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EDITORIAL

Minimally invasive treatment of cholecysto-choledocal lithiasis: The point of view of the surgical endoscopist

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Abstract

The rate of choledocholithiasis in patients with symptomatic cholelithiasis is estimated to be approximately 10%-33%, depending on the patient's age. Development of Endoscopic Retrograde Cholangiopancreatography and Laparoscopic Surgery and improvement of diagnostic procedures have influenced new approaches to the management of common bile duct stones in association with gallstones. At present available minimally-invasive treatments of cholecysto-choledocal lithiasis include: single-stage laparoscopic treatment, perioperative endoscopic treatment and endoscopic treatment alone. Published data evidence that, associated endoscopic-laparoscopic approach necessitates increased number of procedures per patient while single-stage laparoscopic treatment is associated with a shorter hospital stay. However, current data does not suggest clear superiority of any one approach with regard to success, mortality, morbidity and cost-effectiveness. Considering the variety of therapeutic options available for management, a critical appraisal and decision-making is required. Endoscopic retrograde cholangiopancreatography/EST should be adopted on a selective basis, *i.e.*, in patients with acute obstructive suppurative cholangitis, severe biliary pancreatitis, ampullary stone impaction or severe comorbidity. In a setting where all facilities are available, decision in the selection of the therapeutic option depends on the patients, the number and size of choledocholithiasis stones, the anatomy of the cystic duct and common bile duct, the surgical history of patients and local expertise.

Key words: Cholecysto-choledocal lithiasis; Laparoscopic treatment; Endoscopic treatment; Minimally invasive therapy; Management strategies

Core tip: Development of Endoscopic Retrograde Cholangiopancreatography and Laparoscopic Surgery have influenced new approaches to the management of cholecysto-choledocal lithiasis. At present available minimally-invasive treatments include: single-stage laparoscopic treatment, perioperative endoscopic treatment and endoscopic treatment alone. Current data does not suggest clear superiority of any one approach with regard to success, mortality, morbidity and cost-effectiveness. Considering the variety of therapeutic options available for management, a critical appraisal and decision-making is required. This should preferably be dictate on the patient, the clinical presentation, the timing of diagnosis (established pre-operative diagnosis or incidental intraoperative diagnosis), the surgical pathology and the local expertise.

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INTRODUCTION

The rate of choledocholithiasis (CBDS) in patients with symptomatic cholelithiasis is estimated to be approximately 10%-33%, depending on the patient's age[1-4]. In Western countries CBDS typically originate in the gallbladder and migrate into the common bile duct. Compared to stones in the gallbladder the natural history of secondary CBDS is not well understood. It is unclear whether an asymptomatic choledocholithiasis requires treatment. A prospective study of common bile duct calculi in patients undergoing laparoscopic cholecystectomy (LC) have suggested that a third of patients with CBDS at the time of cholecystectomy pass their stones spontaneously within 6 wk of surgery[1]. It is not clear what stone size precludes transpapillary migration into the duodenum nor which criteria will predict complications if CBD stones are not treated. On the other hands, complications of ductal stones, including pain, partial or complete biliary obstruction, cholangitis, hepatic abscesses or pancreatitis are well recognized and often serious. Therefore, it is generally recommended to treat CBD stones whenever detected, except in selected patients that have contraindications (*e.g.,* high risk patients, refusal of operative or endoscopic treatment *etc.*), when conservative and expecting modality are accepted[5].

For many years, open cholecystectomy with choledochotomy and/or surgical sphincterotomy and cleaning of the bile duct were the gold standard to treat both pathologies. Development of endoscopic retrograde cholangiopancreatography (ERCP) and laparoscopic surgery and improvement of diagnostic procedures have influenced new approaches to the management of CBDS in association with gallstones.

ERCP has become a widely available and routine procedure, whilst open cholecystectomy has largely been replaced by a laparoscopic approach, which is considered the treatment of choice for gallbladder removal since NIH Consensus on 1993[6]. New imaging techniques such as magnetic resonance cholangiography (MR) 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 CBDS.

MANAGEMENT STRATEGIES OF CHOLECYSTO-CHOLEDOCAL LITHIASIS

The primary challenge in the management of CBD stones in association with gallstones is to select the best strategy with regard to success, morbidity and cost-effectiveness. At present available minimally-invasive treatments of cholecysto-choledocal lithiasis include: single-stage laparoscopic common bile duct exploration (LCBDE), perioperative endoscopic treatment and endoscopic treatment alone (Table 1).

Laparoscopic common bile duct exploration can be achieved through transcystic approach or by performing choledochotomy. Endoscopic treatment comprises preoperative ERCP with endoscopic sphincterotomy (ES) followed by LC (sequential treatment), intraoperative ERCP with ES (LC + ES, rendezvous technique) as a single stage treatment of CBDS, postoperative ERCP with ES as a two stage treatment of CBDS and ERCP with ES without subsequent gallbladder removal. Each of these options has advantages and disadvantages that have been reported in numerous publications that are summarized in Table 2[7-14].

