

Improvement of laparoscopic interventions on the bile ducts in choledocholithiasis

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Abstract

Objective. To improve the technique of laparoscopic choledocholithotomy to improve the results of choledocholithiasis treatment.

Materials and methods. The study covers the period from 2012 to 2022, during which 144 patients with choledocholithiasis were treated. In 120 patients, the surgical intervention was successfully performed using a fully laparoscopic approach: in 48 patients (group 1), the common bile duct was drained with a T-shaped drainage; in 34 patients (group 2), the intervention on the common bile duct was completed with a primary suture of the duct; in 38 patients (group 3), a biliary stent was inserted integrally with subsequent suturing of the choledochotomy opening.

Results. In group 1, 5 (10.4%) patients had serious complications that required repeated surgical interventions: dislocation of the T-shaped drainage in 1 (2.1%) patient, development of biliary peritonitis in 4 (8.3%) patients. In the treatment of patients in group 2, a number of advantages were noted compared to the treatment of patients with T-shaped drains. The majority of patients with primary common bile duct suture were discharged on the 3rd day after surgery, and they returned to active work in 2 to 3 weeks. At the same time, 3 (8.8%) patients in this group had complications that required repeated surgical interventions: in 1 patient with multiple choledocholithiasis, bile leakage into the abdominal cavity was caused by a residual stone, in 2 patients – by papillitis and partial inflammatory stenosis of the large duodenal papilla. They underwent endoscopic papillotomy. Of the 38 patients in group 3, 32 had biliary stents that migrated to the intestine on their own. These patients had no complaints in the long term. In 6 patients, the stents remained in the ducts for 30 days after surgery. In 5 of them, endoscopic dosed papillotomy with a needle papillotome was performed, after which the stents were easily removed from the ducts. In 1 patient, a stone up to 6 mm in diameter fell out of the common bile duct along with the stent. None of the patients had signs of pancreatitis or elevated blood amylase levels.

Conclusions. Laparoscopic interventions on the common bile duct allow successful removal of large and numerous calculi in one stage. Primary suturing of the common bile duct has significant advantages over the installation of T-shaped drains and allows to reduce the treatment time. In case of multiple choledocholithiasis and suspected stenosis of the duodenal papilla, it is advisable to combine primary common bile duct suture with antegrade stenting of the bile ducts.

Keywords: choledocholithiasis; laparoscopic interventions; bile ducts; biliary stenting.

The course of cholelithiasis is often complicated by choledocholithiasis, which can develop in 5–20% of young patients, and in elderly patients the incidence of this complication is 20–30% [1, 2]. Endoscopic papillotomy (EP) is considered to be the "gold standard" for removing stones from the bile ducts, which is performed after endoscopic retrograde cholangiopancreatography (ERCPG) [2, 3].

At the same time, in a significant number of patients, ERCPG and EP are associated with significant technical difficulties: atypical location of the duodenal papilla, presence of duodenal diverticula, very large common bile duct (CBD) calculi, etc. In addition, EP can be accompanied by serious complications, such as profuse bleeding (2–5%), destructive pancreatitis (3–7%), perforation of the posterior wall of the duodenum (2–3%) [4], and when performed with the removal of calculi, the patient must undergo at least two surgeries.

Given these difficulties, many surgeons use laparoscopic interventions on the bile ducts during laparoscopic cholecystectomy (LCHE) [5–7]. Randomised multicentric studies have confirmed certain advantages of this tactic – removal of stones from the bile ducts during LCHE [8, 9].

The best way to remove calculi from the Bile duct is through the vesical duct [6]. However, unfortunately, such an intervention is possible in a small number of patients. In the presence of large and numerous calculi, laparoscopic choledocholithotomy (LCLT) is required [10]. In the standard version, such an operation is usually completed with the placement of a T-shaped drainage in the bile ducts to drain the bile ducts [11, 12]. The use of T-shaped drainage can often lead to such serious complications as its dislocation, which requires repeated surgery, as well as bile leakage past the drainage, which leads to biliary peritonitis and other complications [13]. Long-term presence of the drainage is associated with inconvenience for the patient and restriction of his/her work activity. In addition, after removal of the drainage from the abdominal cavity, bile leaks into the abdominal cavity in some patients, leading to the development of biliary peritonitis, which requires a second operation [14].

