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ORIGINAL ARTICLE

Laparoscopic Transcystic Common Bile Duct Exploration in the Emergency Is as Effective and Safe as in Elective Setting

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Abstract

Background Emergent laparoscopic transcystic common bile duct exploration (LTCBDE) has been reported to be on the increase in some institutions, reflecting the growing confidence with the technique. However, no study has focused on the outcomes of LTCBDE in the non-elective setting. The aim of this study is to investigate whether LTCBDE can be performed effectively and safely in the emergency.

Methods This is a retrospective study of 500 consecutive patients with choledocholithiasis subjected for LTCBDE at the Hospital Italiano de Buenos Aires from January 2009 to January 2018. Procedures were classified according to the setting as emergent or elective. Demographic data and perioperative parameters were compared between groups.

Results Throughout the period comprised, 500 patients were admitted for choledocholithiasis and gallstones. A single-step treatment combining LTCBDE and laparoscopic cholecystectomy was attempted: 211 (42.2%) were performed electively and the 289 (57.8%) as an emergency. There was no significant difference in the success rate of LTCBDE (93.9% versus 93.8%, $p = 0.975$) for the two groups. The operative time was slightly longer in the emergency group (122 ± 63 versus 106 ± 53 min, $p = 0.002$). Postoperative recovery was slower in the emergency group, as reflected by a higher rate of prolonged postoperative stay (21.1% vs 5.7%, $p < .001$). The rates of postoperative complications were similar between groups (2.8% vs 5.9%, $p = 0.109$).

Conclusion Emergent LTCBDE can be performed with equivalent efficacy and morbidity when compared to an elective procedure. Patients undergoing emergent procedures have longer procedures and hospital stays.

Keywords Laparoscopic common bile duct exploration · Choledocholithiasis · Safety · Efficacy · Emergency

Introduction

Between 10 and 18% of people undergoing laparoscopic cholecystectomy (LC) for gallstones have common bile duct stones (CBDS).[1] The currently available methods to restore biliary patency in these cases include endoscopic retrograde cholangiopancreatography (ERCP) before, during, or after cholecystectomy and common bile duct exploration (LCBDE) during cholecystectomy. In recent years, the development of advanced laparoscopic skills has made surgical exploration the method of choice in many high-volume centers because of its benefits: high efficacy,[2, 3] shorter hospital stay, and lower costs.[4–6] This approach also maintains the function of the sphincter of Oddi.[7] Common bile duct exploration can be performed using either a transcholedochal or a transcystic approach, being the latter preferred as it avoids morbidity induced by common bile duct (CBD) incision and the possible adverse results arising from a T-tube placement. The safety and efficiency of laparoscopic transcystic common bile duct exploration (LTCBDE) has already been established for CBDS in elective situations. However, the profile of emergent LTCBDE on patients remains to be studied. The aim of this study is to compare outcomes of emergent and elective LCBDE via the transcystic approach.

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Methods

A prospectively maintained laparoscopic cholecystectomy (LC) database was reviewed to identify all adults patients (age > 18 years) who underwent LTCBDE between January 2009 and January 2018. The study population included 500 consecutive patients with CBDS subjected for LTCBDE at Hospital Italiano de Buenos Aires. Exclusion criteria were hepatolithiasis, Mirizzi syndrome, and suspected bile duct or gallbladder cancer. Patients with severe acute cholangitis (in whom emergency ERCP was indicated) or severe acute pancreatitis were also excluded. Patients were grouped according to the mode of presentation (elective or emergency). Patients in the emergency group were operated on the next available inpatient list during the index admission. The primary outcome measure was the CBDS clearance rate. Secondary outcome measures were conversion rate, choledochotomy rate, morbidity, mortality, length of hospital stay (HS), and recurrence.