ANALYSIS OF THE CURRENT LITERATURE

Current data does not suggest clear superiority of any one approach with regard to success, mortality, morbidity and cost-effectiveness. Published data evidence that associated endoscopic-laparoscopic approach necessitates increased number of procedures per patient while LCBDE is associated with a shorter hospital stay[15-17]. Moreover, the long-term sequelae of sphincterotomy can also be avoided with laparoscopic bile duct clearance[18,19].

However there are several issues concerning these results that deserve some considerations. First, coming from experienced laparoscopic centers, the application of these results to the wider surgical community should be made with some caution. Second, when applying the results to clinical practice, it is important to consider the inclusion criteria for each of the studies, since many studies excluded patients from laparoscopic CBD exploration in cases of high-risk patients (American Standards Association status 3-4), acute cholangitis, gallstone pancreatitis or anatomy precluding LCBDE. Finally, most of the trials were limited by their small sample size.

Moreover, it is important also to note that the laparoscopic technique has not been widely accepted by the surgical community. In common practice, from a 2005 survey of English hospitals, it is estimated that only 20% of bile duct explorations are performed laparoscopically[20]. Similarly, a survey of general surgeons practicing in the United States showed that, although 44% of surgeons could perform laparoscopic CBD exploration, only 22% actually did so routinely and that 75% considered the preoperative ERCP as the preferred approach to a patient with choledocholithiasis[21]. The most common reasons for not performing LCBDE were that the procedure was too time consuming (58%), lack of equipment (24%), increased morbidity (1.5%) and lack of skill (1.5%).

DECISION-MAKING IN THE SELECTION OF THE THERAPEUTIC OPTION

Considering the variety of therapeutic options available for management, a critical appraisal and decision-making

Table 1 Management strategies of minimally invasive treatment of cholecysto-choledocal lithiasis

One step surgical treatment	Laparoscopic
Endoscopic + surgical approach	Preoperative ERCP Intraoperative ERCP Postoperative ERCP
Endoscopic treatment alone[1]	Endoscopic stones extraction without subsequent cholecystectomy

[1]Selected patients. ERCP: Endoscopic retrograde cholangiopancreatography.

is required. This should preferably be dictate on the patient, the clinical presentation, the timing of CBD stones diagnosis (established pre-operative diagnosis or incidental intraoperative diagnosis), the surgical pathology and the local expertise.

Patient

An assessment of operative risk needs to be made prior to scheduling intervention. Where this risk is deemed prohibitive, endoscopic therapy should be considered as an alternative since endoscopic treatment is less invasive than surgical approach. For patients aged less than 50-60 years, although the available evidence suggests that ERCP with ES can be safely used for extracting stones, it's important to take in mind late complications of ES including recurrent stone formation and cholangitis[18,19,22-24]. For an individual patient these risks need to be weighed against those of alternative treatment options.

Clinical presentation

Bacterial contamination of bile is a common finding in patients with CBDS and may causes acute cholangitis. Biliary decompression is considered the primary treatment of acute cholangitis due to biliary stones. Immediate decompression could be planned for patients who fail to respond to antibiotic therapy or who have signs of septic shock. Urgent decompression (< 72 h) could be planned for patients who respond to initial therapeutic measures or patients with poor prognostic parameter (elderly patients; associated comorbidities). The most appropriate method of biliary decompression is ES supplemented by stenting and/or stone extraction. Surgical approach in this group is associated with a considerably higher mortality than ERCP and should be avoided[25-29].

Common bile duct stones are a recognized cause of acute pancreatitis. The United Kingdom guidelines for the management of acute pancreatitis advocate urgent therapeutic ERCP in every patient with suspected gallstone etiology and predicted severe pancreatitis or when there is cholangitis, jaundice or a dilated common bile duct[30]. Conversely, the AGA Institute guidelines on acute pancreatitis recommend that early ERCP is not indicated in patients with predicted severe pancreatitis without concomitant cholangitis or high suspicion of a persistent common bile duct stone[31]. Laparoscopic cholecystectomy is recommended as a treatment of choice for biliary

Table 2 Discussion overview of management strategies

Type of procedure	Advantages	Disadvantages
ERCP + ES	Less invasive Procedure of choice in post-cholecystectomy patients, acute cholangitis, gallstone pancreatitis	Equipment Local expertise 2 stage procedure Complications
LCBDE: transcystic	Minimal invasive One stage procedure	Equipment Local expertise Anatomic variations Prolonged OR time
LCBDE: choledochotomy	One stage procedure	Most invasive Necessitate of T-tube Prolonged OR time

ERCP: Endoscopic retrograde cholangiopancreatography; ES: Endoscopic sphincterotomy; LCBDE: Laparoscopic common bile duct exploration; OR: Operative time.

acute pancreatitis. The timing of LC following acute biliary pancreatitis can vary markedly depending on the severity of pancreatitis and the overall health of the patient. In mild disease LC can be safely performed within 7 d, whereas in severe disease, especially in extended pancreatic necrosis, at least three weeks should elapse because of an increased infection risk[32]. Routine preoperative ERCP is considered unnecessary in non-jaundiced patients with mild biliary pancreatitis scheduled to undergoing cholecystectomy since in this group of patients 80% of stones spontaneously pass and it is uncommon to find ductal stones in this group at ERCP[33-37]. Every effort should be made to identify biliary obstruction, including MRCP and EUS when accessible, before resorting to ERCP[38,39]. In the setting of acute pancreatitis, it's important to note that ERCP is generally more difficult to perform because the duodenum and ampulla are edematous[35].

