

# The role of choledochoscopy in transductal laparoscopic common bile duct exploration

K. Atstupens, H. Plaudis, E. Saukane, A. Rudzats

Riga East University Hospital, Clinic *Gailezers*, Latvia

✉ Kristaps Atstupens: [kristofss@inbox.lv](mailto:kristofss@inbox.lv)

K. Atstupens, PhD, Docent, <https://orcid.org/0000-0001-9363-6195>

H. Plaudis, PhD, Prof., <http://orcid.org/0000-0002-3951-5437>

E. Saukane, Certified surgeon, <https://orcid.org/0000-0002-0455-1745>

A. Rudzats, Certified surgeon, <https://orcid.org/0000-0002-1026-8567>

Laparoscopic common bile duct exploration (LCBDE) performed by choledochoscope through the cystic duct or directly through the incision in the common bile duct (CBD) are well established methods for restoring biliary drainage function in patients with choledocholithiasis. Although it plays a crucial role in the transcystic approach, transductal approach can be achieved differently. However, it has restrictions in availability due to its expensiveness.

**OBJECTIVE** — to report efficacy of transductal LCBDE without laparoscopic choledochoscopy.

**MATERIALS AND METHODS.** This is a prospective study of urgently admitted patients who underwent trans-ductal LCBDE due to confirmed choledocholithiasis. During laparoscopy, clearance of the CBD was achieved in two ways: by choledochoscopy (group CS+, n=43) and without it (group CS–, n=34). The data of patient demographics, comorbidities, operative outcomes, morbidity, mortality and long-term biliary complications were analysed and compared between the groups.

**RESULTS.** Out of a total of 154 patients with confirmed choledocholithiasis, the trans-ductal approach of LCBDE was applied to 77 patients. In 43 patients, clearance was done with choledochoscope (group CS+) and in 34 patients without it (group CS–). Gallstone related complications and comorbidities did not differ between the groups. Surgery was done 4 days after admission in both groups. Median duration of the operation was significantly shorter in the group CS–, 93 vs 120 minutes ( $p=0.036$ ), without any difference in conversion and complication rates. Clearance rate was markedly high in both groups.

**CONCLUSIONS.** Transductal laparoscopic common bile duct exploration without choledochoscopy is a time-saving, safe and effective way for CBD clearance, without additional equipment.

## KEYWORDS

choledocholithiasis, laparoscopic common bile duct exploration, intraoperative ultrasound, choledochoscopy.

**ARTICLE** • Received 2021-11-11 • Received in revised form 2021-11-17

© General Surgery, 2021

Gallstone related complications resulting from choledocholithiasis are associated with potentially life-threatening conditions such as biliary pancreatitis and cholangitis often accompanied by mechanical jaundice that requires urgent restoration of biliary drainage function. Recently reported studies have shown incidence of the common bile duct (CBD) stones up to 8–20 % in patients with gallstone disease [1]. Existing recommendations suggest two main approaches to the treatment of these conditions — endoscopy first or a one-step surgery.

Endoscopic retrograde cholangio-pancreatography (ERCP) is widely accepted and can be a useful

procedure for the treatment of choledocholithiasis [2]. However, the method is invasive and associated with a 5–10 % complication rate and 0.1–1 % mortality rate [3]. Along with the progressive course of advanced laparoscopy, laparoscopic common bile duct exploration (LCBDE) assisted by laparoscopic choledochoscopy has become an effective and safe alternative [4] as well as more advantageous in comparison with a two-step approach [5]. However, choledochoscopy has restrictions due to its expensiveness and availability.

Despite the fact of consensus on the transcystic choledochoscopy in patients with small stones and

not dilated CBD, there is still undefined technique for LCBDE for transductal approach and the role of choledochoscopy in it.

**OBJECTIVE** – to report efficacy of transductal LCBDE without laparoscopic choledochoscopy.

## Materials and methods

### Patients

This clinical study includes urgently admitted and prospectively collected patients during the time period from January 2012 to February 2016 with complicated gallstone disease and high risk of choledocholithiasis according to the criteria of the American Society of Gastrointestinal Endoscopy [13] (Fig. 1). All patients were selected for laparoscopic cholecystectomy and common bile duct exploration in a single time. Patients with transcystic approach were excluded from the study, whereas patients with transductal approach were further analysed and stratified in two groups according to the way of CBD clearance – with (group CS+) or without choledochoscopy (group CS–) (Fig. 2). Complicated forms of gallstone disease were based on evidence of biliary pancreatitis, cholangitis and/or characteristic symptoms complex of biliary colic

