J Nepal Health Res Counc 2025 April-June; 23 (67): 377-384

Surgical Treatment of Bile Duct Stones after Failed Endoscopic Management

Bishnu Prasad Kandel,[1] Nishnata Koirala,[1]Deepak Sharma,[1] Narendra Maharjan,[1] Sumita Pradhan Maskey,[1] Ramesh Singh Bhandari, [1] Paleswan Joshi Lakhey,[1]

[1]Department of Surgical Gastroenterology, Tribhuvan University Teaching Hospital, Institute of Medicine , Tribhuvan University, Kathamndu, Nepal.

ABSTRACT

Background: Bile duct calculi occur in a significant proportion of patients with cholelithiasis. They are usually managed by endoscopic methods, but surgical management is needed in complicated cases. The choice of a specific surgical procedure depends on various factors, such as the extent of bile duct dilation, the location of stones, and the presence of stricture or fistula. In this study, we described the different surgical procedures and their outcomes for patients with bile duct stones that could not be cleared by endoscopic methods.

Methods: This is a retrospective cross-sectional study of patients who underwent different surgical procedures for bile duct stones. Patients treated from January 2022 to December 2024 were included in the study. Demographic and clinical data were obtained from medical records and analyzed.

Results: There were 55 patients, of whom 36 were female. Pain in the abdomen and jaundice were the most common symptoms. Laparoscopic common bile duct exploration was done in 10 (18.2%) patients. Bile duct stones along with biliary fistulas, hepatolithiasis, or liver atrophy were present in 16(29.1%) cases. Besides bile duct exploration, other procedures, including choledochoduodenostomy or hepaticojejunostomy(14.5%), choledochoplasty (5.5%), and liver resection (12.7%), were required for the management of these patients. There was no mortality, but two (3.6%) patients had residual stones, and eight (14.5%) patients developed major complications with Clavien-Dindo grade three or more.

Conclusions: Bile duct calculi that could not be cleared by endoscopic methods require surgical intervention. CBD exploration in combination of other required procedures can be performed for the management of bile duct stones and their complications with good outcomes.

Keywords: Bile duct; bile duct exploration; cholelithiasis, choledocholithiasis; hepatolithiasis.

INTRODUCTION

Bile duct stone is a common health problem that can lead to life-threatening complications. Calculi in common bile ducts (CBD) are usually secondary stones found in up to 13.7% of all patients with gallbladder stones.[1] It can also occur as primary stones after removal of the gallbladder, especially in patients at high risk for recurrent stone formation.[2] In some patients, stones can be found in more proximal biliary trees, including common hepatic ducts or intrahepatic bile ducts. A high probability of complications, including obstructive jaundice, cholangitis, and pancreatitis, demands early clearance of bile duct stones.[3,4] Endoscopic retrograde cholangiopancreatography (ERCP) with sphincterotomy and removal of stones is the minimally invasive method, and it is the preferred treatment for CBD stones.[5,6] In the presence of multiple large stones or impacted stones in the biliary tree, it cannot be cleared even after multiple sessions of ERCP. Calculi in intrahepatic ducts cause special challenges as they are difficult to remove by endoscopic methods and more likely to recur.[7]

Surgical CBD exploration and stone clearance is the next treatment option in such conditions. Surgery can be done by open or laparoscopic methods and

Correspondence: **Dr Bishnu Prasad Kandel , Department of Surgical Gastroenterology, Tribhuvan University Teaching Hospital, Institute of Medicine , Tribhuvan University, Kathamndu, Nepal. Email: drkandel@hotmail.com, Phone: +9779851164240.**

has the inherent advantage that CBD clearance and cholecystectomy can be done in one setting.[8] Patients with recurrent stones, impacted stones, or biliary stricture may require biliary enteric anastomoses like choledochoduodenostomy or hepaticojejunostomy. Few patients with stones in hepatic ducts with cholangitic abscesses or atrophic liver segments may also need resection of an involved segment of the liver.[7] Surgical management is also expected to be difficult in such selected patients with failed ERCP with reported major complication rates of 15 percent.[9] In this cross-sectional study, we summarized the indications and outcomes of different surgical procedures done for bile duct stones after failed ERCP.

