

Treatment of Secondary Choledocholithiasis

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[Abstract] **Objectives** To evaluate the clinical outcome of the different approach of treatment for the secondary choledocholithiasis. **Methods** The clinical data of 102 cases which had secondary choledocholithiasis was retrospectively analyzed from January 2010 to December 2011. The micro-invasive group had 44 cases including 25 cases of LCBDE and 19 cases of EST+ LC. The open choledocholithotomy with T-tube drainage (OCHTD) had 58 cases. **Results** The micro-invasive was performed successfully on 44 cases. The number of stones in the common bile duct stones of the LCBDE group (2.42) was more than that of EST + LC (1.22) ($P = 0.031$). The complication occurrence of micro-invasive operation group (20.5%) was significantly lower than that of OCHTD group (55.2%) ($P < 0.001$). The occurrence of postoperative pain in micro-invasive operation group (18.2%) was significantly lower than that in OCHTD group (68.9%) ($P < 0.001$). There was no statistical difference ($P = 0.057$) in operative time micro-invasive operation group and OCHTD group (88.07 + 24.76 min Vs 101.17 + 43.33 min). The gastrointestinal tract function recovered significantly faster in LCBDE group (27.50 h) than OCHTD group (51.10 h) ($P < 0.001$). The time of abdominal drainage after operation of LCBDE group (4.25 d) was significantly shorter than that of T-tube drainage of OCHTD group (7.41 d) ($P < 0.001$). The median postoperative hospitalization stays of micro-invasive operation group (8 d) was significantly shorter than that of OCHTD group (13.74 d), $P < 0.001$. **Conclusion** Both LCBDE and EST + LC were safe and reliable procedures. These procedures have low rate of complications, imply a shorter postoperative stay, and offer the patients more comfortable postoperative period than OCHTD. They are ideal procedure for treating patients with Secondary Choledocholithiasis.

[Key words] Choledocholithiasis; Laparoscopic cholecystectomy; Choledocholithotomy; Endoscopic sphincterotomy

Choledocholithiasis can be classified into two types, depending on their site of origin; Primary stones from de novo from the bile duct (after cholecystectomy), whereas Secondary stones are presumed to have migrated from the gallbladder into the common bile duct (CBD). Secondary stones are identical in composition to stones in the gallbladder (predominantly cholesterol in 80% and black pigment in

20% and are presumed to be formed in the gallbladder with subsequent migration into common bile duct (CBD).^[1] The events predisposing to this migration remain unknown; however the diameter of the cystic duct appears to be important.

Choledocholithiasis are one of the medical conditions leading to surgical intervention. They may occur in 3% -14.7% of all patients for whom

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cholecystectomies are preformed.^[2,3] When patients present with CBD, the one important question that should be answered: what is the best modality of treatment under the giving conditions. There are competing technologies and approaches for diagnosing CBDS with regard to diagnostic performance characteristics, technical success, safety, and cost effectiveness. Management of CBDS usually requires two separate teams: the gastroenterologist and the surgical team. One of the main factors in the management is initially the detection of CBDS, before, during, or after cholecystectomy.

The main options for treatment are pre- or postoperative ERCP with endoscopic biliary sphincterotomy (EST), laparoscopic or open surgical bile duct clearance. None of these treatment options are used for clinical circumstances in modern days such as electrohydraulic lithotripsy (EHL), extracorporeal shockwave lithotripsy (ESWL), and laser lithotripsy. Variables such as disease status, patient demographics, availability of endoscopic, radiological and surgical expertise, and healthcare economics will all have significant influence on practice^[4]