frequently accompanied by pale stools and dark urine. Preoperative diagnosis of cholangitis was based on the criteria recommended in the Tokyo Guidelines 2013 – evidence of inflammatory response (increased white blood cells  $> 10 \cdot 1000/\mu\text{L}$ ) or CRP  $> 10$  mg/L, cholestatic pattern presented by abnormal liver function tests (alkaline phosphatase, GGT, ALT, AST  $\geq 1.5$  standard deviation) or bilirubin  $\geq 34.2$   $\mu\text{mol/L}$  and gallstones in the gallbladder and/or dilatation of the common bile duct  $> 6$  mm confirmed by trans-abdominal US [9, 10]. The diagnosis of biliary pancreatitis was made when two of the following revised Atlanta 2012 criteria were presented – abdominal pain consistent with acute pancreatitis; serum lipase activity more than three times greater than the upper limit of normal; and characteristic findings of acute pancreatitis on radiological investigations [11]. Severity grading of cholangitis and pancreatitis were also evaluated according to the Tokyo Guidelines 2013 (Fig. 3) and revised Atlanta 2012 criteria (Fig. 4), respectively. Preoperative anaesthesiological status was assessed in all patients using the American Society of Anaesthesiologists Physical Status classification system (ASA score) [6, 7].

### Diagnosis of choledocholithiasis

In the time of admission all patients had trans-abdominal ultrasound (TAUS) investigation as a screening where indirect signs of the presence or absence of CBD stones, specifically the CBD diameter more than 6 mm or intrahepatic bile duct dilation, were evaluated. According to the availability, part of them had preoperative magnetic resonance cholangio-pancreatography (MRCP) or computed tomography (CT) in case of suspected malignancy. During laparoscopy all patients underwent intraoperative ultrasound (IOUS) for approval of previously detected or diagnosing choledocholithiasis.

#### Predictors of choledocholithiasis

- Very strong
  - CBD stone on transabdominal US
  - Clinical ascending cholangitis
  - Bilirubin  $> 4$  mg/dL
- Strong
  - Dilated CBD on US ( $> 6$  mm with gallbladder *in situ*)
  - Bilirubin level 1.8–4.0 mg/dL
- Moderate
  - Abnormal liver biochemical test other than bilirubin
  - Age older than 55 years
  - Clinical gallstone pancreatitis

#### Assigning a likelihood of choledocholithiasis based on clinical predictors

Presence of any very strong predictor	<i>High</i>
Presence of both strong predictors	<i>High</i>
No predictors present	<i>Low</i>
All other patients	<i>Intermediate</i>

Figure 1. Predictors of choledocholithiasis (American Society of Gastrointestinal Endoscopy)

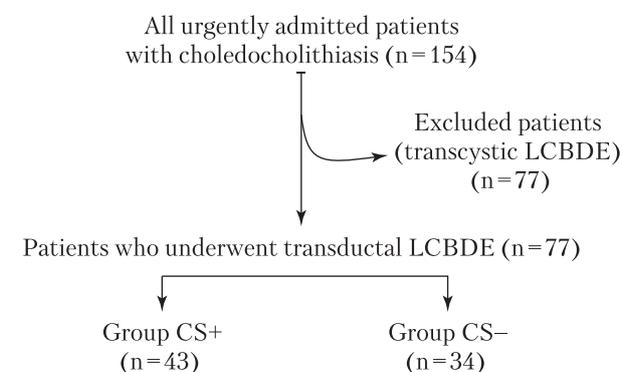


Figure 2. Study population

**Grade I (mild) acute cholangitis**

Grade I cholangitis does not meet the criteria of Grade III (severe) or Grade II (moderate) acute cholangitis at initial diagnosis

**Grade II (moderate) acute cholangitis**

Grade II acute cholangitis is associated with any two of the following conditions:

- Abnormal white blood cells count ( $> 12,000 \text{ mm}^3$ ,  $< 4,000 \text{ mm}^3$ )
- High fever ( $\geq 39^\circ\text{C}$ )
- Age ( $\geq 75$  years old)
- Hyperbilirubinemia (total bilirubin  $\geq 5 \text{ mg/dL}$ )
- Hypoalbuminemia ( $< \text{standard deviation} \cdot 0.7$ )

**Grade III (severe) acute cholangitis**

Grade III acute cholangitis is defined as acute cholangitis that is associated with the onset of dysfunction in at least one of any of the following organs/systems:

<b>Disfunctions</b>	<b>Parameters</b>
<i>Cardiovascular</i>	Hypotension required dopamine $\geq 5\mu\text{g/kg}$ per min, or any dose of epinephrine
<i>Neurological</i>	Disturbance of consciousness
<i>Respiratory</i>	$\text{PaO}_2/\text{FiO}_2$ ratio $< 300$
<i>Renal</i>	Oliguria, serum creatinine $> 2.0 \text{ mg/dL}$
<i>Hepatic</i>	International normalised ratio $> 1.5$
<i>Hematological</i>	Platelet count $< 100,000 \text{ mm}^3$