METHODS

This is a retrospective cross sectional study on the patients who underwent surgical management for choledocholithiasis from January 2022 to December 2024 in the Department of Surgical Gastroenterology, X HOSPITAL. Patients who had calculi in choledochal cysts were not included in the study. Patient data on demographics, current diagnosis, different surgical interventions performed, and their perioperative outcomes within 30 days of surgery were recorded. Postoperative complications were graded according to Clavien-Dindo grading, and the comprehensive complication index (CCI) was calculated from all the complications. Clavien-Dindo grade three or more was defined as major complication. Categorical data were presented as percentages and continuous data as mean and median. Patients' demographic and clinical data were compared between those who had major complications and those who had minor or no complications. Statistical Package for Social Sciences (SPSS) version 20 by IBM Corporation, NY, USA, was used for data analysis. Mann-Whitney U test was used for continuous variables, and Fisher's Exact test was used for categorical variables. Ethical clearance was obtained from the institutional review committee for the study.

ERCP was done as the first treatment option for choledocholithiasis except for those with multiple large calculi, calculi in intrahepatic ducts, or stricture in CBD who underwent surgery without ERCP. Many patients underwent repeated sessions of ERCP before referring for surgical management. Magnetic resonance cholangiopancreatography (MRCP) was done in all the patients before surgery to evaluate the location, number, and size of stones and the degree of dilation or stricture of the biliary tree. Percutaneous transhepatic biliary drainage (PTBD) was done for biliary drainage in a few selected patients with cholangitis if immediate ERCP was not possible.

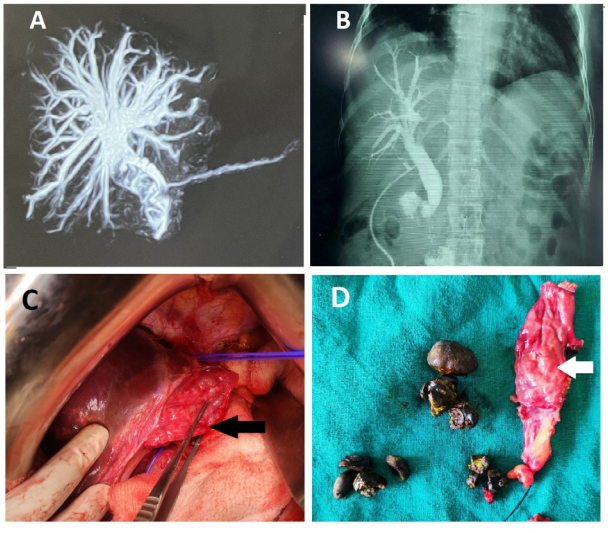

Figure 1. A: MRCP showing multiple large stones in the bile duct, B: T tube cholangiogram, C: Intraoperative picture showing atrophic segment II and III of liver. D: Resected atrophic liver segment II and III along with multiple calculi.

Laparoscopic or open CBD exploration was decided based on the surgeon's discretion. The complicated procedures like choledochoplasty, hepaticojejunstomy or liver resection were performed by open technique only. In both open and laparoscopic methods, if gall bladder was present, it was dissected first and used for retraction of the bile duct. Supraduodenal choledochotomy was made, and stones from the CBD were removed using forceps, a Fogarty biliary balloon, or saline irrigation. Choledochoscopy was done in all patients to assist and confirm stone clearance (Figure 1). Cholecystectomy was done, CBD was closed over the T-tube in most of the patients, and primary closure was done in patients who do not have stricture or fistula, had few stones in CBD only and stone clearance was confirmed by intraoperative choledochoscopy. T tube was also avoided in all patients with PTBD or biliary stent in situ (Figure 2). Choledochoduodenostomy or hepaticojejunostomy was done in patients with dilated CBD with multiple stones or distal stricture or if stone clearance cannot be achieved. Choledochoplasty was done in patients with Mirizzi syndrome where the defect on the CBD was closed with part of the gallbladder wall. Segmental resection of the liver was done for calculi limited to a few segmental intrahepatic ducts with associated atrophy of that segment of the liver. A cholangiogram

was done via T-tube or PTBD on the second week of surgery. All patients received preoperative prophylactic antibiotics. Postoperative antibiotics were used if the bile culture sent during the operation was positive.