The management of secondary choledocholithiasis has changed dramatically over the past decade. Formerly, patients presenting with signs or symptoms of CBD stones (pain, jaundice, pancreatitis, cholangitis, or elevated obstructive enzymes) underwent open cholecystectomy with intraoperative cholangiography (IOC), followed by open common bile duct exploration (CBDE) with stone removal and T-tube placement. Although a high success rate of CBD clearance was achieved, the significant morbidity and mortality of major abdominal surgery remained.^[5,6] The development of laparoscopic cholecystectomy (LC) as a minimally invasive approach to eliminate the ongoing source of gallstones in conjunction with increasingly sophisticated techniques for CBD stone removal by endoscopic retrograde cholangiopancreatography (ERCP) has revolutionized the treatment of secondary choledocholithiasis.^[7-9]

Endoscopic retrograde cholangiopancreatography (ERCP) has become a widely available and routine procedure, whilst open cholecystectomy has largely been replaced by a laparoscopic approach, which may or may not include laparoscopic exploration of the common bile

duct (LCBDE). But EST destroy Oddi's sphincter. In addition new imaging techniques such as magnetic resonance cholangiopancreatography (MRCP) and endoscopic ultrasound (EUS) offer the opportunity to accurately visualize the biliary system without instrumentation of the ducts. As a consequence clinicians are now faced with a number of potentially valid options for managing patients with suspected CBDS.^[10]

1 MATERIALS AND METHODS

A retrospective database, which contained the data of all patients with surgical and minimally invasive surgical treatments for the secondary choledocholithiasis, at the Department of Hepatobiliary Surgery, Second Affiliated Hospital of Kunming Medical University, China, was used. All patients with newly diagnosed choledocholithiasis who had come to hospital for the treatment within two years, between January 2010 and December 2011, are retrospectively analyzed.

All the patients were diagnosed with B-USG, computed tomography (CT), ERCP or Magnetic Resonance Cholangiopancreatography (MRCP), informed about their health conditions where upon they agreed to the appropriate surgical procedure before operation. ERCP and EST were performed as the first line modality of treatment, after the patient diagnosed with choledocholithiasis. Patients underwent surgery when ERCP failed. Surgical procedures included CBD exploration and T-tube insertion. In the modern days, laparoscopic cholecystectomy (LC) is the surgery of choice. In some patients with previous open cholecystectomy who had subsequent adhesions, open surgery were performed, through a right subcostal or upper abdominal midline incision. T-tube was inserted in the CBD when its diameter was less than 12 mm and in patients with cholangitis. Seven to eight days after surgery, T-tube cholangiography was performed. In cases without retained stones the T-tube was extracted 21 to 30 days after surgery.

Patients were categorized in three groups. The micro-invasive group had 44 cases including 25 cases of LCBDE and 19 cases of EST+LC. The open choledocholithotomy with T-tube drainage (OCHTD) had 58 cases.

1.1 Selection Criteria

The patients with symptomatic choledocholithiasis proved by MRCP/MRI Transabdominal Ultrasound (B-USG) and other essential investigations.

1.2 Exclusion criteria

Suspected CBD malignancy, Contraindications and/or absence of compliance to the diagnostic and/or therapeutic procedures (MRCP and ERCP), and finally

Contraindications to laparoscopic surgery as glaucoma, pulmonary emphysema, and left heart failure, pregnancy

The aim of this study was to evaluate the different approach, efficacy and outcome of treatment of secondary CBD stones. The patients in divided into three categories The micro-invasive group including cases of LCBDE and cases of EST+ LC. And the other category for the open choledocholithotomy with T-tube drainage (OCHTD). There were 41 male and 61 female subjects with a range of age group 26–84 years. The patients were found to have definite common bile duct stones at endoscopic retrograde cholangiopancreatography (ERCP) or magnetic resonance cholangiopancreatography (MRCP). Endoscopic sphincterotomy (EST) was performed in most of the patient and basket extraction of common bile duct stones attempted. Those patients with complete clearance was not achieved were subjected to Laparoscopic cholecystectomy (LC). This EST + LC category includes 19 patients with male 8 and female 11 patients with a range of age group 28–72 years. While other group of 25 patients were subjected to treatment for Laparoscopic Common bile duct Exploration (LCBDE) with male 10 and female 15 patients with a range of age group 33–78 years. And open choledocholithotomy with T-tube drainage (OCHTD) group of 58 patients with male 23 and female 35 patients and a range of age group 26–84 years.