A number of surgeons began to use the primary Biliary Suture after LCLT [15]. At the same time, in some patients, bile leaks through the primary Biliary Suture due to temporarily increased pressure in the bile duct system caused by spasm

of the sphincter of the large papilla of the duodenum after intervention on the bile ducts. The cause of bile leakage and biliary peritonitis may be a leftover calculus that was located in the lumen of the intrahepatic ducts and, after surgery, descended into the Biliary Duct and became lodged in the large papilla of the duodenum.

Given these possible complications, many surgeons are afraid to perform primary suturing on the opening of the VSD.

The aim of the study was to improve the technique of LCLT to improve the results of choledocholithiasis treatment.

Materials and methods

A retrospective analysis of the results of LCLT performed in 144 patients with choledocholithiasis from 2012 to 2022 was performed. The average age of patients was (56.4 ± 8.7) years (from 29 to 85 years). There were 98 (68.1%) women and 46 (31.9%) men. 85 (59.0%) patients had serious comorbidities.

All patients underwent a complete clinical and laboratory examination with a mandatory ultrasound examination of the abdominal cavity prior to surgery. Magnetic resonance cholangiography was performed in 39 patients.

The success of various treatment tactics was assessed by the following criteria: duration of surgery, frequency and type of intraoperative and postoperative complications, frequency of repeated surgical interventions, and length of hospital stay.

Long-term results in the period from 6 months to 10 years were studied in 118 operated patients. In addition to detailed clinical and laboratory examinations, ultrasound, computed tomography (CT) and magnetic resonance imaging (MRI) with contrast cholangiography were performed, if necessary.

The quality of life of patients in each group was studied using a special SF-36 questionnaire (the Short Form – 36). All the data obtained were processed using Microsoft Office Excel.

Results

Fifty-eight (40.3%) patients were hospitalised with signs of acute cholecystitis. They were operated on immediately. Scheduled surgery was performed on 86 (59.7%) patients. Due to the severe condition and severe jaundice in 12 patients, percutaneous biliary drainage was performed first. Laparoscopic intervention in these patients was performed after stabilisation and reduction of bilirubin levels to subnormal levels. In 17 patients, an attempt was made to perform EP with the removal of calculi, but due to the difficulties of the location of the large papilla of the duodenum in the large diverticulum of the duodenum, and the large size of the calculi, this procedure was unsuccessful. These patients underwent LCLT. In 12 patients over 65 years of age with biliary dilatation of more than 2 cm, laparoscopic choledochoduodenostomy was performed with good short-term and long-term results.

In 12 patients, it was not possible to remove the gallstones from the duodenum due to their insertion into the lumen of the large papilla of the duodenum. Conversion laparotomy was performed in these patients. The remaining 120 patients underwent successful LCLT. These patients were divided into three groups.

In group 1 ($n = 48$), the operation was completed with the placement of a T-shaped drain. External drainage of the Biliary Duct was performed mainly in patients with signs of cholangitis who were hospitalised with signs of acute cholecystitis. In patients operated on as planned, after successful LCLT and control cholangiography or fibrocholedochoscopy to exclude remaining calculi, the primary suture was attempted to be placed on the dissected wall of the gallbladder and sutured tightly. At the same time, in 34 patients (group 2), the primary suture of the Biliary Duct was applied without additional interventions.

