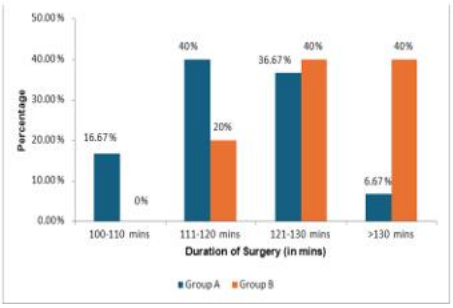
Operative Time

The mean total operative time was significantly shorter in Group A (continuous suturing) compared to Group B (interrupted suturing). Group A had a mean operative time of 118.93 ± 7.65 minutes, whereas Group B required 128.20 ± 7.63 minutes. This difference was statistically significant ($p < 0.0001$), indicating that continuous suturing was associated with improved operative efficiency. As shown in the below tables 1 and 1.1

Table1;

Duration of Surgery (in mins)	Group A		Group B	
	Patients	Percentage	Patients	Percentage
100-110 mins	5	16.67%	0	0%
111-120 mins	12	40%	6	20%
121-130 mins	11	36.67%	12	40%
>130 mins	2	6.67%	12	40%
Total	30	100%	30	100%
Mean± SD	118.93± 7.65		128.20± 7.63	
Range	104-133		114-143	
t-value	4.699			
p- Value	< 0.0001 (HS)			

TABLE 1.1



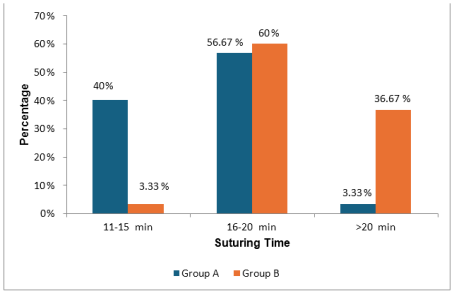
Suturing Time

The time required for CBD closure was significantly lower in the continuous suturing group. In Group A, the mean suturing time was **16.40 ± 1.94 minutes,** compared to **19.50 ± 3.00 minutes** in Group B. A greater proportion of patients in Group B required more than 20 minutes for suturing (36.67% vs 3.33%). Statistical analysis confirmed a highly significant difference between the two techniques (t = 4.753, p < 0.0001), demonstrating that continuous suturing is more time-efficient than interrupted suturing. As shown in table 2 and 2.2

Table 2;

Suturing Time	Group A		Group B	
	Patients	Percentage	Patients	Percentage
11-15 min	12	40%	1	3.33%
16-20 min	17	56.67%	18	60%
>20 min	1	3.33%	11	36.67%
Total	30	100%	30	100%
Mean±SD	16.40±1.94		19.50±3.00	
Range	13-21		15-15	
t-test	4.753			
p-value	< 0.0001 (HS)			

TABLE 2.2



Intraoperative Blood Loss

Intraoperative blood loss was marginally lower in the continuous suturing group; however, this difference was not statistically significant.

Post-operative Pain

Postoperative pain was assessed using the Visual Analogue Scale (VAS) shown in fig 3 at 24 hours, 72 hours, and 1 week. Mean pain scores at 24 hours were 5.13 ± 1.10 in Group A and 5.67 ± 1.12 in Group B. At 72 hours, the scores were 3.27 ± 1.05 and 3.70 ± 0.70, respectively, while at 1 week they were 1.67 ± 0.71 in Group A and 1.97 ± 0.61 in Group B. Although pain scores were consistently lower in the continuous suturing group, the differences were not statistically significant at any time point (p > 0.05). as shown in table 3

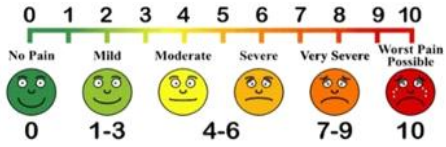


Table 3:

Time interval	Postsurgical pain (VAS)	No. of patients	Mean	Std. Deviation	95% CI	t-test	p-Value
24 hours	Group A	30	5.13	1.10	-0.0337 to 1.1137	1.884	0.0646 (NS)
	Group B	30	5.67	1.12			
72 hours	Group A	30	3.27	1.05	-0.0312 to 0.8912	1.866	0.0671 (NS)
	Group B	30	3.7	0.70			
1 week	Group A	30	1.67	0.71	-0.0421 to 0.6421	1.755	0.0845 (NS)
	Group B	30	1.97	0.61			

Drain Output

Mean postoperative drain output at 24 hours was **89.17 ± 24.64 ml** in Group A and **82.00 ± 14.54 ml** in Group B. At 72 hours, drain output reduced to **52.83 ± 27.09 ml** and **47.50 ± 21.60 ml**, respectively. At 1 week, mean drain output was **22.83 ± 18.27 ml** in Group A and **15.67 ± 12.23 ml** in Group B. Although drain output was marginally higher in the continuous suturing group at all intervals, these differences were statistically non-significant (**p > 0.05**). As shown in table 4

Table 4:

Time interval	Amount in drain	No. of patients	Mean	Std. Deviation	95% CI	t-test	p-Value
24 hours	Group A	30	89.17	24.64	-17.6259 to 3.2859	-1.373	0.1751 (NS)
	Group B	30	82.00	14.54			
72 hours	Group A	30	52.83	27.09	-17.9922 to 7.3322	-0.843	0.4029 (NS)
	Group B	30	47.50	21.60			
1 week	Group A	30	22.83	18.27	-15.1949 to 0.8749	-1.784	0.0797 (NS)
	Group B	30	15.67	12.23			

Post-operative Complications

In Group A, postoperative bile leak and jaundice were observed in **3 patients (10%)**, while **1 patient (3.33%)** developed CBD narrowing. In Group B, bile leak and jaundice were noted in **1 patient (3.33%)**. No cases of peritonitis or pancreatitis were observed in either group. Overall complication rates were **10% in Group A** and **3.33% in Group B**, with the difference being statistically non-significant (**p = 0.0703**). As shown in table 5

Table :5

Complications	Group A		Group B	
	Patients	Percentage	Patients	Percentage
Bile leak	3	10%	1	3.33%
Jaundice	3	10%	1	3.33%
Peritonitis	0	0%	0	0%
CBD narrowing	1	3.33%	0	0%
Pancreatitis	0	0%	0	0%
p-value	0.0703 (NS)			

Post-operative CBD Diameter

The mean postoperative CBD diameter was **12.86 ± 1.37 mm** in Group A and **13.10 ± 1.34 mm** in Group B. No statistically significant difference was observed between the two groups (**p = 0.4955**). As shown in Table 6

Table 6

Post-operative CBD diameter (in mm)	Group A		Group B	
	Patients	Percentage	Patients	Percentage
≤10	1	3.33%	1	3.33%

>10	29	96.67%	29	96.67%
Total	30	100%	30	100%
Mean±SD	12.86±1.37		13.10±1.34	
Range	9.5-15.5		10-16	
t-test	0.686			
p-value	0.4955 (NS)			

Comparison of Pre- and Post-operative CBD Diameter

Both groups demonstrated a mild increase in postoperative CBD diameter compared to preoperative measurements. However, the differences between pre- and post-operative diameters were statistically non-significant in both Group A (**p = 0.1860**) and Group B (**p = 0.0586**). As shown in table 7

Table 7:

	Group A	Group B
Pre-operative CBD diameter	12.36±1.52	12.42±1.39
Post-operative CBD diameter	12.86±1.37	13.10±1.34
t-test	1.338	1.929
p-value	0.1860 (NS)	0.0586 (NS)

Hospital Stay

The mean duration of hospital stay was **8.13 ± 1.04 days** in Group A and **8.53 ± 1.33 days** in Group B. Although hospital stay was marginally longer in the interrupted suturing group, the difference was not statistically significant (**p = 0.1995**). As shown in table 8