Definitions

The diagnosis of acute cholangitis and acute cholecystitis was made according to the "Tokyo Guidelines," which is a combination of clinical features, laboratory data, and imaging findings.[8] Acute pancreatitis (AP) was defined and classified according to the Atlanta definition revised in 2012[9] as the presence of at least two of the following three features: (1) abdominal pain consistent with AP (acute onset of a persistent, severe epigastric pain often radiating to the back), (2) a serum lipase or amylase concentration of at least three times the upper limit of normal, and (3) characteristic findings of AP on multiple detector computed tomography (MDCT) and less commonly magnetic resonance imaging (MRI). Interstitial edematous pancreatitis was defined as acute inflammation of the pancreatic parenchyma and peripancreatic tissues without recognizable tissue necrosis. Necrotizing pancreatitis was defined as inflammation associated with pancreatic parenchymal necrosis and/or peripancreatic necrosis. Operative time (OT) was defined as the interval between the initial skin incision and skin closure. Operative mortality (OM) was defined as death within 90 days after surgery or before discharge from the hospital. Morbidity included all postoperative complications and was classified according to Dindo classification.[10] Complications of grade III or higher were defined as major complications. Postoperative HS was defined as the number of days spent in the hospital postoperatively.

Surgical Procedures

A modified American technique of LC was employed, as described previously.[11] Intraoperative cholangiogram (IOC) was routinely used in all patients. Briefly, Calot's triangle was identified and dissected using monopolar electrosurgery energy (hook cautery). Once the cystic duct had been identified, a clip was placed at the cystic duct–infundibulum junction, and a lateral incision was made just below the clip. A 5-Fr catheter was introduced into the cystic duct and fixed with an Olsen clamp. When the cystic duct could not be identified easily during dissection, cholangiography was performed by direct puncture of the gallbladder. Radio-opaque dye was then injected into the biliary system. The biliary anatomy was visualized dynamically using a mobile C-arm unit and an image intensifier with immediate print for documentation.

When CBDS were detected under IOC, a transcystic approach with a Dormia basket (Cook®) was used to remove the stones. To obtain a higher successful cannulation rate, the cystic duct was usually dissected close to its junction within the CBD, unless this junction was very low and intrapancreatic. A balloon-dilating catheter of the proper outer diameter according to the inner diameter of the common duct was used to free large solitary or impacted stones unable to be retrieved by the Dormia basket. Gentle papillary pneumatic dilation followed by flush irrigation with saline was also employed to aid in clearing the CBD of stone fragments and debris, normally coupled with intravenous glucagon administration to assist in relaxing the sphincter of Oddi. After all stones were retrieved, clearance of the proximal and distal bile duct was confirmed by repeated IOC.

In patients in whom transcystic approach has failed, a laparoscopic choledochotomy was performed to clear the CBD if the CBD diameter was more than 8 mm. The anterior aspect of the CBD was opened by performing a 10- to 20-mm incision. The choledochotomy was performed vertically on the supraduodenal part of the anterior aspect of the CBD with scissors. The length of the CBD opening was proportionate to the size of the biggest stone. Stone extraction was the most difficult step. Protruding stones can be extracted with atraumatic forceps. Others were flushed through the choledochotomy with saline irrigation. For the remaining stones, the same techniques for LTCDE were used: wire-basket, Fogarty balloon. Small stones were flushed or pushed through the papilla. The most difficult cases to manage were impacted stones and intrahepatic duct stones. Impacted stones that could not be removed or pushed through the papilla were fractured. Intrahepatic duct stones are retrieved with wire-basket or Fogarty balloon. All the stones removed from the CBD were put into an endoscopic bag placed above the liver to avoid stone spillage in the abdominal cavity. After an ultimate fluoroscopic control, the choledochotomy was closed. If no biliary drainage were used, the choledochotomy was closed with a running suture of 5 or 6.0 absorbable suture. In those cases where a biliary decompression is needed, authors prefer transpapillary stenting (placed laparoscopically).

All operations were performed or supervised by a member of the hepatopancreatobiliary surgery unit (staff surgeon or senior fellow). Blood was sampled on the day of the

LTCBDE procedure and on post-procedure day 1. Patients suspected to have AP underwent abdominal CT. Patients were followed up at 1 week, 1 month, and 1 year after operation. Data for each patient were recorded prospectively from the date of index operation to a minimum of 12 months after surgery or death, whichever occurred first. Patients with a post-LTCBDE AP were assessed every 3 months during the first year (with clinical evaluation and liver function blood tests). According to the findings and clinical judgment, additional imaging studies were employed to rule out recurrence.