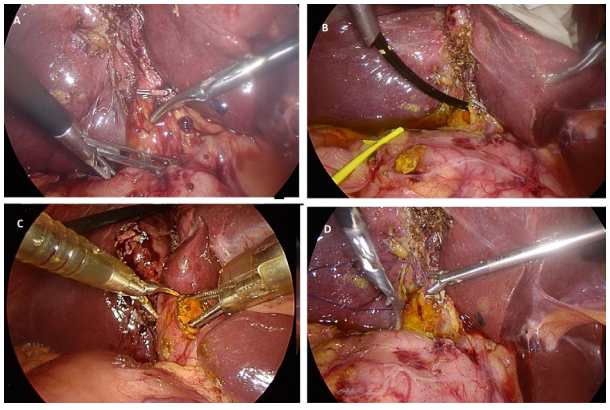

Figure 2. Intraoperative pictures laparoscopic CBD exploration A: Choledochotomy made B: intraoperative choledochoscopy (picture also shows the biliary stent removed from CBD) C: Stone removed from CBD D: Primary closure of CBD.

RESULTS

There were a total of 55 patients included in this study, out of which 19 (34.5%) were male and 36 (65.5%) were female. The mean age was 57.4 ±15 years, which was similar among males and females. Pain in the abdomen was the most common symptom, which occurred in 43 (78.2%) patients, whereas 4 (7.3%) patients were asymptomatic and were detected incidentally on ultrasound (USG) of the abdomen done for other indications. (Table 1) Most of the patients underwent ERCP as first-line treatment. Bile duct cannulation was not possible in nine patients, mainly because of altered anatomy. Five (9.1%) patients were directly taken for surgical management without attempting ERCP because of the presence of a large impacted calculus, CBD calculus with hepatolithiasis, or the presence of a fistula. Eighteen (32.7%) patients also had calculi in the intrahepatic duct besides the presence of calculi in the CBD or CHD. Fistula in the biliary tree was found in 11 (20.0%) patients, out of which cholecystocholedochal fistula (Mirizzi syndrome) and cholecystoduodenal fistula were the most common ones.

Table 1. Clinical features with location and complications of bile duct stones.

Variables	Number	Percentage
Total	55	100
Gender		
Male	19	34.5
Female	36	65.5
History		
Jaundice	39	70.1
Cholangitis	19	35.5
History of previous surgery		
Cholecystectomy	20	36.4
CBD Exploration	4	7.3
Preoperative ERCP		
Performed	41	74.5
Failed cannulation of CBD	9	16.4
Not attempted	5	9.1
Mean number of ERCP per patient	1.6±1.1	
Location stone		
CBD/CHD	55	100
Left hepatic duct	8	14.5
Right hepatic duct	6	10.9
Both side hepatic duct	4	7.3
Fistula in biliary tree		
No	44	80.0
Cholecystocholedochal	4	7.3
Cholecystoduodenal	6	10.9
Cholecystocolonic	2	3.6
Choldochoduodenal	2	3.6

Abbreviation: CBD: common bile duct, CHD: common hepatic duct, ERCP: Endoscopic retrograde cholangiopancreaticogram.

Four patients had Mirizzi syndrome; three of them were managed with choledochoplasty, and hepaticojejunostomy was done in one patient. All the patients with choledochoplasty improved without complications. For cholecystoduodenal and cholecystocolic fistula, the fistulous communication with the duodenum or colon was dismantled, the margins were refreshed, and the duodenal or colon opening was closed in single-layer interrupted sutures. Both patients with cholecystocolonic fistulas developed surgical site infections. One patient with cholecystoduodenal fistula developed a lower respiratory tract infection, which improved after treatment. Seven patients underwent hepatic resection besides CBD exploration. Among them, three had superficial surgical site infections, one had lower respiratory tract infection, and one other patient had a bile leak from the liver cut margin, which improved after ultrasound-guided pigtail catheter insertion.

Table 2. Various surgical procedures and post operative complications.(n=55)

Variables	Number	Percentage
Surgical procedure		
CBD Exploration only	39	70.1
Choledochoplasty	3	5.5
Choledochoduodenostomy	6	10.9
Hepaticojejunostomy	2	3.6
Left lateral sectionectomy	5	9.1
Right hemihepatectomy	2	3.6
T Tube placement		
Yes	28	50.9
No	27	49.1
Surgery Access		
Laparoscopic	10	18.2
Laparoscopic converted to open	8	14.5
Open	37	67.2
Maximum size of stone(Mean)	19.2±4.8 mm	
CBD diameter(mm)	17.3±4.9	
Duration of hospital stay(Mean)	10.2±5.8 days	
Postoperative complications		
None	20	36.4
SSI	21	38.2
RTI	3	5.5
Cholangitis	2	3.6
Bile leak	4	7.3
Residual stones	2	3.6
Grading of complications		
Minor complications(CD<3)	23	41.8
Major complications(CD≥3)	8	14.5
Median CCI(Range)	8.7(0-50.1)	

Abbreviation: CBD: common bile duct, SSI: surgical site infection, RTI: respiratory tract infection, CD: Clavien-Dindo grading, CCI: comprehensive complication index.