Timing of diagnosis

CBD stones can be diagnosed before the LC (established preoperative diagnosis), during (incidental diagnosis) or after the LC. ERCP with ES is recommended as the primary form of treatment for patients with CBDS post cholecystectomy. This approach is advocated, though it should be noted there are no trials directly comparing endoscopic stone extraction with surgical stone extraction in this setting. Successful endoscopic treatment is possible in the majority of patients and in skilled hands duct clearance can be achieved in over 90%, though in 5%-25% of patients this requires two or more ERCPs[5,40-42]. In patients with preoperative diagnosis or incidental diagnosis, decision may depend on the surgical pathology and local expertise.

Surgical pathology

There are several factors that can affect the choice of the technique including the size and number of CBD stones, the cystic duct size and anatomy, the diameter of the common bile duct, and the past surgical history.

Transcystic stone clearance may be hampered by cys-

tic duct anatomy (tortuous, < 3 mm in diameter), proximal (hepatic duct) stones, strictures and large (> 6 mm) or numerous stones (> 5)[43-45]. Following laparoscopic choledochotomy, closure over a T-tube may be required if the common bile duct is inflamed[46-48]. Extraction of ductal stones *via* an endoscopic biliary sphincterotomy may be difficult or inappropriate for a variety of reasons, including size, shape and number of stones, intrahepatic location, stone impaction, Billroth Ⅱ gastrectomy or Roux-en-y anatomy, recurrent bile duct stones after prior open exploration of the CBD and biliodigestive anastomosis, periampullary diverticula, and Mirizzi syndrome[8,49].

It is important that adequate biliary drainage is ensured in patients with CBD stones that have not been extracted by standard or advanced (such as lithotripsy) endoscopic techniques, eventually by a temporary biliary stent. The use of a biliary stent as sole treatment for CBDS should be restricted to a selected group of patients with limited life expectancy and/or prohibitive surgical risk[50-52].

Local expertise

For successful endoscopic stones extraction, skilled endoscopist, nursing and radiography staff are essential. ERCP training program is mandatory to achieve selective cannulation rates in excess of 80%. It is important that once formal training is completed endoscopists perform an adequate number of biliary sphincterotomies (40-50) per year to maintain their performance. It is recommended that all endoscopists performing ERCP should be able to supplement standard stone extraction techniques with advanced techniques (mechanical lithotripsy, electro-hydraulic lithotripsy and laser lithotripsy) when required[52-57]. There is significant learning curve for laparoscopic bile duct surgery both amongst surgeons and nursing staff[58]. LCBDE requires a flexible choledochoscope together with light source and camera, and disposable instrumentation similar to that required for ERCP (*e.g.*, baskets, balloons, stents). Laparoscopic common bile duct exploration *via* choledochotomy requires advanced laparoscopic skills and longer operative times. As previously reported, closure over a T-tube may be required if the common bile duct is inflamed[46-48].

ENDOSCOPIC SPHINCTEROTOMY WITH STONE EXTRACTION WITHOUT SUBSEQUENT CHOLECYSTECTOMY

Retrospective studies of patients who have undergone endoscopic sphincterotomy for bile duct stones with gallbladders left *in situ* suggest that about 10% of patients develop recurrent biliary problems (mainly acute cholecystitis) over 1 years[59]. The risk of acute cholecystitis after sphincterotomy without a cholecystectomy ranges from 1% to 16%; most of these cases tend to occur soon (within 4-6 wk) after the sphincterotomy in those with gallbladder stones[60-63]. Therefore in patients with CBDS and gallstones ES with stone extraction as sole treatment should be avoided unless there are patient related factors that make cholecystectomy inappropriate. The role of LC in patients with empty gallbladders is less clear. Large scale prospective follow-up of such patients suggests that, following successful ES, there is a low rate of recurrent bile duct stones and a low risk of cholecystitis[60].

CONCLUSION

ERCP/EST should be adopted on a selective basis, *i.e.,* in patients with acute obstructive suppurative cholangitis, severe biliary pancreatitis, ampullary stone impaction or severe comorbidity. In a setting where all facilities are available, decision in the selection of the therapeutic option depends on the patients, the number and size of CBD stones, the anatomy of the cystic duct and common bile duct, the surgical history of patients and local expertise.

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