In group 3 ($n = 38$), patients underwent antegrade stenting of the Bile duct with 7–8 Fr stents and only then the dissected wall was sutured tightly. This procedure was

Table 1. Characteristics of patients

Indicators.	Group of patients		
	1st (n=48)	2nd (n=34)	3rd (n=38)
Average age (years)	59,6 ± 7,4	50,6 ± 8,6	52,4 ± 8,2
Gender (n)			
Ч	19	12	15
Ж	29	22	23
Number of patients			
with jaundice	18	10	12
with cholangitis	16	4	5
Diameter of the LPG (cm)	2,1 ± 0,4	1,9 ± 0,5	2,0 ± 0,4
Number of calculi	2,3 ± 1,2	1,8 ± 1,0	2,2 ± 1,2

Table 2. LHLT results

Indicators.	Group of patients		
	1st (n=48)	2nd (n=34)	3rd (n=38)
Duration of the operation (min)	102 ± 18	98 ± 16	104 ± 21
Duration of abdominal drainage (days)	4 ± 0,6	3,9 ± 0,9	2,0 ± 0,5
Length of stay in hospital after surgery (days)	6,2 ± 1,7	3,2 ± 1,4	2,6 ± 1,2
Number and degree of complications according to Clavien-Dindo	5	3	2
I	0	0	0
II	0	0	2
IIIa	0	2	0
IIIc	5	1	0
IVa	0	0	0
IVc	0	0	0
V	0	0	0

performed in patients who had to pass a balloon catheter through the large papilla of the duodenum several times during the removal of calculi or who had to use a balloon catheter to dilate the sphincter of the large papilla of the duodenum and push small calculi into the intestinal lumen in case of multiple choledocholithiasis. In these patients, due to manipulation of the sphincter of the large duodenal papilla, prolonged spasm of the papilla could be expected, which could lead to failure of the jejunal sutures. In our opinion, the placement of an antegrade stent could have prevented this complication.

Comparing the main characteristics of patients in the three groups (Table 1), it was found that in group 1 there were more patients over 65 years of age ($p < 0.01$), more patients with jaundice and cholangitis ($p < 0.01$) than in groups 2 and 3. The diameter of the LV was practically the same in patients of groups 1 and 3 ($p > 0.05$), and in patients of group 2 the diameter of the LV was statistically significantly smaller than the diameter of the LV in patients of groups 1 and 3 ($p < 0.01$).

The duration of surgical intervention (Table 2) did not differ significantly in patients of groups 1 and 3 ($p > 0.05$). In patients of group 2, the duration of surgery was statistically significantly shorter than in patients of groups 1 and 3 ($p < 0.01$). Drainage of the abdominal cavity lasted 2 times longer in patients of groups 1 and 2 than in patients of group 3 ($p = 0.028$). This was explained by the fact that in a number of patients with external drainage of the biliary tract and in patients with primary suture of the biliary tract, bile leakage through the drains was observed. The number and nature of complications in all groups were different, but did not differ statistically significantly between groups ($p > 0.05$).

Of the 48 patients in group 1 who underwent T-shaped drainage of the pancreas, 5 had serious complications. In 1 patient, the T-shaped drainage was dislocated, which led to

bile leakage into the abdominal cavity. The patient underwent relaparoscopy on the 2nd day. The T-shaped drainage was re-installed, the hole in the spleen was re-sutured, and the patient recovered. Control cholangiography through the T-shaped drainage was performed in all patients on days 7–14. No occult calculi were found in the Biliary Duct. After 2 weeks, the T-shaped drains were closed, and patients continued conservative treatment. T-shaped drains were completely removed 30–45 days after surgery. Despite the fact that the control cholangiograms showed the absence of residual calculi in the Biliary tract, 4 patients had abundant bile leakage into the abdominal cavity with the development of biliary peritonitis. In this regard, the patients were operated on repeatedly, 2 underwent relaparoscopy. Two patients underwent laparotomy in other medical institutions. After drainage and rehabilitation of the abdominal cavity, the patients recovered, but 1 patient developed a postoperative ventral hernia.