Two patients developed localized peritonitis due to bile leak after the removal of the T-tube. The t-tube of the first patient was removed on the third week whereas it was accidentally dislodged on the fifth postoperative day of the second patient. Both patients required readmission, antibiotics, and percutaneous drain placement. (Table 2) Among all the patients, 23 patients had minor complications graded as Clavien-Dindo less than three, most of which were superficial surgical site infections. There was no mortality, and the median comprehensive complication index was 8.7(0-48.1). Residual stone was found in four patients, all of whom were CBD exploration without biliary enteric anastomosis. Eight patients had major complications. Most of the major complications were due to bile leaks or residual stones which needed further interventions. There was no significant difference on clinical or operative parameters between those who developed major complications and those who improved without major complications.(Table 3)

Table 3. Comparison of patients characters between those with major complications and without major complications.

Variables	Total number	Major complication absent	Major complication present	t value or chi square value	*p* value
Total patients	55	47(85.5%)	8(14.5%)		
Mean Age	57.3±14.7	56.7±14.8	60.6±14.6	-0.69	0.49 *
CBD diameter(mm)	20.0±5.2	19.9±5.4	20.5±4.7	-0.29	0.78 *
Size of stone(mm)	19.7±5.3	19.5±5.1	20.6±6.5	-0.54	0.59 *
No. of ERCP	1.6± 1.1	1.6 ±1.2	1.7±1.0	-1.35	0.18 *
Duration of hospital stay	10.8± 6.7	9.4 ±4.2	19.1±11.7	-4.34	0.01 *
CCI	12.1 ±13.3	7.8 ± 8.3	36.8± 9.8	-8.84	0.01 *
Gender				0.36	0.85†
Male	19(34.5%)	16(34.0%)	3(37.5%)		
Female	36(65.5%)	31(66.0%)	5(62.5%)		
Past biliary surgery				1.98	0.16 †
No	35(63.6%)	31(65.9%)	4(50.0%)		
Yes	20(36.4%)	16(34.1%)	4(50.0%)		
Fistula				0.29	0.81 †
No	44(80.0%)	38(80.5%)	6(75.0%)		
Yes	11(20.0%)	9(19.5%)	2(25.0%)		
Surgery approach				0.20	0.65 †
Laparoscopic	10(18.2%)	9(19.1%)	1(12.5%)		
Open	45(81.8%)	38(80.9%)	7(87.5%)		
Presence of co morbidity				1.97	0.15 †
No	33(60.0%)	30(63.8%)	3(37.5%)		
Yes	22(40.0%)	17(36.2%)	5(62.5%)		
Use of T-tube				0.24	0.50 †
No	27(49.1%)	23(48.9%)	4(50.0%)		
Yes	28(50.9%)	24(51.1%)	4(50.0%)		
Surgical procedure				0.65	0.88 †
CBD Exploration only	36(65.5%)	31(65.9%)	5(52.5%)		
CBD Exploration with additional procedures	19(34.5%)	16(34.1%)	3(37.5%)		

Abbreviation: CBD: common bile duct, CCI: comprehensive complication index, ERCP: endoscopic retrograde cholangiopancreatography. * t test, † chi-square test

DISCUSSION

Choledocholithiasis and hepatolithiasis are common surgical conditions worldwide, but their incidence varies in different parts of the world with the highest prevalence in the Asia-Pacific region.[10] Choledocholithiasis is usually secondary calculus but can occur de novo, especially in high-risk patients with anatomical abnormalities of CBD (periampullary diverticulum, dilated CBD), infections, or metabolic abnormalities.[2,11] Transabdominal ultrasound is an easily available tool for the diagnosis of cholelithiasis and hepatolithiasis, but choledocholithiasis is difficult to detect by ultrasound. Endoscopic ultrasound and MRCP are investigations with high sensitivity and specificity for detecting CBD stones.[12] All our patients underwent MRCP before surgery, which shows the extent of dilation of the biliary tree, size, location, number of stones, and biliary stricture which helped in decision-making for choosing specific surgical procedures. Patients who underwent liver resection also need triple-phase computed tomography to evaluate the vascular anatomy and volumetric analysis of the liver.