Statistical Analysis

Quantitative variables were presented, according to a parametrical or non-parametrical distribution, as mean ± standard deviation or median and interquartile range, respectively. Qualitative variables were presented as absolute value and percentage. For statistical comparison, the Student's *t* test was used for quantitative variables, while chi-square and Fisher exact probability tests for qualitative variables. The statistically significant independent factors obtained by univariate analyses were entered into a multiple stepwise logistic regression model. Statistical significance was considered to have been achieved when $p < 0.05$.

Results

During the past 10 years, a total of 500 patients with suspected or confirmed choledocholithiasis underwent LTCBDE at the Hospital Italiano de Buenos Aires, including 211 performed electively and 289 emergencies. Baseline characteristics of the patients were summarized according to the setting in Table 1. There were no differences in sex, age, BMI, history of upper abdominal surgeries, American Society of Anesthesiologists (ASA) Physical Status classification system, or comorbidities between patients with elective and emergent LTCBDE. Reasons for hospital admission in emergent LTCBDE are summarized in Table 2. The median time from admission to surgery in patients who underwent emergency LTCBDE was 2 (0–7) days.

The intraoperative data are summarized in Table 3. Stones ($n = 473$) or intraluminal bile sludge ($n = 16$) was confirmed in 489 patients (97.8%) on exploration. Operative time was 106 ± 53 min in elective LTCBDEs and 122 ± 63 min in the emergent LTCBDEs ($p = 0.002$). The number of patients with OT longer than 2 h was significantly higher in the emergency group (32.2% vs 43.2%; $p = 0.012$). In the analyzed group of patients, 469 (93.8%) had complete patency restoration through a transcystic approach. Twenty-eight patients required bile duct exploration through choledochotomy (5.6%), this rate being similar in both groups (5.8 vs 5.2%; $p = 0.748$). Only four patients (0.8%) were converted to open surgery, due to dense adhesions and unclear anatomy. At the end of the biliary exploration, the biliary tree was free of stones in 493 patients (98.6%). Seven patients (1.4%) had unremovable small mural stones during the operation that required further intervention with ERCP.

Overall morbidity for all 500 patients was relatively low, with postoperative AP being the most common complication

Table 1 Demographic and preoperative characteristics of the cohort

	Total LTBDTE ($N = 500$)	Elective ($n = 211$)	Emergency ($n = 289$)	*p*
Age[a]	61.9 ± 17.8	63.5 ± 17	60.9 ± 17.7	0.106
Sex, male[b]	179 (35.8)	72 (42.2)	107 (37)	0.504
BMI[a]	27.4 ± 4.7	26.9 ± 4.8	27.8 ± 4.5	0.600
ASA > 2[b]	86 (17.2)	37 (17.5)	49 (17)	0.865
Previous UAS[b]	31 (6.2)	18 (8.5)	13(4.4)	0.065
Comorbidities[b]				
CVD	119 (23.8)	53 (25.1)	66 (22.8)	0.595
Diabetes	63 (12.6)	34 (16.1)	30 (10.3)	0.054
Obesity	137 (27.4)	53 (25.1)	84 (29)	0.328
Renal injury	10 (2)	6 (2.8)	4 (1.3)	0.516
Preoperative LFTs				
ALP (units/l)[c]	170 (13–1519)	115 (13–435)	218 (21–1519)	< 0.001
TB (mg/dl)[c]	2.6 (0.4–12.3)	1.4 (0.4–3.4)	3.6 (0.4–12.3)	< 0.001

ALP, alkaline phosphatase; *BMI*, body mass index; *CVD*, cardiovascular disease; *LFTs*, liver function tests; *LTCBDE*, laparoscopic transcystic common bile duct exploration; *TB*, total bilirubin, *UAS*, upper abdominal surgery

[a] Results expressed by mean (± SD)

[b] Results expressed as absolute value and percentage

[c] Results expressed as median value and range

Table 2 Reasons for emergent laparoscopic bile duct exploration

	Emergency ($n = 289$)
Reason for admission[a]	
Biliary colic with oral intolerance	12 (4.1)
Non-severe acute cholangitis	63 (21.8)
CL with jaundice	103 (35.6)
Acute cholecystitis	80 (27.7)
Acute pancreatitis	31 (10.7)