Table 8:

Duration of Hospital stay	Group A		Group B	
	Patients	Percentage	Patients	Percentage
6-10 days	29	96.67%	28	93.33%
>10 days	1	3.33%	2	6.67%
Total	30	100%	30	100%
Mean±SD	8.13±1.04		8.53±1.33	
Range	6-11 days		6-11 days	
t-test	1.298			
p- Value	0.1995 (NS)			

DISCUSSION

Choledocholithiasis is a well-recognized complication of gallstone disease, affecting approximately 10–20% of patients with cholelithiasis and contributing significantly to hepatobiliary morbidity worldwide [17-18], With advances in minimally invasive surgery and perioperative care, primary closure of the common bile duct (CBD) following choledochotomy has increasingly replaced traditional T-tube drainage owing to reduced morbidity, shorter hospital stay, and avoidance of tube-related complications[18-20],

However, the optimal suturing technique for primary CBD closure remains a subject of debate. The present study was undertaken to compare continuous and interrupted suturing techniques in terms of operative efficiency and postoperative outcomes. The results of current study concluded that continuous suture technique for primary CBD repair in patients having choledocholithiasis is technically feasible and more time-efficient and is linked to lower post operative pain and shorter duration of stay in the hospital. But, the incidence of post operative complications although found non significant like bile leakage, jaundice and CBD narrowing is more with continuous sutures than interrupted sutures. Thus, interrupted suture technique has a better safety profile than continuous group.

Age Distribution

The study population predominantly comprised middle-aged and elderly patients, which is consistent with the known age-related increase in gallstone disease and its complications. There was no statistically significant difference in age distribution between the continuous and interrupted suturing groups, confirming appropriate baseline comparability. Similar age profiles have been reported by Yizhou Sun et al. [14], and Xiangdong Liu et al. [16], indicating that age is unlikely to act as a confounding factor in comparative analyses of CBD closure techniques.

Gender Distribution

Both groups demonstrated a marked female predominance, reflecting the higher prevalence of gallstone disease among women. The gender distribution did not differ significantly between the two groups, ensuring comparability for outcome assessment. These findings are in concordance with those reported by Zhu Jie et al. [21],, further supporting the representativeness of the study population.

Operative time

The mean operative duration was significantly shorter in the continuous suturing group. Similar reductions in operative time with continuous closure have been reported by Xiangdong Liu et al.(2018)[13], Yizhou Sun et al. (2025)[14], and Di Wu et al. (2022)[22] This advantage is likely related to fewer knot placements, reduced instrument handling, and a more streamlined suturing process.

Suturing time

The suturing time required for CBD closure alone was also significantly shorter with continuous suturing. Comparable findings have been documented by Yizhou Sun et al(2025)[14]., Wai Lai et al.2023[23], and Xiangdong Liu et al.(2018)[13], supporting the efficiency of continuous closure. Reduced knot tying and uninterrupted suture progression contribute to this benefit.

Intraoperative bleed

Intraoperative blood loss was comparable between the two groups, with no statistically significant difference observed. Similar findings have been reported by Wei Lai et al. [23] and Yizhou Sun et al. [14], who also found no significant difference in blood loss between continuous and interrupted suturing techniques. Yang et al. [24] reported minimal blood loss during laparoscopic CBD exploration with primary closure. Although non-significant, continuous suturing showed a trend toward lower blood loss, possibly due to reduced suturing time and tissue handling.

Post-operative pain

Postoperative pain scores were marginally lower in the continuous group at all assessed intervals, although the differences were not statistically significant. While limited literature directly compares pain outcomes between suturing techniques, shorter operative duration and less tissue manipulation may account for this trend. Yizhou Sun et al.(2025)[14] similarly reported improved postoperative quality-of-life scores with continuous suturing.