Of the 34 patients in group 2 who underwent primary biliary suturing, complications occurred in 3. In all 3 patients, there was abundant bile leakage through the drains with the development of biliary peritonitis. During repeated laparoscopic operations, it turned out that in 1 patient the cause of bile leakage was a residual stone. It was not detected during the first operation because it was located in the intrahepatic ducts. When the patient started to walk, the stone descended under the force of gravity and blocked the large papilla of the duodenum. During the second surgery, the calculus was removed. A T-shaped drain was placed in the jejunum, the abdominal cavity was drained and sanitised, after which the patient recovered and was discharged from the hospital on the 10th day after surgery.

In 2 patients, the cause of bile leakage was a prolonged spasm of the large papilla of the duodenum after manipulation of the papilla during the removal of multiple calculi.

These patients underwent ES, after which the bile leakage stopped and the patients recovered.

Of the 38 patients in group 3 who underwent integral biliary stent placement with subsequent suturing of the biliary opening, minor bile leakage was observed in 2 patients within 2 days. On the 3rd day, bile leakage stopped, and the patients were discharged from the hospital. Transient elevation of blood amylase levels with signs of pancreatitis was observed in 2 patients. After conservative therapy, the pancreatitis disappeared.

During the follow-up of patients in group 3, it was found that out of 38 patients, 32 had biliary stents that migrated to the intestine on their own. These patients had no complaints in the long term.

In 6 patients, stents remained in the ducts for 30 days after surgery. These patients had signs of papillitis and partial stenosis of the large papilla of the duodenum. It should be noted that all these patients had multiple (3 to 12) calculi in the bile ducts with signs of cholangitis during the first surgery. In 5 patients, endoscopic dosed papillotomy with a needle papillotome was performed, after which the stents were easily removed from the ducts. In 1 patient, a stone up to 6 mm in diameter fell out of the Bile duct with the stent. EP in these patients was technically very easy to perform, as there was no need to cannulate the hole in the large papilla of the duodenum. The wall of the great papilla of the duodenum was dissected on the installed stent without any complications. None of the patients had signs of pancreatitis or elevated blood amylase levels.

In 1 patient, the stent was removed using an endoscopic loop without any difficulties. There were no signs of stenosis of the great papilla of the duodenum in this patient.

No complications were observed in the follow-up of patients in group 3 in the long term from 6 to 36 months.

It should be noted that patients with primary suture of the VSD returned to work and active life much earlier. Patients who underwent drainage of the LES with T-shaped drainage had limited ability to work for 1 to 2 months, as the presence of external drainage caused significant restrictions on their activity.

Discussion

In the era of laparoscopic surgery, a T-shaped external drainage was usually placed on the bile ducts after intervention to decompress it, prevent bile from leaking into the abdominal cavity, and to allow contrasting the bile ducts [11]. Despite a number of advantages of external drainage of the bile ducts, the use of T-shaped external drainage led to serious complications in 5–63% of patients [14, 16]. Dislocation of the T-shaped drainage often occurred, which required repeated surgery. Bile may leak around the T-shaped drainage. Biliary fistulas after removal of T-shaped tubes and the

formation of biliary stenosis have been described. In addition, the presence of a T-shaped external drainage can contribute to the development of severe cholangitis. After discharge from the hospital, patients with T-shaped external drainage experience discomfort for a long time and are limited in their ability to work [15].

The tactics of treating patients with gallstone disease have changed radically in recent decades. Currently, the vast majority of surgeons use laparoscopic techniques in patients with gallbladder and bile duct pathology. In choledocholithiasis, two-stage operations are usually used. First, EP is performed with the removal of calculi from the bile ducts, and then LCE. However, a number of studies have shown the advantage of one-stage treatment of patients when interventions on the bile ducts with the removal of calculi are performed during LCE [8, 9]. The best results are obtained by removing calculi through the bile duct. At the same time, in a significant number of patients with large and numerous gallstones in the bile ducts, LHLT has to be performed. In this case, external drainage of the bile ducts is performed using T-shaped drains.