The comparison between these group with respect to their clinical characteristics (number, age, sex, symptomatic presentation like fever, acute cholecystitis, acute cholangitis, right upper quadrant Pain, gallstone Pancreatitis, history of Jaundice. Also included Operation time, postoperative hospital stay, conversion rate to open surgery, postoperative complication, recurrence rate of choledocholithiasis, and mortality. For

the reference, Table 1, showing the details of clinical data of the patients with their clinical characteristics.

The clinical presentation with right upper quadrant pain was seen in 91 patients, acute cholecystitis in 33 patients, acute cholangitis in 44 patients, and history of jaundice in 44 patients. Liver function tests was done to analyze the clinical condition of patients. The patients with AST or ALT was found increased in 43 patients, γ -GT increased in 59 patients.

2 RESULTS

During this study period, a total of 102 patients underwent treatment of choledocholithiasis in our hospital. The minimally invasive surgical treatments were performed in 44 patients and 58 patients underwent open choledocholithotomy with T tube drainage (OCHTD). This population comprised of 40.9% male cases with age ranges 57 (28 ~ 78 years) in minimally invasive group and 39.7% male cases with age ranges 59.5 (26 ~ 84 years) in open choledocholithotomy with T tube drainage (OCHTD) group. ALT or AST was found increased in 47.7%, γ -GT increased in 56.8%, AKP increased in 38.6% minimally invasive group while ALT or AST was found increased in 37.9% γ -GT increased in 58.6%, AKP increased in 36.2% in open choledocholithotomy with T tube drainage (OCHTD) group.

The average number of CBD stones extracted in patient in minimally invasive group were 1 (1–7) and in open choledocholithotomy with T tube drainage (OCHTD) group were 1 (1–20) with ($P = 0.096$). The size of CBD stones comparing maximum diameter in cm the first group of minimally invasive group shows diameter of 0.9 (0.3–2.5) and OCHTD group was 0.8 (0.2 ~ 5.0) ($P = 0.163$). The large average size of CBD, along with the large average stone size and number attests to the choledocholithotomy procedure with T-tube drainage route used in the majority of patients.

There was less significant difference in the rate of postoperative complication was observed in minimally invasive group in compare to the patients underwent open choledocholithotomy with T tube drainage (OCHTD) group. Postoperative pain was reported in 40 cases underwent OCHTD and with ERCP/EST+LC in 7 cases. A single case reported with LCBDE. There was

Tab. 1 Clinical data of the patients with their characteristics

Clinical Data	LCBDE	EST + LC	OCHTD
No. of Cases (n)	25	19	58
Male / Female Cases	10/15	8/11	23/35
Age (Years)	60 (33~78)	55 (28~72)	59.5 (26~84)
Acute Cholecystitis	13	4	16
Acute Cholangitis	7	11	26
Gallstone Pancreatitis	5	3	4
Right upper quadrant Pain	22	16	53
Fever	10	6	18
Nausea and Vomiting	13	10	30
History of Jaundice	8	14	22
ALT or AST increased	12	9	22
AKP increased	9	8	21
γ -GT increased	14	11	34
Total Bilirubin / Direct Bilirubin	15	15	36
Combined with chronic cholecystitis gallstone	18	18	39
Associated with Atrophic cholecystitis	2	1	8
Gallbladder Effusion	0	0	4

AST - Aspartate Aminotransferase, ALT- Alanine Aminotransferase, AKP- Alkaline Phosphatase γ -GT -Gamma-glutamyl-transpeptidase