Figure 3. **Severity grading of cholangitis (Tokyo Guidelines 2013)**

<i>Mild acute pancreatitis</i>	No organ failure; no local and systemic complications
<i>Moderate acute pancreatitis</i>	Transient organ failure ( $< 48$ hours) and/or local or systemic complications or exacerbation of pre-existing comorbidities
<i>Severe acute pancreatitis</i>	Persistent organ failure (single or multiple)

Figure 4. **Severity grading of pancreatitis (revised Atlanta criteria 2012)**

**Laparoscopy**

The standard four-trocar technique was used for cholecystectomy and LCBDE. At the beginning of operation, Callot's triangle was dissected and cystic duct, artery and common bile duct were identified. Cystic duct and artery were clipped and cystic artery was divided. The gallbladder was left *in situ* and retracted during IOUS and LCBDE.

IOUS was performed with BK Medical flex Focus 800 US machine and special flexible laparoscopic transducer 8666-RF. The US transducer was inserted through the epigastric trocar and placed on the superior edge of the hepatoduodenal ligament and slid inferiorly to the distal end for the examination of CBD. The proximal part of CBD, left and right hepatic ducts and their junction were investigated through the right hepatic lobe. Diameter of CBD and cystic duct, as well as the size and number of stones were measured for determining the approach of choledochoscopy. The transcholedochal approach was chosen in cases when stones in CBD were larger than the obtainable diameter of cystic duct or when very distal insertion of the cystic duct in CBD was found by IOUS, or when common bile duct was more than 10 mm and choledocho-duodenostomy was expected, or when more than five stones were found.

An incision of the supraduodenal part of CBD was made longitudinally and the duct was flushed with normal saline. Afterwards, in group CS+, 2.5 mm flexible choledochoscope was inserted in a distal as well as in a proximal part of the bile duct and lobar intrahepatic bile ducts were examined. The stones were removed using Dormia baskets inserted through the instrument channel of the choledochoscope. However, in the group CS– clearance of CBD was achieved using Fogarty (No 3 or 4) catheters or extensive flushing with saline. After removal of all stones, clearance of the common bile duct was confirmed with repeated IOUS. After clearance common bile duct was closed in three ways: primary closure with interrupted 3–0 absorbable sutures and in exceptional cases of severe cholangitis or  $\text{CBD} > 15 \text{ mm}$ , T-tubes or choledocho-duodenostomies were performed.

All IOUSs and LCBDEs were performed by specially trained surgeons.

The data of patient demographics, comorbidities, operative outcomes, morbidity, mortality and long-term biliary complications were analysed and compared between the groups.

**Statistical analysis**

The interval data was presented in median (Me) with interquartile range (IQR) and was confirmed by the Kolmogorov-Smirnov test for the asymmetrical distribution of data. Comparison of the interval

data in groups CS+ and CS– was performed with the Mann-Whitney U test, the nominal data comparison was performed using the Pearson  $\chi^2$  test and Fisher's exact test. Significant dynamics of laboratory analysis were revealed by the Wilcoxon test. The correlation between hospital stays and clinical data was evaluated using the Spearman rho method. Also, the correlation coefficient was compared between the groups. A logistic regression analysis was performed to identify factors associated with a longer hospital stay. A p-value < 0.05 was considered as statistically significant. The statistical analysis was performed with SPSS version 20 and MedCalc version 15.

## Results

### Demographics

Out of a total of 154 patients who were urgently admitted and had confirmed stones in the common bile duct, 77 underwent transductal LCBDE (see Fig. 1). From this cohort, transductal LCBDE was done by laparoscopic choledochoscope in 43 patients (group CS+) and without it in 34 patients (group CS–). There were 22 males and 55 females in the cohort. The median age in cohort was 65 years (IQR 74.5–55.5) and that did not differ between the groups as well as there was no obvious statistically significant difference in gender and comorbidities (according to the ASA score). Biliary pancreatitis was more evident in the group CS– (p = 0.028), however, cholangitis in the group CS+ (p = 0.028). Patients with jaundice were presented equally in both groups. The median preparation time for patients before surgery was equally 4 days in the groups (IQR 6–2) (Table 1).

### Preoperative radiological imaging study

Pre-operative screening performed by trans-abdominal US was done in 71 patients of cohort and CBD stones were found in 28–48% of patients without difference in the groups. Specific preoperative diagnostic modalities like CECT and MRCP were done in 27 patients of cohort (35%) without difference between the groups. Choledocholithiasis was established in 40–67% of patients examined by CECT, and in 80–89% of patients examined by MRCP (Table 2).

### Laparoscopy

The median time of surgery was statistically significantly shorter in the group CS– without considerable rate of conversions. There were two patients in the group CS+ with conversion to open surgery

due to the impacted stones in CBD. IOUS was done successfully in all patients. Larger stones in CBD as well as more pronounced dilation of CBD were detected significantly frequently in the group CS–.