CL, choledocolithiasis

[a] Results expressed as absolute value and percentage

(3%). The rate of postoperative pancreatitis was higher in the emergency group in the univariate analysis, but did not reach statistical significance (1.9% vs 3.8%, $p = 0.062$). All but one case were mild edematous AP that only required conservative management. Four patients had biliary leaks in the series. The rate of bile leakage was statistically similar in both groups (0.4% vs 1%, $p = 0.642$). Three out of four bile leaks were grade A according to bile leakage grading system and were self-limiting. Surgical intervention was required in one patient with clinically relevant bile leakage (grade B/C). Four other patients required reoperations, mostly due to intraabdominal bleeding. One patient had a common bile duct injury that was identified and repaired intraoperatively without further complications. There was a significant increase in postoperative hospital stay between emergency and elective groups ($p < 001$). There were more patients discharged after postoperative day two in the emergent exploration group (21.1% versus 5.7%, $p < 0.001$, Table 4).

The median follow-up was 24 (range 3–60) months. Recurrence of CBDS was observed in 18 (3.6%) patients, with no differences between both groups (3.7% vs 3.5%, $p = 0.844$). In 15 of those patients, recurrence was diagnosed more than a year after operation. All cases of recurrence were treated endoscopically.

Discussion

CBDS may occur in 10 to 18% of patients in whom cholecystectomies were performed.[12] There are mainly two approaches to the treatment of patients with CBDS: LC + LCBDE or LC + intraoperative/perioperative ERCP. Both methods have shown comparable morbidity, mortality, and clearance rates.[13–16] However, unless performed intraoperatively, ERCP requires at least one additional procedure for cholecystectomy and does have associated complications such as pancreatitis, cholangitis, bleeding, and duodenal perforation.[17–21] The combined LC with intraoperative ERCP and CBDS extraction may be performed as a one-stage procedure. Yet, this strategy requires a readily available skilled endoscopist and a good logistic planning concerning equipment. This may constitute a problem in the emergency setting, when the availability of these resources can be limited. For this reason, the skills to perform an IOC and a laparoscopic stone extraction are a useful component of the laparoscopic surgeon's armamentarium. Some institutions have reported an increasing number of emergent LTCBDE performed, reflecting the growing confidence with this technique.[2] However, to the best of our knowledge, there are no studies with specific attention fixed on the

Table 3 Intraoperative variables during laparoscopic transcystic common bile duct explorations

	Total LBDTE ($N = 500$)	Elective ($n = 211$)	Emergency ($n = 289$)	*p*
CL at exploration[b]	473 (94.6)	199 (94.3)	274 (94.8)	0.808
Bile sludge at exploration[b]	16 (3.2)	6 (2.8)	10 (3.5)	0.699
Negative exploration[b]	11 (2.2)	6 (2.8)	5 (1.7)	0.539
Placement of an additional trocar[b]	6 (1.2)	1 (0.4)	5 (1.7)	0.203
Operative time[a]	115 ± 60	106 ± 53	122 ± 63	*0.002*
Operative time > 120 min[b]	193 (38.6)	68 (32.2)	125 (43.2)	*0.012*
Multiple stones[b]	429 (85.8)	177 (83.8)	252 (87.2)	0.295
Conversion to open surgery[b]	4 (0.8)	1 (0.5)	3 (0.1)	0.642
Drainage placement[b]	151 (30.2)	51 (24.2)	101 (34.9)	*0.010*
Failure of LTCBDE[b]	31 (6.2)	13 (6.1)	18 (6.2)	0.975
Choledochotomy[b]	28 (5.6)	11 (5.2)	17 (5.8)	0.748
Retained stone[b]	7 (1.4)	3 (1.4)	4 (1.4)	0.972

Italic was used when $p < 0.05$

CL, choledocholithiasis; *AP*, acute pancreatitis; *LTCBDE*, laparoscopic transcystic common bile duct exploration

[a] Results expressed by mean (± SD)

[b] Results expressed as absolute value and percentage

Table 4 Postoperative outcomes after laparoscopic bile duct transcystic exploration