Treatments approach for Choledocholithiasis

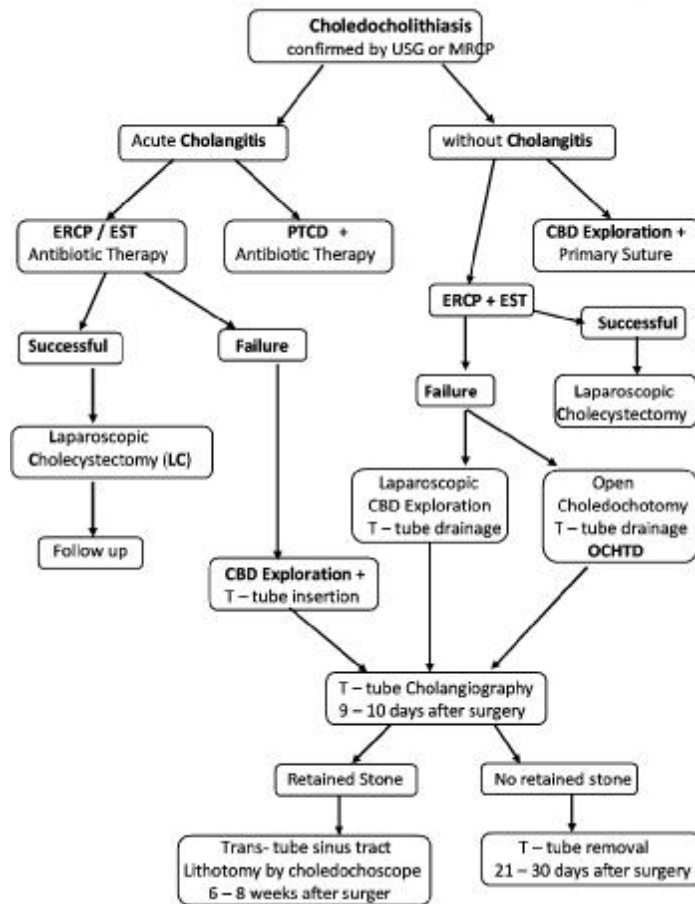


Fig. 1 Algorithm showing treatment approach of choledocholithiasis

Tab. 2 Basic Clinical data of Minimally invasive group and the open Choledocholithotomy with T-Tube Drainage group

Clinical Data	Minimally Invasive Group	OCHTD	P
No. of Cases (n)	44	58	
	Percentage (%) of Male Cases	40.9% (18 / 44)	39.7% (23 / 58)
0.898		Age (Years)	57 (28 ~ 78)
59.5 (26 ~ 84)	0.092		ALT or AST increased (%)
47.7% (21 / 44)	37.9% (22 / 58)	0.321	
AKP increased (%)	38.6% (17 / 44)	36.2% (21 / 58)	0.802
	Y-GT increased (%)	56.8% (25 / 44)	58.6% (34 / 58)
0.855		Total Bilirubin / Direct Bilirubin increased (%)	68.2% (30 / 44)
62.1% (36 / 58)	0.522		Combined with chronic chole- cystitis gallstone
81.1% (36 / 44)	67.2% (39 / 58)	0.098	Associated with Atrophic chole- cystitis
6.8% (3 / 44)	13.8% (8 / 58)	0.343	
Gallbladder Effusion	0 % (0 / 44)	6.9% (4 / 58)	0.132
	CBD diameter (cm)	1.15 (0.6 ~ 2.0)	1.2 (0.6 ~ 2.5)
0.492		CBD stones max. diameter (cm)	0.9 (0.3 ~ 2.5)
0.8 (0.2 ~ 5.0)	0.163		No. of CBD stones (piece)
1 (1 ~ 7)	1 (1 ~ 20)	0.096	

Tab. 3 Complication: Postoperative Pain and Gastrointestinal reactions

Surgical Approach	LCBDE	EST+LC	OCHTD	P
P.value		Postoperative Pain (%)	4% (1/25)	36.8% (7 / 19)
69.9% (40 / 58)		0.000		Nausea and Vomiting (%)
4% (1 / 25)	36.8% (7/19)	12.1% (7/58)		0.007