Choledochoduodenostomies were performed significantly more often in the group CS–, mostly due to the excessive (over 15 mm in diameter) dilatation of CBD and objective signs of papillary stenosis (unsuccessful insertion of 3 mm drain through the papilla). However, T-tubes were placed in 17 patients of all cohort, mainly due to the cholangitis, without difference between groups. Primary closure was achieved in 61% of the group CS+, which is significantly more often compared with the group CS– (Table 3).

Table 1. Preoperative characteristics

Indicator	CS+ (n = 43)	CS– (n = 34)	p
Age, years	62 (74–47)	68 (76–62)	0.087
Male/female	13/30	9/25	0.717
Pre-operative time, days	4 (6–2)	4 (6–2)	1
ASA I	8	6	0.936
ASA II	21	18	0.936
ASA III	14	10	0.936
Concomitant pancreatitis	6	12	0.028
Mild	3	0	0.099
Moderate	1	2	0.099
Severe	2	0	0.099
Cholangitis	33	18	0.028
Mild	25	8	0.031
Moderate	8	8	0.031
Severe	0	2	0.031
Jaundice	29	22	0.801

Quantitative data are presented as mean (interquartile range), categorical data are presented as a number of cases.

ASA – American Society of Anaesthesiologists Physical Status classification system.

Table 2. Preoperative radiological imaging study

Indicator	CS+ (n = 43)	CS– (n = 34)	p
TAUS	11 (28.0%)/40	15 (48.0%)/31	0.070/1
CECT	2 (40.0%)/5	2 (67.0%)/3	0.155/1
MRCP	8 (89.0%)/10	8 (80.0%)/9	1/0.745

The data are presented as verified choledocholithiasis/total number of patients studied.

TAUS – trans-abdominal ultrasound;

MRCP – magnetic resonance cholangiopancreatography;

CECT – contrast-enhanced computed tomography.

### Complication rate

The overall postoperative complication rate was observed in 11.7%, including mild pancreatitis in two patients from the group CS+, treated conservatively, as well as a bile leak in one patient, which was conservatively treated for 3 days by drainage, one bleeding from the liver bed with obtained hemostasis by re-laparoscopy, one subhepatic biloma drained percutaneously with ultrasound guidance, one case with retained stone in CBD underwent successful endoscopic clearance and one patient with embolism of pulmonary artery. However, in the group CS-, one patient developed hypertension crisis that was averted by medications, and one patient had a bile leak from

choledocho-duodenostomie and bile peritonitis. Despite the re-operation and repair of anastomosis, the above-mentioned case resulted in irreversible multiorgan dysfunction and death.

### Outcomes

Postoperative and total hospital stay was not significantly different in the groups. Totally 13 patients in postoperative period were treated in ICU without difference in the number of patients and days between the groups. One year readmission rate due to late biliary complications was similar. The reasons for re-hospitalization included choledocholithiasis, acute pancreatitis, cholangitis, whereas one patient was re-hospitalized to evacuate choledochostome. Choledocholithiasis was successfully managed with ERCP. Totally complete clearance rate of the common bile duct was high, without difference in the groups (Table 4).

Table 3. Operation data

Indicator	CS+ (n = 43)	CS- (n = 34)	p
Operation time, min	120 (140–90)	93 (125–76)	0.036
Diameter of CBD, mm	12 (15–10)	18 (20–13)	0.001
Largest stone in the CBD, mm	8 (10–6)	10 (15–10)	<0.001
Primary closure	26 (61.0%)	5 (15.0%)	<0.001
T-tubes	10 (23.0%)	7 (21.0%)	0.779
Choledocho-duodenostomies	7 (16.0%)	22 (65.0%)	<0.001
Conversion of laparoscopic to open surgery	2 (5.0%)	0	0.502

Quantitative data are presented as mean (interquartile range), categorical data are presented as a number of cases and percentage.

Table 4. Main outcomes

Indicator	CS+ (n = 43)	CS- (n = 34)	p
Hospital stay, days	12 (16–9)	11 (13–8)	0.428
Post-operative time, days	6 (10–4)	6 (8–5)	0.756
ICU stay, days	6 (14.0%)	7 (21.0%)	0.440
Morbidity	7 (16.2%)	2 (5.8%)	0.097
Mortality	0	1 (3.0%)	0.442
Readmission	5 (12.0%)	3 (9.0%)	1
Clearance rate of CBD, %	95	100	0.189

Quantitative data are presented as mean (interquartile range), categorical data are presented as a number of cases and percentage.

### Correlation analysis

Correlation analysis revealed that the total hospital stay had a moderate positive correlation in patients with inserted T-tubes and a strong positive correlation with severity of biliary pancreatitis in groups CS+ and CS-. However, choledocho-duodenostomies in the group CS- patients was associated with less hospital stay. Prolongation of total hospital stay was associated with comorbidities according to ASA score in the group CS+.