ERCP is the preferred treatment for choledocholithiasis but may not be successful in 7 to 27% of cases.[6,8] Most of our patients underwent ERCP as the first-line treatment, and they were referred for surgical management when the stone clearance was found difficult. The ERCP was performed by different teams from different centers and there were no uniform criteria for failure of ERCP for stone clearance. Laparoscopic cholecystectomy with CBD exploration can be done as a single-setting treatment and has a conversion rate of 14 to 43 percent.[13-15] Laparoscopic CBD exploration was attempted on only 18 patients and had a higher conversion rate, mainly due to dense adhesions around Calot's triangle and the presence of a fistula.

Routine use of T-tube after CBD exploration has not shown a significant benefit on the outcome of the patients.[16,17] Some studies have shown a higher rate of bile leak and other complications after T-tube placement.[18] Two of our patients developed complications related to the use of a T-tube. Choledochoplasty was done in three patients with cholecystocholedochal fistula where partial cholecystectomy was done and part of the gall bladder wall was used to repair the CBD. All choledochoplasty in our series were done by open technique. Choledochoplasty is described by some authors as a good alternative to biliary enteric anastomosis.[19-21] Liver resection has a higher stone clearance rate but has higher postoperative morbidity.[22]

Surgical site infection was the most common complication in this study. It might be due to prolonged use of biliary stent or PTBD, which is found to increase wound infection rate after biliary surgery.[23,24] Bile leak from choledochotomy site or biliary enteric anastomosis site can lead to serious complications. The rate of bile leak in our study was comparable to other studies.[25,26] Our study had a small sample size and selected group of patients who needed complex surgical procedures. Long-term follow-up is required, as these patients may develop stricture or recurrent stones.

CONCLUSIONS

Clearance of bile duct stones by ERCP may be difficult in presence of large impacted stones, biliary stricture or fistula. Bile duct exploration, biliary-enteric anastomosis or liver resection can be done for their management with good outcomes.

CONFLICT OF INTERESTS

The authors declare no conflict of interests.

REFERENCES

1. Chen H, Jorissen R, Walcott J, Nikfarjam M. Incidence and predictors of common bile duct stones in patients with acute cholecystitis: a systematic literature review and meta-analysis. ANZ J Surg 2020;90(9):1598–1603.[Article]

2. Zhang J, Ling X. Risk factors and management of primary choledocholithiasis: a systematic review. ANZ J Surg 2021; 91(4):530–536.[Article]

3. Nawara H, Ibrahim R, Abounozha S, Alawad A. Best evidence topic: Should patients with asymptomatic choledocholithiasis be treated differently from those with symptomatic or complicated disease? Ann Med Surg 2021 Feb; 62:150.[Article]

4. Oh DJ, Nam JH, Jang DK, Lee JK. Complications of common bile duct stones: A risk factors analysis. Hepatobiliary Pancreat Dis Int 2021 Aug 1;20(4):361–365.[Article]

5. Ghazanfor R, Liaqat N, Changeez M, Tariq M, Malik S, Ghazanfar KR, et al. Choledocholithiasis: treatment options in a tertiary care setup in Pakistan. Cureus. 2017 Aug 21;9(8).[Download PDF]

6. Buxbaum JL, Abbas Fehmi SM, Sultan S, Fishman DS, Qumseya BJ, Cortessis VK, et al. ASGE guideline on the role of endoscopy in the evaluation and management of choledocholithiasis. Gastrointest Endosc 2019 Jun 1;89(6):1075-1105.e15.[Article]

7. Xia H, Zhang H, Xin X, Liang B, Yang T, Liu Y, et al. Surgical Management of Recurrence of Primary Intrahepatic Bile Duct Stones. Liao R, editor. Can J Gastroenterol Hepatol 2023 Jan 23;2023:1–8. [Article]

8. Hari RK. Current Management of Choledocholithiasis-narrative Review Article. Asian J Med Health. 2024 Mar 15;22:32–40.