A large number of studies have reported a significant complication rate (10 to 15%) when performing LHLT with T-shaped drainage of the SVG. One of the latest Cochrane reviews highlighted the following disadvantages of using T-shaped drains: prolongation of the operation duration, significant prolongation of hospitalisation, and an increase in the number of complications compared with primary suturing of the SVG opening [17]. In this regard, a number of surgeons are trying to limit the use of T-shaped drains.

Primary suturing of the Biliary Ducts allows to shorten the hospitalisation period and avoid complications associated with the placement and removal of T-shaped drains [9, 17]. Unfortunately, the primary biliary suture does not decompress the bile ducts, which can lead to bile leakage through the suture. Increased pressure in the bile duct system may be due to prolonged spasm of the sphincter of the large papilla of the duodenum as a result of transmural manipulations during the removal of calculi. If there are residual stones in the bile ducts, there will also be increased pressure in the bile duct system. Despite the use of control cholangiography and fibrocholedochoscopy, stones remain in 3–11% of patients with choledocholithiasis. Bile leakage was noted in 5% of patients after primary biliary stapling [14, 18, 19].

Our study confirmed the main findings of the world's leading surgeons. After the installation of T-shaped drainage, 5 (10.4%) patients developed serious complications that required repeated surgical interventions. Moreover, if the dislocation of the T-shaped drainage in the early postoperative period was observed in only 1 (2%) patient, then biliary peritonitis developed in 4 (8.3%) patients after removal of the T-shaped drainage within 30 to 45 days. It is important to em-

phasise that after laparoscopic surgery, the adhesion process in the abdominal cavity develops to a much lesser extent than after laparotomy, and therefore no tubular structures of connective tissue are formed around the drains, and therefore bile freely enters the abdominal cavity, causing severe biliary peritonitis, which requires repeated intervention. Such complications, which require repeated surgical interventions, significantly worsen the results of using T-shaped drains.

We have noted a number of advantages of using the primary jejunal suture in patients with choledocholithiasis over the installation of T-shaped drains. The majority of patients with primary jejunal suture were discharged on the 3rd day after surgery, and they returned to active work in 2 to 3 weeks. At the same time, 3 (8.8%) patients had complications that required repeated surgical interventions. In 1 patient with multiple choledocholithiasis, the cause of bile leakage into the abdominal cavity was a residual stone. The patient had to be operated on again. In 2 other patients, bile leakage was caused by a prolonged spasm of the sphincter of the large duodenal papilla, papillitis and partial inflammatory stenosis of the papilla. They underwent EP.

The above complications with primary suture opening of the bile ducts prompted us to start using antegrade stenting of the bile ducts. This fairly simple technique allows decompressing the bile ducts, reducing the duration of surgery and hospitalisation, reducing the incidence of complications and significantly improving the quality of life of patients after surgery [20]. According to our observations, even when stones remain, an antegrade stent prevents bile leakage and the development of biliary peritonitis. In addition, the presence of an antegrade stent makes it quite easy to perform papillotomy with a needle papillotome, since no cannulation of the large papilla of the duodenum is required. Foreign authors report that antegrade stents can increase the effectiveness of papillotomy and removal of calculi from 82 to 100% [17].

It should be noted that none of the patients with the stent had abundant bile leakage into the abdominal cavity. Complications included the development of mild pancreatitis with a transient increase in blood amylase levels. In most patients, the stents migrated to the intestine on their own. According to foreign authors, the presence of a stent in the bile ducts for more than 30 days indicates scarring stenosis of the large papilla of the duodenum [21]. In these 5 patients, we performed papilosphincterotomy with a good long-term result.

Thus, our studies have shown significant advantages of primary LAD suture over the use of T-shaped drainage. The duration of hospitalisation of patients with primary BMS suture and antegrade stenting was statistically significantly shorter than that of patients with T-shaped drainage.