### Discussion

Consensus exists that the therapy for choledocholithiasis should be administered with the fewest number of procedures, lowest cost and less morbidity. Considering the fact that the recent study reported 11%–21% high incidence of choledocholithiasis in patients with gallstone disease at the time of cholecystectomy [13] and the variety of different modalities for CBD stones managing, there is still no consensus concerning the management of CBD stones. In general, there are two different approaches recommended in the literature for management of choledocholithiasis, based on more accurate preoperative diagnosis followed by endoscopic procedure and delayed surgery or definitive treatment of choledocholithiasis during laparoscopic cholecystectomy without specific pre-operative radiological investigation.

Magnetic resonance cholangio-pancreatography is considered as a routine, specific preoperative non-invasive diagnostic modality for the biliary tree, with a high sensitivity (81–100%) and specificity (92–100%) [21]. However, MRCP may miss

the stones less than 5 millimetres in diameter and bile sludge especially in the case of pancreatitis [22–24]. Moreover, there are some medical restrictions in MRCP, like expressed obesity, claustrophobia, and metallic prostheses.

Endoscopic retrograde cholangio-pancreatography (ERCP) usually combined with endoscopic papillotomy is a widely used treatment tool for patients with a high risk of biliary stones [13–15]. Despite the fact of high sensitivity (89%–93%) and specificity (100%) [15], the complications associated with ERCP are remarkable. Relatively high incidence of post-ERCP pancreatitis in general population is still a problem and it occurs in 4.5% [16–18]. Other complications like bleeding, perforation of duodenum or bile duct and post-papillotomy ascending cholangitis and cholecystitis can occur in 5%–8%, as well as mortality due to this procedure in 0.2–0.5% [19, 20]. Even more, ERCP may fail in case of difficult anatomy, biliary strictures or large stones (more than 10–15 mm in diameter or equal to the CBD diameter) even if performed by experienced endoscopists [27].

Considering the requirement of more advanced skills in laparoscopic surgery and choledochoscopy, ERCP still remains the first method of choice in many hospitals, but recently published articles demonstrated similar or better clearance rate of biliary stones performed by LCBDE compared to a two-step approach, as well as the complications related with papillotomy like cholangitis can be avoided [28, 29]. Moreover, contrary to the view that ERCP alone is used more often in elderly patients with significant comorbidities, LCBDE can be safe for elderly patients with undifferentiated results in general population [30]. Most authors suggest common bile duct exploration simultaneously with laparoscopic cholecystectomy [23–26].

LCBDE is performed either by the application of trans-cystic or trans-ductal approaches, and the role of choledochoscopy is paramount. Trans-cystic approach of choledochoscopy is restricted in many patients because of the limited size of the stones (< 6 mm), number of the stones (< 5) and size of the cystic duct [31, 33]. Moreover, transcystic stone clearance may be hampered by anomalous anatomy, proximal (common hepatic duct) stones and biliary strictures [41]. If the patients are not suitable for these criteria, the trans-ductal approach should be applied. Despite the advantages of LCBDE, it is associated with a higher risk of bile leakage, especially for the trans-ductal approach, [32] and should be performed by highly experienced and skilled surgeons. However, many limitations for the use of choledochoscopy still exist. Most of choledochoscopes

are guided in two planes which restricts manoeuvring as well as two trained surgeons are required for the procedure [34]. Moreover, application of the choledochoscopy is associated with lack of availability and prolonged learning curve.

The results of our study confirmed the findings reported in the literature that the patients' general status, comorbidities and typical complications (bile leakage, bleeding from the liver bed) were similar in patients who underwent LCBDE. Pre-operative radiology by TAUS screening was mostly ordered for detecting indirect signs suggestive of the possibility of the CBD stones. However, pre-operative CECT scan and MRCP were performed when other reasons of bile stasis (mostly malignancy) were suspected [21, 35, 36].

The above-mentioned results demonstrate that choledochoscopy significantly increases duration of surgery compared with the group CS– as well as conversions were not observed in the group CS–. For the clearance control after CBD exploration as well as for diagnosis of choledocholithiasis before exploration we used IOUS. IOUS is a useful, safe, non-invasive, quick imaging method with a sensitivity and specificity of 80%–100% and 98%–100%, respectively [37–39]. It can be repeated in any time of surgery. Moreover, IOUS is useful in cases with severe infiltrate and difficult anatomy. High clearance and low readmission rate due to residual stones in CBD prove efficacy of this method [40], similarly to our study.