Tab. 4 Surgical Approach and Complications

Surgical Approach Complications	LCBDE (n = 25)	EST + LC (n = 19)	OCHTD (n = 58)	P
Incisional infection Liquefaction	4% (1/25)	0% (0/19)	32.8% (19/58)	0.001
Abdominal Hemorrhage (%)	4% (1/25)	0% (0/19)	6.9% (4/58)	0.824
Urinary Tract Infection / Retention (%)	4% (1/25)	5.3% (1/19)	8.6% (5/58)	0.869
Intestinal Infection (%)	8% (2/25)	5.3% (1/19)	0% (0/58)	0.077
Bile Leakage (%)	4% (1/25)	0% (0/19)	3.4% (2/58)	1.000
Pancreatitis (%)	0% (0/25)	10.5% (2/19)	0% (0/58)	0.058
Residual Stones (%)	4% (1/25)	0% (0/19)	8.6% (5/58)	0.527

Tab. 5 Total Operation Time, Gi function Recovery Time ($\bar{x} \pm s$)

Surgical Approach	LCBDE	EST+LC	OCHTD
Total Surgical Time (Time/minute)	86.80 ± 29.6	89.74 ± 17.8	101.17 ± 43.33
Recovery of Gi function Time (Time/hour)	24 (24 ~ 36)	–	54 (24 ~ 108)

Tab. 6 Cost of Hospitalization and postoperative Hospital Stay

Surgical Approach	LCBDE	EST+LC	OCHTD
Hospitalization Cost (Yuan)	10431 (8790 ~ 17414)	13400 (10475 ~ 32617)	9271.5 (5874 ~ 28888)
Postoperative Hospital Stay (Time/day)	6 (3 ~ 13)	9 (6 ~ 27)	13 (6 ~ 32)

significantly higher rate of complaints of nausea and vomiting with patients underwent endoscopic sphincterotomy (EST). Table 3 showing details on postoperative pain and gastrointestinal reactions.

Table 4. below shows Surgical approach and complications for the treatment of Choledocholithiasis. The overall incidence of complications in OCHTD group was significantly higher than in minimally invasive group. OCHTD shows high rate of incisional infection with 32.8% (19 / 58). There was no abdominal hemorrhage in case of EST/LC group while 4% (1/25) patients of LCBDE and 6.9% (4/58) patients with OCHTD shows abdominal hemorrhage. Residual stone was found in 4% (1/25) patient with LCBDE and 8.6% (5/58) patients with OCHTD. Bile leakage was observed in two cases of OCHTD group and only a single case of LCBDE. Urinary tract infections were encountered in one patient with both LCBDE and EST/LC group and in five patients with OCHTD group.

The mean operation time was 86.80 + 29.6 minutes in LCBDE group, 89.74 + 17.82 minutes in ERCP/EST + LC group and 101.17 + 43.33 minutes in OCHTD group. Gastrointestinal function recovery was seen faster in LCBDE group in compare with OCHTD group. This is shown below in table 5.

Among the secondary outcomes, only duration between the first procedure until hospital discharge and overall professional fee charges differed significantly between the 3 groups (Table 6). Duration of hospital stay from the procedure to discharge was 6 (3 ~ 13) days which reveals shorter in the LCBDE group, for the ERCP/EST+LC group; 9 (6 ~ 27) days and Open choledocholithotomy with T-tube drainage (OCHTD) was 13 (6 ~ 32) days. Professional fees charged in Chinese currency (Yuan) by the hospital for the 2-procedure ERCP/EST+LC arm were significantly higher 13400 (10475 ~ 32617) in compare to the single-procedure LCBDE arm costs 10431 (8790 ~ 17414) and Open choledocholithotomy with T-tube drainage was 9271.5 (5874 ~ 28888). Total hospitalization charges, patient acceptance, and quality of life scores were, however, not significantly different.