Post- operative complication

Overall postoperative complications were comparable between the two groups. However, bile leak and postoperative jaundice were observed more frequently in the continuous suturing group. Similar trends have been reported by Xianhua Ma et al.2023[14], who noted a slightly higher incidence of biliary leakage with continuous closure. Bile leak following primary duct closure may be related to uneven suture tension, needle-hole leakage, or friable duct walls. CBD narrowing was infrequent and clinically insignificant. No cases of peritonitis or pancreatitis were observed, consistent with prior reports.

Post-operative CBD diameter

Postoperative CBD diameter increased marginally in both groups without significant intergroup differences, a finding comparable to that reported by Xianhua Wu et al.2023[14] Duration of hospital stay was similar between groups, in agreement with earlier studies, indicating that suturing technique alone may not significantly influence overall recovery time.

In summary, continuous suturing offers advantages in operative efficiency, whereas interrupted suturing may be associated with a lower incidence of bile-related complications. Both techniques are safe and effective when applied judiciously with meticulous surgical technique.

CONCLUSION

Primary closure of the common bile duct following exploration is a safe and effective alternative to T-tube drainage in patients with choledocholithiasis. We concluded that both continuous and interrupted suturing techniques are effective options for primary closure of the common bile duct following exploration in patients with choledocholithiasis. Continuous suturing was associated with improved operative efficiency, reflected by shorter operative and suturing times with hemostatic feature and comparable postoperative recovery parameters. However, a higher incidence of bile-related complications, including bile leak, postoperative jaundice, and ductal narrowing, was observed with continuous closure. In contrast,

interrupted suturing, although more time-consuming, appeared to provide a more secure closure with a lower complication profile. No significant differences were noted between the two techniques with respect to postoperative CBD diameter or drain output. These findings suggest that while continuous suturing offers technical and time-related advantages, interrupted suturing may be preferable in patients with fragile or narrow bile ducts. Selection of the suturing technique should therefore be individualized, guided by ductal characteristics, intraoperative findings, and surgeon expertise.

Limitations:

The study had a small sample size, short duration, and region-specific data, limiting generalizability. Larger, multicentric studies are recommended for broader validation.