Additional T-tubes were used similarly in both groups in patients with a significant risk of bile leakage from choledochotomy (severe cholangitis, uncertainty regarding duct clearance, edema or spasm of the sphincter after exploration), like it is reported in other studies (41) and in any case T-tubes as a controlled biliary fistula allow postoperative radiological evaluation of the biliary system for retained stones and early endoscopic clearance when indicated. However, choledochoduodenostomies were performed in selected cases, significantly more often in the group CS– due to the extensive dilatation of CBD. Primary closure of CBD after clearance was achieved in cases that lacked the above-mentioned conditions, significantly more often in the group CS+. The similar recommendations and results for primary closure of CBD were reported by other authors [42, 43].

According to the results of our study and reported studies, the hospital stay is strongly associated with a use of T-tubes [42, 43] and severity of biliary pancreatitis. Similarly to the reported data, comorbidities based on ASA score were associated with a prolongation of hospital stay [44].

This study shows that LCBDE guided by intra-operative ultrasonography in transductal approach without choledochoscopy resulted in high clearance rate, low complication rate and low one-year readmission rate.

## Conclusions

Transductal laparoscopic common bile duct exploration without choledochoscopy is a time-saving, safe and effective way for bile duct cleaning without additional equipment.

## DECLARATION OF INTERESTS

Authors have no conflict of interest to declare.

## ETHICS APPROVAL AND WRITTEN INFORMED CONSENTS STATEMENTS

The assessment and usage of all clinical data was approved and permitted before the study by the ethics committee of the Riga Stradins University. The study protocol conformed to the ethical guidelines of the «World Medical Association (WMA) Declaration of Helsinki — Ethical Principles for Medical Research Involving Human Subjects» adopted by the 18th WMA General Assembly, Helsinki, Finland, June 1964 and amended by the 59th WMA General Assembly, Seoul, South Korea, October 2008 [8].

## AUTHOR CONTRIBUTIONS

K. Atstupens: conception and design, acquisition, analysis and interpretation of data, drafting the article, critical revision of the article; H. Plaudis: conception and design, critical revision of the article; E. Saukane, A. Rudzats: acquisition, analysis and interpretation of data.

All authors have read and agreed to the published version of the manuscript.