9. Gad EH, Zakaria H, Kamel Y, Alsebaey A, Zakareya T, Abbasy M, et al. Surgical (Open and laparoscopic) management of large difficult CBD stones after different sessions of endoscopic failure: A retrospective cohort study. Ann Med Surg 2019 May 31; 43:52–63.[PMC6556483]

10. Tazuma S. Epidemiology, pathogenesis, and classification of biliary stones (common bile duct and intrahepatic). Best Pract Res Clin Gastroenterol 2006 Jan 1; 20(6):1075–1083.[Article]

11. Xiao M, Zhou Y, Wang Z, Dai W, Wang D, Wan Z, et al. The dysregulation of biliary tract microflora is closely related to primary choledocholithiasis: a multicenter study. Sci Rep 2024 Apr 18;14(1):9004. [Article]

12. Meeralam Y, Al-Shammari K, Yaghoobi M. Diagnostic accuracy of EUS compared with MRCP in detecting choledocholithiasis: a meta-analysis of diagnostic test accuracy in head-to-head studies. Gastrointest Endosc. 2017 Dec;86(6):986–993.[Article]

13. Singh AN, Kilambi R. Single-stage laparoscopic common bile duct exploration and cholecystectomy versus two-stage endoscopic stone extraction followed by laparoscopic cholecystectomy for patients with gallbladder stones with common bile duct stones: systematic review and meta-analysis of randomized trials with trial sequential analysis. Surg Endosc 2018 Sep 1; 32(9):3763–3776.doi: https://doi.org/10.1007/s00464-018-6170-8

14. Payá-Llorente C, Domingo-del Pozo C, Gonzálvez-Guardiola P, Santarrufina-Martínez S, Pareja-Ibars E, Martínez-Pérez A. Conversion to open surgery during laparoscopic common bile duct exploration: predictive factors and impact on the perioperative outcomes. HPB 2022 Jan 1;24(1):87–93.[Article]

15. Chue KM, Aw JWB, Chua SHM, Chen Z, Iyer SG, Madhavan K, et al. A predictive nomogram to identify factors influencing the success of a concomitant laparoscopic cholecystectomy with common bile duct exploration for choledocholithiasis. HPB 2018 Apr 1;20(4):313–320.[Article]

16. Gurusamy KS, Koti R, Davidson BR. T-tube drainage versus primary closure after open common bile duct exploration. Cochrane Database Syst Rev. 2013 Jun 21;(6):CD005640.[Article]

17. Hua J, Meng H, Yao L, Gong J, Xu B, Yang T, et al. Five hundred consecutive laparoscopic common bile duct explorations: 5-year experience at a single institution. Surg Endosc. 2017 Sep;31(9):3581–3589.[Article]

18. Ahmed I, Pradhan C, Beckingham IJ, Brooks AJ, Rowlands BJ, Lobo DN. Is a T-tube Necessary after Common Bile Duct Exploration? World J Surg 2008 Jul 1; 32(7):1485–1488.doi: https://doi.org/10.1007/s00268-008-9475-2

19. Chen H, Siwo EA, Khu M, Tian Y. Current trends in the management of Mirizzi Syndrome: A review of literature. Medicine (Baltimore) 2018 Jan];97(4):e9691.[Article]

20. Xu X qun, Hong T, Li B lu, Liu W, He X dong, Zheng C ji. Mirizzi syndrome: our experience with 27 cases in PUMC Hospital. Chin Med Sci J Chung-Kuo Hsueh Ko Hsueh Tsa Chih. 2013 Sep;28(3):172–7.[Article]

21. Koo JGA, Tham HY, Toh EQ, Chia C, Thien A, Shelat VG. Mirizzi Syndrome-The Past, Present, and Future. Med Kaunas Lith. 2023 Dec 21;60(1):12. [Article]

22. García D, Marino C, Ferreira Coelho F. Liver resection for hepatolithiasis: A multicenter experience in Latin America. Surgery. 2023, 173:299–304. 10.1016/j.surg.2022.10.024

23. Gong L, Huang X, Wang L, Xiang C. The effect of preoperative biliary stents on outcomes after pancreaticoduodenectomy. Medicine (Baltimore) . 2020 ; 99(42):e22714.[PMC7571999]

24. Ng ZQ, Suthananthan AE, Rao S. Effect of preoperative biliary stenting on post-operative infectious complications in pancreaticoduodenectomy. Ann Hepato-Biliary-Pancreat Surg 2017 Nov;21(4):212-216.[PMC5736741]

25. Liu D, Cao F, Liu J, Xu D, Wang Y, Li F. Risk factors for bile leakage after primary closure following laparoscopic common bile duct exploration: a retrospective cohort study. BMC Surg 2017 Jan 5;17(1):1. doi: https://doi.org/10.1186/s12893-016-0201-y

26. Hua J, Lin S, Qian D, He Z, Zhang T, Song Z. Primary Closure and Rate of Bile Leak following Laparoscopic Common Bile Duct Exploration via Choledochotomy. Dig Surg 2015 Jan 22;32(1):1-8. doi: https://doi.org/10.1159/000368326