3 DISCUSSION

This study would suggest that, different approach of treatment for secondary choledocholithiasis can be performed both safely and effectively. Secondary stones are similar in composition to gallbladder stones. The management of choledocholithiasis has always been challenging. Nowadays, ERCP has essentially replaced open surgery for safe and effective CBD stone extraction. However, laparoscopic common bile duct exploration (LCBDE) is still a common procedure where ERCP fails. After the introduction of ERCP, single ERCP with EST or followed by cholecystectomy enables patients to avoid the burden of major operative risk and to relieve cholangitis symptoms. With the diffusion of laparoscopic surgery, ERCP with EST followed by LC has become a generalized method and their efficacy and safety has been compared to those of LCBDE. The ideal method of CBD stones removal is the one that does not cause injury to the sphincter of Oddi, because it is desirable to preserve the sphincter in patients younger than aged 60 years. Endoscopic methods, such as ERCP ± EST, need an experienced and skilled endoscopist to be successful. Even after ERCP, EST is not always possible, and when EST is successful, the duct is not always cleared of stones.

In our center, the appropriate surgical method was chosen based on the patient's condition. In this context, the use of MR cholangiography in cases of suspected choledocholithiasis, can confirm not only the presence of stones but also can provide essential information concerning the anatomic location and number of stones, their size, mobility, and the anatomy of the biliary tree. This assessment allowed to select with confidence the most appropriate approach, laparoscopic or open, as well as the type of operation to perform.^[11] In patients with sepsis due to cholangitis and accompanying diseases, it was necessary to shorten the time of surgery. In addition, biliary-enteric anastomosis increased the risk of complications. In such cases, the T-tube was inserted following CBD exploration as most preferred choice. Most authors have preferred insertion of T-tube for CBD drainage, but some centers have utilized transcystic tubes (C-tube) or antegrade stenting with choledochorrhaphy for CBD drainage.^[12] In patients with retained stone, Trans-tube sinus tract Lithotomy by choledochoscope has been performed, 6

– 8 weeks after surgery with provision of an access route for removal of retained choledocholithiasis.

Currently, many centers use laparoscopy for CBD surgeries. Expert surgical teams have reported a CBD clearance rate of about 97%. The morbidity rate has been reported to be 9.5% and retained stone rate of 2.7% for exploratory laparoscopic CBD.^[13] Nevertheless, in comparison to open surgery, laparoscopic surgery is more time consuming,^[14] yet has shorter postoperative hospitalization. Open surgery is still straight forward for management of choledocholithiasis and has a higher stone clearance rate.

Similar to LC, LCBDE has an advantage of less postoperative pain, short duration of hospitalization and early return to society. Already, LC replaced open cholecystectomy (OC) as the gold standard treatment for acute cholecystitis. Nevertheless, it has been reported that LCBDE is superior to ERCP with LC in terms of patient risk and cost effectiveness, because it can be performed during a single procedure. Choledochoscope, is useful for removing a large stone, which is difficult for ERCP, and easier to inspect CBD. The optimal method for performing open CBD exploration is unclear. The routine use of IOC during laparoscopic cholecystectomy remains controversial. Generally, ERCP is more feasible in this subgroup since postoperative T-tube cholangiography shows the anatomy of the biliary tree and large or impacted stones that have been extracted during surgery. In cases with CBD diameters less than 12 mm, the T-tube was used because of the high risk for anastomotic stricture and subsequent complications. Most surgeons have preferred insertion of T-tube for CBD drainage.

The maximum duration of hospital stay was seen in patients with conversion to open procedures because all of these were failures of laparoscopic surgery. The patients with T-tube drainage also had longer operative time in average $101.17 + 43.33$ minutes, because external biliary drainage was mostly used during the initial part of the series or in cases of complicated choledocholithiasis. Higher conversion rates are well documented while gaining proficiency in laparoscopic exploration of the common bile duct. Factors required to achieve a high success rate in LCBDE include adequate training, standardization of surgical technique, and accurate positioning of the trocars. Primary closure after

common bile duct exploration seems at least as safe as T-tube drainage.