## REFERENCES

- Tozatti J, Mello ALP, Frazon O. Predictor factors for choledocholithiasis. *Arq Bras Cir Dig*. 2015 Apr-Jun;28(2):109-12
- ASGE Standards of Practice Committee, Maple JT, Ikenberry S, Anderson MA, Appalaneeni V, Decker GA, Early D, Evans JA, Fanelli RD, Fisher D, Fisher L, Fukami N, Hwang JA, Jain R, Jue T, Khan K, Krinsky ML, Malpas P, Ben-Menachem T, Sharaf RN, Dominitz JA. The role of endoscopy in the management of choledocholithiasis. *Gastrointestinal Endoscopy*. 2012;75(1): 230-0.e14
- Veizakis A, Fragulidis G, Polydorou A. Endoscopic retrograde cholangiopancreatography-related perforations: Diagnosis and management. *World J Gastrointest Endosc*. 2015 Oct 10;7(14):1135-41. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4600179/>
- Qiu W, Sun XD, Wang GY, Zhang P, Du XH, Lv GY. The clinical efficacy of laparoscopy combined with choledochoscopy for cholelithiasis and choledocholithiasis. *Eur Rev Med Pharmacol Sci*. 2015 Oct;19(19):3649-54.
- Cuschieri A, Lezoche E, Morino M, 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.
- Sankar A, Johnson SR, Beattie WS, Tait G, Wijesundera DN. Reliability of the American Society of Anesthesiologists physical status scale in clinical practice. *Br J Anaesth*. 2014;113:424-32.
- Aronson WL, McAuliffe MS, Miller K. Variability in the American society of anesthesiologists physical status classification scale. *AANA J*. 2003;71:265-74.
- World Medical Association. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. *JAMA*. 2013;310:2191-914.
- Takada T, Strasberg SM, Solomkin JS, et al. TG13: Updated Tokyo Guidelines for the management of acute cholangitis and cholecystitis. *J Hepatobiliary Pancreat Sci*. 2013;20:1-7. PMID: 23307006
- Kiryama S, Takada T, Strasberg SM, et al. TG13 guidelines for diagnosis and severity grading of acute cholangitis (with videos). *J Hepatobiliary Pancreat Sci*. 2013; 20:24-34. PMID: 23307001
- Banks PA, Bollen TL, Dervenis C, et al. Classification of acute pancreatitis-2012: revision of the Atlanta classification and definitions by international consensus. *Gut*. 2013;62(1):102-11. PMID: 23100216
- Maple JT, Ikenberry SO, Anderson MA, et al. The role of endoscopy in the management of choledocholithiasis. *Gastrointest Endosc*. 2011;74:731-44. doi: 10.1016/j.gie.2011.04.012.
- Costi R, Gnocchi A, Di Mario F, Sarli L. Diagnosis and management of choledocholithiasis in the golden age of imaging, endoscopy and laparoscopy. *WJG 20th Anniversary Special Issues (15): Laparoscopic resection of gastrointestinal*.
- Williams EJ, Green J, Beckingham I, Parks R, Martin D, Lombard M. Guidelines on the management of common bile duct stones (CBDS). *Gut*. 2008;57:1004-21 PMID: 18321943 DOI: 10.1136/gut.2007.121657
- Williams EJ, Green J, Beckingham I, Parks R, Martin D, Lombard M. Guidelines on the management of common bile duct stones (CBDS). *Gut*. 2008; 57:1004-21 [PMID: 18321943 DOI: 10.1136/gut.2007.121657
- Freeman ML, Nelson DB, Sherman S, et al. Complications of endoscopic biliary sphincterotomy. *N Engl J Med*. 1996;335:909-18.
- Cheng CL, Sherman S, Watkins JL, et al. Risk factors for post-ERCP pancreatitis: a prospective multicenter study. *Am J Gastroenterol*. 2006;101:139-47.
- Freeman ML, DiSario JA, Nelson DB, et al. Risk factors for post-ERCP pancreatitis: a prospective, multicenter study. *Gastrointest Endosc*. 2001;54:425-34.
- Ong TZ, Khor J L, Selamat DS, Yeoh KG, Ho KY. Complications of endoscopic retrograde cholangiography in the post-MRCP era: a tertiary center experience. *World J Gastroenterol*. 2005;11:5209-12.
- 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;351:159-61.
- Hallal AH, Amortegui JD, Jeroukhimov IM, et al. Magnetic resonance cholangiopancreatography accurately detects common bile duct stones in resolving gallstone pancreatitis. *J Am Coll Surg*. 2005;200:869-75.
- Freitas ML, Bell RL, Duffy AJ. Choledocholithiasis: evolving standards for diagnosis and management. *World J Gastroenterol*. 2006;12:3162-7. PMID: 16718834
- Sinha R. Early laparoscopic cholecystectomy in acute biliary pancreatitis: the optimal choice? *HPB*. 2008;10:332-5. PMID: 18982148
- Li P, Zhang Z, Li J, Jin L, Han W, Zhang J. Diagnostic value of magnetic resonance cholangiopancreatography for secondary common bile duct stones compared with laparoscopic trans-cystic common bile duct exploration. *Med Sci Monit* 2014;20:920-6. PMID: 24894946
- Sangrasi AK, Syed BM, Memon AI, Laghari AA, Talpur KAH, Qureshi JN. Laparoscopic cholecystectomy in acute gallstone pancreatitis in index hospital admission: Feasibility and safety. *Pak J Med Sci*. 2014; 30:601-5. PMID: 24948988
- Tranter SE, Thompson MH. Comparison of endoscopic sphincterotomy and laparoscopic exploration of the common bile duct. *Br J Surg*. 2002;89:1495-504.
- Gerasimos S, Christos C, Spiliotis M, Ram C. Endoscopic extraction of large common bile duct stones: A review article. *World J Gastrointest Endosc*. 2012 May 16;4(5):167-79.
- Shojaiefard A, Esmailzadeh M, Ghafouri A, Mehrabi A. Various techniques for the surgical treatment of common bile duct stones: a meta review. *Gastroenterol Res Pract*. 2009;2009:840208.
- 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. *Ann Surg Treat Res*. 2014;86:1-6.