REFERENCES

1. Lee HM, Min SK, Lee HK. Long-term results of laparoscopic common bile duct exploration by choledochotomy for choledocholithiasis: 15-year experience from a single center. Annals of surgical treatment and research. 2014;86(1):1–6.
2. Warner RL, Coleman KC, Musgrove KA, Bardes JM, Borgstrom DC, Grabo DJ. A review of general surgery resident experience in common bile duct exploration in the ERCP era. Am J Surg. 2020;220(4):899–904.
3. Williams E, Beckingham I, El Sayed G, Gurusamy K, Sturgess R, Webster G, Young T. Updated guideline on the management of common bile duct stones (CBDS). Gut. 2017;66(5):765–82.
4. McDermott J, Kao LS, Keeley JA, Nahmias J, de Virgilio C. Management of Gallstone Pancreatitis: A Review. JAMA Surg. 2024;159(7):818–25.
5. Garteiz Martínez D, Sánchez AW, López Acosta ME. Laparoscopic T-tube choledochotomy for biliary lithiasis. JSLS : Journal of the Society of Laparoendoscopic Surgeons. 2008;12(3):326–31.
6. Koo SS, Krishnan RJ, Ishikawa K, Matsunaga M, Ahn HJ, Murayama KM, Kitamura RK. Subtotal vs total cholecystectomy for difficult gallbladders: A systematic review and meta-analysis. Am J Surg. 2024;229:145–50.
7. Zhan Z, Han H, Zhao D, Song G, Hua J, Xu B, Song Z. Primary closure after laparoscopic common bile duct exploration is feasible for elderly patients: 5-Year experience at a single institution. Asian J Surg. 2020;43(1):110–5.
8. Deng M, Yan J, Zhang Z, Wang Z, Zhang L, Ren L, Fan H. Greater than or equal to 8 mm is a safe diameter of common bile duct for primary duct closure: single-arm meta-analysis and systematic review. Clin J Gastroenterol. 2022;15(3):513–21.
9. Hajibandeh S, Hajibandeh S, Sarma DR, Balakrishnan S, Eltair M, Mankotia R, Budhoo M, Kumar Y. Laparoscopic Transcystic Versus Transductal Common Bile Duct Exploration: A Systematic Review and Meta-analysis. World J Surg. 2019 Aug;43(8):1935-1948. doi: 10.1007/s00268-019-05005-y. PMID: 30993390.
10. Xiang, L., Li, J., Liu, D. *et al.* Safety and Feasibility of Primary Closure Following Laparoscopic Common Bile Duct Exploration for Treatment of Choledocholithiasis. *World J Surg* **47**, 1023–1030 (2023).
11. Zhu T, Lin H, Sun J et al (2021) Primary duct closure versus T-tube drainage after laparoscopic common bile duct exploration: a meta-analysis. J Zhejiang Univ Sci B 22(12):985–1001.
12. Tan YP, Lim C, Junnarkar SP et al (2021) 3D Laparoscopic common bile duct exploration with primary repair by absorbable barbed suture is safe and feasible. J Clin Transl Res 7(4):473–478.
13. Wu D, Jin W, Zhang Y, An Y, Chen X, Chen W. Primary suture of the common bile duct: continuous or Interrupted? J Laparoendosc Adv Surg Tech A. 2022;32(4):390-4.
14. Sun Y, Zhou S, Tang S, Li Z, Xu A. Laparoscopic primary suture of the common bile duct in patients with common bile duct stones: a comparative analysis of two suturing methods in terms of safety, efficacy, and convenience with 16-month follow-up. BMC Surg. 2025;25(1).
15. Ha JPY, Tang CN, Siu WT, Chau CH, Li MKW. Primary closure versus T-tube drainage after laparoscopic choledochotomy. **Hepatogastroenterology.** 2004;51(60):1605-8.
16. Liu X, Luo D, Chen H, Liu J, Peng F, Fang C, et al. Application of barbed sutures in laparoscopic common bile duct exploration. **Surg Laparosc Endosc Percutan Tech.** 2018;28(5):324-7.
17. Costi R, Gnocchi A, Di Mario F, Sarli L. Diagnosis and management of choledocholithiasis. **World J Gastroenterol.** 2014;20(40):13382-401.
18. Williams EJ, Green J, Beckingham I, Parks R, Martin D, Lombard M. Guidelines on the management of common bile duct stones. **Gut.** 2008;57(7):1004-21.
19. Cai XJ, Wang YF, Yu H, Liang X, Zhang ZT. Laparoscopic choledochotomy with primary closure versus T-tube drainage. **World J Surg.** 2008;32(8):1665-71.
20. Zhu Q, Qian Y, Wang Y, Gong J. T-tube drainage or primary closure after choledochotomy: a meta-analysis. **Surg Endosc.** 2011;25(4):1282-90.
21. Wang Haibiao, Jie Z, Hong L, Zhou Shaocheng, Bin Z. A study of primary single and layered suture technique by using two-port laparoscopic choledocholithotomy. J Minim Access Surg. 2019;15(4):311-5.
22. Ma X, Cai S. Outcomes and safety of laparoscopic common bile duct exploration with primary closure versus T-tube drainage: a meta-analysis. **Appl Bionics Biomech.** 2023;2023:7300519.
23. Lai W, Xu N. Feasibility and safety of choledochotomy primary closure in laparoscopic common bile duct exploration without biliary drainage. **Sci Rep.** 2023;13(1):1-9.
24. Yang Y, Han L, Lin DN, Hu ZJ, Tu W, Chen F, et al. The safety and efficacy of primary duct closure without endoscopic nasobiliary drainage after laparoscopic common bile duct exploration. Gastrointest Tumors. 2020;7(4):117–24.