The hospitalization costs and the other charges for surgical procedures were charged in Chinese currency (Yuan) by the hospital. The charges were considerably higher 13400 (10475 ~ 32617 Yuan) for the 2-procedure ERCP/EST+LC arm in compare to the single-procedure LCBDE arm that costs 10431 (8790 ~ 17414 Yuan) and Open choledocholithotomy with T-tube drainage was 9271.5 (5874 ~ 28888) .

Complications are known to be associated with the use of T tubes. Biliary leaks have been shown to occur at the time of tube removal or at CBD exploration which may progress to intraperitoneal collections, external fistulae or even peritonitis. The CBD may even be traumatized at the time of removal with possible fibrosis and stricture. Although surgery is clearly more effective in dealing with retained ductal stones than its alternatives, it is generally considered to be associated with a higher morbidity and mortality.

4 CONCLUSION

Choledocholithiasis remains a challenging problem for clinicians. Currently, ERCP is used mainly for extraction of CBD stones, but surgery is the method of choice when ERCP fails. Performing an IOC assists in the detection of CBD stones but routine use of IOC remains controversial. Although ERCP and then laparoscopic CBD exploration are selective methods in most centers, open CBD exploration is the most effective method. Selection of treatment depends on physicians' experience and available resources.

LCBDE is a procedure with a long and significant learning curve, reflecting the requirement of mastering intracorporeal suturing and knotting as well as choledochoscopy. Once mastered, LCBDE can be performed within an operative time comparable to that for OCBDE. Patients with successful LCBDE experience the same benefits as seen after LC. The index study proves that LCBDE when performed by an experienced surgeon results in no additional morbidity or mortality as compared to open surgery, with excellent success rates, and thus specially benefits the subgroup of patients with multiple, large, impacted stones in a dilated CBD who were traditionally subjected to OCBDE. Laparoscopic primary closure of the CBD is safe and successful for the man-

agement of CBD stones. Application of IOC and choledochoscopy to ensure clearance of the CBD and careful suturing are essential for primary closure.

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继发性胆总管结石的治疗

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[摘要] **目的** 评价临床不同治疗方法对继发性胆总管结石的疗效。 **方法** 回顾性分析 2010 年 1 月至 2011 年 12 月昆明医科大学第二附属医院肝胆外二科收治的继发性胆总管结石病例 102 例。 **结果** 微创手术组 44 例, 其中腹腔镜胆道探查术 25 例 (LCBDE 组), 内镜下十二指肠乳头切开取石联合腹腔镜胆囊切除术 19 例 (EST+LC 组); 开腹胆道探查联合 T 管引流术 58 例 (OCHTD 组); 手术均成功。 LCBDE 组结石平均数较 EST+LC 组多, 差异有统计学意义 ($P < 0.05$)。 微创手术组并发症发生率低于 OCHTD 组, 差异有统计学意义 ($P < 0.01$)。 微创手术组术后疼痛的发生率低于 OCHTD 组, 差异有统计学意义 ($P < 0.01$)。 微创手术组手术时间与 OCHTD 组相当, 差异无统计学意义 ($P > 0.05$)。 微创手术组胃肠道功能恢复时间短于 OCHTD 组, 差异有统计学意义 ($P < 0.01$)。 LDCDE 组腹腔引流管拔出时间短于 OCHTD 组, 差异有统计学意义 ($P < 0.05$)。 微创手术组术后住院时间短于 OCHTD 组, 差异有统计学意义 ($P < 0.05$)。 **结论** 腹腔镜胆道探查术及十二指肠乳头切开取石治疗继发性胆总管结石是安全、有效的; 其并发症的发生率要低于开腹胆道探查术, 而且其术后住院时间也要短于开腹胆道探查术; 其是治疗继发性胆总管结石理想的治疗手段。

[关键词] 胆总管结石; 腹腔镜胆囊切除术; 胆总管切开取石术; 内镜下十二指肠乳头切开取石术

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