30. Parra-Membrives P, Martínez-Baena D, Lorente-Herce JM, Jiménez-Vega J. Laparoscopic common bile duct exploration in elderly patients: is there still a difference? *Surgical Laparoscopy, Endoscopy & Percutaneous Techniques*. 2014;24(4):e118-e122.
31. Tokumura H, Umezawa A, Cao H, et al. Laparoscopic management of common bile duct stones: transcystic approach and choledochotomy. *J Hepatobiliary Pancreat Surg*. 2002;9(2):206-12.
32. Reinders JS, Gouma DJ, Ubbink DT, van Ramshorst B, Boerma D. Transcystic or transductal stone extraction during single-stage treatment of choledochocystolithiasis: a systematic review. *World J Surg*. 2014 Sep;38(9):2403-11. doi: 10.1007/s00268-014-2537-8.
33. Puhalla H, Flint N, O'Rourke N. Surgery for common bile duct stones—a lost surgical skill; still worthwhile in the minimally invasive century? *Langenbecks Arch Surg*. 2015;400:119-27.
34. Hoffman A, Rey JW, Kiesslich R. Single operator choledochoscopy and its role in daily endoscopy routine. *World J Gastrointest Endosc*. 2013 May 16;5(5):203-10.
35. Taylor AC, Little AF, Hennessy OF, Banting SW, Smith PJ, Desmond PV. Prospective assessment of magnetic resonance cholangiopancreatography for noninvasive imaging of the biliary tree. *Gastrointest Endosc*. 2002;55:17-22. PMID: 11756908
36. Topal B, Van de Moortel M, Fieuws S, et al. The value of magnetic resonance cholangiopancreatography in predicting common bile duct stones in patients with gallstone disease. *Br J Surg*. 2003;90:42-7. PMID: 12520573
37. Hublet A, Dili A, Lemaire J, Mansvelt B, Molle G, Bertrand C. Laparoscopic ultrasonography as a good alternative to intraoperative cholangiography (IOC) during laparoscopic cholecystectomy: results of prospective study. *Acta Chir Belg*. 2009;10 (3):312-6.
38. Perry KA, Myers JA, Deziel DJ. Laparoscopic ultrasound as the primary method for bile duct imaging during cholecystectomy. *Surg Endosc*. 2008;22 (1):208-13.
39. Santambrogio R, Bianchi P, Opocher E, et al. Intraoperative ultrasonography (IOUS) during laparoscopic cholecystectomy. *Surg Endosc*. 1996;10 (6):622-7.
40. Dili A, Bertrand C. Laparoscopic ultrasonography as an alternative to intraoperative cholangiography during laparoscopic cholecystectomy. *World J Gastroenterol*. 2017 Aug 7;23(29):5438-50. doi: 10.3748/wjg.v23.i29.5438.
41. Guidelines for the Clinical Application of Laparoscopic Biliary Tract Surgery, 2009; Society of American Gastrointestinal and Endoscopic Surgeons (SAGES); <http://www.sages.org>
42. Zhi-Tao Dong, Guo-Zhong Wu, Kun-lun Luo, et al. Primary closure after laparoscopic common bile duct exploration versus T-tube. *Journal of Surgical Research*. 2014;189(2):249-54.
43. Hua J, Lin S, Qian D, et al. Primary closure and rate of bile leak following laparoscopic common bile duct exploration via choledochotomy. *Dig Surg*. 2015;32(1):1-8.
44. Bove A, Di Renzo RM, Palone G, et al. Which differences do elderly patients present in single-stage treatment for cholecystocholedocholithiasis? *Int J Surg*. 2014;12 Suppl 2:S160-3. doi: 10.1016/j.ijsu.2014.08.358. Epub 2014 Aug 23.

## Роль холедохоскопії при черезпротоковому лапароскопічному дослідженні загальної жовчної протоки

К. Атступенс, Х. Плаудіс, Е. Саукане, А. Рудзатс

Ризька Східна університетська лікарня «Гайлєзерс»

Лапароскопічне дослідження (ЛД) загальної жовчної протоки (ЗЖП), яке виконують холедохоскопом крізь міхурову протоку або безпосередньо шляхом розсічення ЗЖП, є поширеним методом відновлення функції пасажу жовчі у пацієнтів з холедохолітіазом. Хоча цей метод відіграє вирішальну роль при черезміхуровому доступі, останній може бути виконаний різними способами. Однак через високу вартість цей метод не часто застосовують.

**Мета** — повідомити про ефективність черезпротокового лапароскопічного дослідження загальної жовчної протоки без лапароскопічної холедохоскопії.

**Матеріали та методи.** Проведено проспективне дослідження 77 терміново госпіталізованих пацієнтів, яким виконали черезпротокове ЛД ЗЖП з приводу підтвердженого холедохолітіазу. Під час лапароскопії видалення конкрементів ЗЖП проводили двома способами: з використанням холедохоскопії (група CS+, n=43) та без неї (група CS–, n=34). У групах дослідження порівняно демографічні показники, характер та частоту супутніх захворювань, результати операцій та летальність.

**Результати.** За ускладненнями та супутніми захворюваннями, пов'язаними з жовчнокам'яною хворобою, групи не відрізнялися. Операцію проводили через 4 дні після госпіталізації в обох групах. Медіана тривалості операції була статистично значущо (p=0,036) меншою в групі CS– (93 та 120 хв відповідно). Не виявлено різниці за частотою конверсії та ускладнень. Кліренс був істотно високим в обох групах.

**Висновки.** Черезпротокове ЛД ЗЖП без холедохоскопії — це економічний, безпечний та ефективний спосіб видалення конкрементів ЗЖП без додаткового обладнання.

**Ключові слова:** холедохолітіаз, лапароскопічне дослідження загальної жовчної протоки, інтраопераційне ультразвукове дослідження, холедохоскопія.

### FOR CITATION

Atstupens K, Plaudis H, Saukanе E, Rudzats A. The role of choledochoscopy in transductal laparoscopic common bile duct exploration. *General Surgery (Ukraine)*. 2021;1:10-17. <http://doi.org/10.30978/GS-2021-1-10>.