At the same time, our experience shows that in real life it is necessary to use all methods of interventions on the Biliary tract in choledocholithiasis. In patients with purulent

cholangitis, it is definitely necessary to drain the Biliary Ducts using T-shaped drains. When there are no signs of cholangitis and there is a firm belief in the complete removal of all calculi, the hole in the gallbladder can be sutured tightly. In patients with multiple choledocholithiasis, as well as with tubular stenosis of the intrapancreatic section of the Biliary Duct, it is advisable to use the primary Biliary Suture with antegrade stenting of the bile ducts.

Conclusions

1. Laparoscopic interventions on the Biliary Ducts allow for the successful removal of large and numerous calculi, with no need for two-stage surgical interventions.
2. The primary suture of the LES during laparoscopic interventions on it has significant advantages over the installation of T-shaped drains, and allows to reduce the time of treatment and rehabilitation of patients.
3. In patients with multiple choledocholithiasis with suspected stenosis of the large papilla of the duodenum, it is advisable to combine primary Biliary Suture with antegrade stenting of the bile ducts.

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Authors' contribution. Grubnik V. V. – concept and design of the study, analysis of the data, formulation of conclusions; Ilyashenko V. V., Zagrebina–Karayani K. V., Parfentiev R. S. – collection and processing of materials, analysis of the data, writing the text, preparation of the article for publication.

Conflict of interest. The authors declare that they have no conflicts of interest.

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References

1. Collins C, Maguire D, Ireland A, Fitzgerald E, O'Sullivan GC. A prospective study of common bile duct calculi in patients undergoing laparoscopic cholecystectomy: natural history of choledocholithiasis revisited. *Ann Surg.* 2004 Jan;239(1):28–33. doi: 10.1097/01.sla.0000103069.00170.9c. PMID: 14685097; PMCID: PMC1356189.
2. Williams EJ, Green J, Beckingham I, Parks R, Martin D, Lombard M, et al. Guidelines on the management of common bile duct stones (CBDS). *Gut.* 2008 Jul;57(7):1004–21. doi: 10.1136/gut.2007.121657. Epub 2008 Mar 5. PMID: 18321943.
3. Hungness ES, Soper NJ. Management of common bile duct stones. *J Gastrointest Surg.* 2006 Apr;10(4):612–9. doi: 10.1016/j.gassur.2005.08.015. PMID: 16627230.
4. Köksal AŞ, Eminler AT, Parlak E. Biliary endoscopic sphincterotomy: Techniques and complications. *World J Clin Cases.* 2018 Dec 26;6(16):1073–86. doi: 10.12998/wjcc.v6.i16.1073. PMID: 30613665; PMCID: PMC6306628.
5. Rhodes M, Sussman L, Cohen L, Lewis MP. Randomised trial of laparoscopic exploration of common bile duct versus postoperative endoscopic retrograde cholangiography for common bile duct stones. *Lancet.* 1998 Jan 17;351(9097):159–61. doi: 10.1016/s0140-6736(97)09175-7. PMID: 9449869.