Variables	Total LBDTE ($N = 500$)	Elective ($n = 211$)	Emergency ($n = 289$)	p	Multivariate analysis		
					OR	95%CI	p
Morbidity (DC > II)[a]	23 (4.6)	6 (2.8)	17 (5.9)	0.109			
PO pancreatitis[a]	15 (3)	4 (1.9)	11 (3.8)	0.062			
Bile leak[a]	4 (0.8)	1 (0.4)	3 (1)	0.642			
Type A	3 (0.6)	0	3	0.267			
Type B-C	1 (0.2)	1	0	0.422			
Postop bleeding[a]	3 (0.6)	1	2	0.511			
Bile duct injury[a]	0 (–)	0 (–)	1 (0.3)	NA			
Mortality[a]	0 (–)	0 (–)	0 (–)	NA			
Reoperation[a]	5 (0.1)	1	4	0.403			
Hospital stay[b]	2 (1–25)	1 (1–4)	2 (1–25)	< 0.001			
HS > 2 days[a]	73 (14.6)	12 (5.7)	61 (21.1)	< 0.001	0.115	0.082–0.162	< 0.001
Readmission < 30 days[a]	9 (1.8)	2 (0.9)	7 (2.4)	0.314			
Stone recurrence[a]	18 (3.6)	8 (3.7)	10 (3.5)	0.844			

CL, choledocholithiasis; *AP*, acute pancreatitis; *HS*, hospital stay; *LTCBDE*, laparoscopic transcystic common bile duct exploration

[a] Results expressed as absolute value and percentage

[b] Results expressed by median (range)

differences between LTCBDE in the emergent and elective setting. The aim of this study (and one of the largest single-center series of LTCBDE) was to determine whether the setting of LTCBDE has an impact in the safety and efficacy of the procedure for patients with CBDS.

A stone clearance success rate of 95.8% is well in line with the results of previous studies concerning LTCBDE[22] and moreover comparable to the stone clearance results that can be achieved with ERCP, which is the main alternative to the transcystic approach.[23, 24] Laparoscopic explorations have also the advantage of preservation of the biliary sphincter.[25] The biliary sphincter plays an important role in preventing the regurgitation of duodenal contents into the biliary tract, and several studies have reported reflux of duodenal content in the bile and pancreatic duct after endoscopic sphincterotomy,[26, 27] which may increase the incidence of pancreatitis, cholangitis, and cancer.[28–30] Importantly, the success rate with the transcystic approach in our series was not influenced by the setting. It should be mentioned that there was a difference in laboratory values indicative of obstructive jaundice between the two groups, and thus, it is possible that a higher prevalence of biliary ductal dilatation might have actually benefited the likelihood of operative success in the emergent cases. However, such dilation is usually part of a chronic process and, in our experience, the majority of the patients are operated before a significant dilation occurs. Additionally, in both emergency and elective groups, choledochotomy prompted only a 5% increase in the biliary exploration success rate. Some surgeons consider LTCBDE to be limited in terms of stone clearance and continue to routinely choose the transductal technique. Although current literature does not clearly favor either treatment options, the transcystic exploration is the least invasive and the quickest procedure. It also avoids the difficult and tedious task of laparoscopic suturing, which entails a well-known risk for bile leaks and bile duct strictures, regardless of whether it is performed transversely or longitudinally.[31, 32] For this reason, authors believe it is reasonable to attempt the transcystic approach first, leaving choledochotomies to patients in whom the CBD is dilated and the transcystic approach has failed.

While most intraoperative variables analyzed showed no significant variance, a difference in OT was observed between the emergency and elective groups. However, the mean OT in the emergent LTCBDE group was only 16 min longer than that registered in the elective group. To some degree, this small difference in the OT may be explained by a more difficult cholecystectomy in the emergency group rather than a more challenging LTCBDE. Consistent with this, surgeons were more prone to place a drain in patients with emergent LTCBDE compared to elective procedures. However, this is only a speculation since time spent on cholecystectomy and biliary exploration is not discriminated in the database.