6. Lyass S, Phillips EH. Laparoscopic transcystic duct common bile duct exploration. *Surg Endosc.* 2006 Apr;20 Suppl 2:S441–5. doi: 10.1007/s00464-006-0029-0. Epub 2006 Mar 16. PMID: 16544067.
7. Verbese JE, Birkett DH. Common bile duct exploration for choledocholithiasis. *Surg Clin North Am.* 2008 Dec;88(6):1315–28, ix. doi: 10.1016/j.suc.2008.08.002. PMID: 18992597.
8. Cuschieri A, Lezoche E, Morino M, Croce E, Lacy A, Toouli J, et al. E.A.E.S. multicenter prospective randomized trial comparing two-stage vs single-stage management of patients with gallstone disease and ductal calculi. *Surg Endosc.* 1999 Oct;13(10):952–7. doi: 10.1007/s004649901145. PMID: 10526025.
9. Ding G, Cai W, Qin M. Single-stage vs. two-stage management for concomitant gallstones and common bile duct stones: a prospective randomized trial with long-term follow-up. *J Gastrointest Surg.* 2014 May;18(5):947–51. doi: 10.1007/s11605-014-2467-7. Epub 2014 Feb 4. PMID: 24493296.
10. Isla AM, Griniatsos J, Karvounis E, Arbuckle JD. Advantages of laparoscopic stented choledochorrhaphy over T-tube placement. *Br J Surg.* 2004 Jul;91(7):862–6. doi: 10.1002/bjs.4571. PMID: 15227692.
11. Leida Z, Ping B, Shuguang W, Yu H. A randomized comparison of primary closure and T-tube drainage of the common bile duct after laparoscopic choledochotomy. *Surg Endosc.* 2008 Jul;22(7):1595–600. doi: 10.1007/s00464-007-9731-9. Epub 2008 Jan 18. PMID: 18202889.
12. Ha JP, Tang CN, Siu WT, Chau CH, Li MK. Primary closure versus T-tube drainage after laparoscopic choledochotomy for common bile duct stones. *Hepatogastroenterology.* 2004 Nov–Dec;51(60):1605–8. PMID: 15532787.
13. Wills VL, Gibson K, Karihaloot C, Jorgensen JO. Complications of biliary T-tubes after choledochotomy. *ANZ J Surg.* 2002 Mar;72(3):177–80. doi: 10.1046/j.1445-2197.2002.02308.x. PMID: 12071447.
14. Zhang HW, Chen YJ, Wu CH, Li WD. Laparoscopic common bile duct exploration with primary closure for management of choledocholithiasis: a retrospective analysis and comparison with conventional T-tube drainage. *Am Surg.* 2014 Feb;80(2):178–81. PMID: 24480219.
15. Podda M, Polignano FM, Luhmann A, Wilson MS, Kulli C, Tait IS. Systematic review with meta-analysis of studies comparing primary duct closure and T-tube drainage after laparoscopic common bile duct exploration for choledocholithiasis. *Surg Endosc.* 2016 Mar;30(3):845–61. doi: 10.1007/s00464-015-4303-x. Epub 2015 Jun 20. PMID: 26092024.
16. El-Geidie AA. Is the use of T-tube necessary after laparoscopic choledochotomy? *J Gastrointest Surg.* 2010 May;14(5):844–8. doi: 10.1007/s11605-009-1133-y. Epub 2010 Mar 16. PMID: 20232173.
17. 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. doi: 10.1002/14651858.CD005640.pub3. PMID: 23794200.
18. Bansal VK, Misra MC, Rajan K, Kilambi R, Kumar S, Krishna A, et al. Single-stage laparoscopic common bile duct exploration and cholecystectomy versus two-stage endoscopic stone extraction followed by laparoscopic cholecystectomy for patients with concomitant gallbladder stones and common bile duct stones: a randomized controlled trial. *Surg Endosc.* 2014 Mar;28(3):875–85. doi: 10.1007/s00464-013-3237-4. Epub 2013 Oct 26. PMID: 24162138.
19. Khaled YS, Malde DJ, de Souza C, Kalia A, Ammori BJ. Laparoscopic bile duct exploration via choledochotomy followed by primary duct closure is feasible and safe for the treatment of choledocholithiasis. *Surg Endosc.* 2013 Nov;27(11):4164–70. doi: 10.1007/s00464-013-3015-3. Epub 2013 May 30. PMID: 23719974.
20. Martínez-Baena D, Parra-Membrives P, Díaz-Gómez D, Lorente-Herce JM. Laparoscopic common bile duct exploration and antegrade biliary stenting: leaving behind the Kehr tube. *Rev Esp Enferm Dig.* 2013 Mar;105(3):125–9. doi: 10.4321/s1130-01082013000300002. PMID: 23735018.
21. Kim EK, Lee SK. Laparoscopic treatment of choledocholithiasis using modified biliary stents. *Surg Endosc.* 2004 Feb;18(2):303–6. doi: 10.1007/s00464-003-8905-3. Epub 2004 Jan 12. PMID: 14712390.

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