LTCBDE appears as a safe procedure with a mortality rate of lower than 1%, as previously reported.[24] Consistent with this, there were no postoperative deaths in our series. Morbidity in the emergent LTCBDE group is slightly higher than that in the elective group, but without a statistically significant difference. As noted by other authors, one of the most common major complications was biliary leak, which

occurred in four patients (0.8%) and was mostly asymptomatic.[22, 33] Another serious but uncommon complication was AP (15 patients, 3%), which had no major clinical impact in most cases. As described previously,[34] the incidence of AP in the present series was higher than the one reported in the literature. This difference may be explained by the fact that amylasemia is routinely evaluated 24 h after each LTCBDE, leading to diagnose AP even in mild cases that can be unnoticed in the postoperative setting if not suspected (as the abdominal pain may be attributed to post-procedure pain). Interestingly, AP in this context did not result in death and did not require surgical, endoscopic, or percutaneous intervention in any case, but had a major clinical relevance delaying discharge in patients undergoing the procedure. There is a significant increase in the postoperative HS in the emergency group compared to the elective group. While events such as AP could have contributed to this disparity, these are still infrequent. Consequently, it is possible that the difference in HS is more related to the worrying over possible complications caused by associated conditions in the emergency group (i.e., inflammation or oral intolerance after pancreatitis and sepsis after cholangitis) rather than actual postoperative complications.

A small number of studies have mentioned the impact of the setting in the outcomes of biliary explorations. Zhu et al. retrospectively analyzed 72 patients subjected to laparoscopic biliary exploration and concluded that emergent laparoscopic biliary exploration is as safe and effective as elective procedures.[35] Nevertheless, this series only included explorations performed using the transductal approach. Hua et al. have recently published another series of 500 laparoscopic common bile duct explorations finding no difference between elective and emergent procedures.[36] This study, however, included only 72 patients with transcystic exploration and a total of 79 emergent procedures. Stromberg et al. analyzed the stone clearance rate in a series of 155 transcystic explorations. The authors concluded that emergent LTCBDE does not constitute a risk factor for failure in stone clearance in the use of this technique.[37] Yet, only a minority of cases (nine patients) were included in the emergency group. A strength of this study is that it combines one of the largest series of biliary exploration procedures using the transcystic route with an extensive proportion of emergent cases. Another difference between the present series and other recent ones is the use of routine IOC, which is likely responsible for the high number of incidental bile duct stones in both elective and emergency groups. Currently, this practice is still seen as controversial. At our institution, routine IOC has several roles: identify CBD stones, provide extra evidence for anatomical decisions during dissection, training purposes, and to diagnose biliary injuries. There is little data on the natural history of asymptomatic bile duct stones, and hence, there is uncertainty on the management of asymptomatic bile duct stones discovered incidentally at the time of laparoscopic cholecystectomy. Some authors believe that these stones may not need to be removed, as they only rarely cause biliary complications. However, this statement is supported by series limited in terms of the number of patients and follow-up. In this scenario, authors believe that data is not reassuring enough to leave known bile duct stones in situ that can be easily removed with a relatively straightforward procedure, particularly in centers with extensive experience in laparoscopic biliary surgery.

The present study has several potential limitations. It is a retrospective observational study, and so open to selection bias. This was minimized by analyzing a consecutive series of patients who had undergone LTCBDE at a single institution. This enhances the validity of the study, both in terms of the stone clearance proportion and analysis of risk factors for failure in stone clearance or complications. Moreover, data collection was prospective, and no patients were lost in the short-term follow-up on which the analyses are based. It may also be a weakness of the study that it represents a single-center experience of the LTCBDE technique. As a high-volume institution in laparoscopic biliary surgery, the performance of LTCBDE may not be transposable to what may be the outcome in a study based on several small-volume centers. In addition, the present data represent the last 10-year experience of the institution, which does not include the first learning curve years that may be the major drawback of the LTCBDE. Additionally, since this study is based on a single-center cohort of cases only, no comparison has been made between the results of LTCBDE and other alternative techniques of treating stones in the common bile duct. The scope of the study is instead focused on comparing short-term outcomes of emergent and elective LTCBDE.

Conclusions

The principal findings of this study were that LCBDE via the transcystic approach can achieve successful CBD clearance rates in over 95% of patients with low morbidity and mortality rates, and a median HS of 2 days. This study highlights the important fact that LTCBDE has a safety profile regardless of the setting, with major operative complications occurring only exceptionally. Emergent LTCBDE can be performed in a timely manner with efficacy and morbidity equivalent to that of an elective procedure if performed in institutions with significant experience in laparoscopic biliary surgery. In the view of these data, surgeons performing LC should be encouraged to use LTCBDE as a tool to manage patients with CBD stones in the emergency setting. Emergent LTCBDE may therefore save the function of the sphincter and prevent unnecessary second hospitalizations or a delayed cholecystectomy.

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