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Chapter 14

An Update on the Management of Choledocholithiasis

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Abstract

The predominant approach to managing choledocholithiasis traditionally involves a two-step procedure, commencing with pre-operative endoscopic retrograde cholangiopancreatography (ERCP) followed by laparoscopic cholecystectomy after a six-week interval. However, with the advent of laparoscopic surgery, laparoscopic common bile duct exploration has emerged as a single-step alternative for treating this condition. Additionally, another approach entails performing intraoperative ERCP and laparoscopic cholecystectomy concurrently. Given the absence of a consensus on the optimal management strategy, we have undertaken this review to examine the various management options available for choledocholithiasis.

Keywords: Choledocholithiasis, Endoscopic Retrograde Cholangiopancreatography, Laparoscopic common bile duct exploration, Open bile duct exploration, and Bile duct stones.

1. Introduction

Choledocholithiasis, a complication arising from gallstone disease, manifests with symptoms such as abdominal pain, followed by the excretion of tea-colored urine and pale stools. This condition is observed in approximately 10 to 15% of cases and is diagnosed through elevated levels of serum bilirubin, serum alkaline phosphatase, and alanine and aspartate aminotransferase. Diagnostic confirmation is achieved through imaging techniques, including ultrasound, computed tomography, or magnetic resonance imaging. Bile duct stones are categorized into primary and secondary stones, with secondary stones being the predominant cause of choledocholithiasis [1].

The management of choledocholithiasis can be categorized into endoscopic and surgical approaches. Endoscopic management involves the utilization of endoscopic retrograde cholangiopancreatography (ERCP), while surgical management encompasses both laparoscopic and open common bile duct exploration. A critical factor in determining the appropriate management strategy is the timing of choledocholithiasis detection, whether it occurs before, during, or after cholecystectomy [2]. ERCP can be conducted as a preoperative, intraoperative, or postoperative procedure. Surgical bile duct exploration can be executed through laparoscopic or open common bile duct exploration, typically performed in conjunction with cholecystectomy [3].

The predominant treatment strategy involves preoperative endoscopic retrograde cholangiopancreatography (ERCP) followed by laparoscopic cholecystectomy. The advent of advanced laparoscopic surgical techniques has facilitated the performance of laparoscopic common bile duct exploration as an independent procedure for choledocholithiasis, and this approach is gradually gaining acceptance. An alternative treatment strategy is the concurrent execution of laparoscopic cholecystectomy and intraoperative ERCP. Additional treatment options include open common bile duct exploration and cholecystectomy, followed by postoperative ERCP [4, 5].

The management of choledocholithiasis can be categorized into either a single-step or a two-step approach. The single-step approach entails common bile duct exploration, which can be performed through either a laparoscopic or open surgical procedure. Conversely, the two-step approach involves preoperative endoscopic retrograde cholangiopancreatography (ERCP) followed by laparoscopic cholecystectomy [6, 7]. Additionally, other treatment modalities for choledocholithiasis include intraoperative ERCP in conjunction with laparoscopic cholecystectomy, commonly referred to as the rendezvous technique [8].

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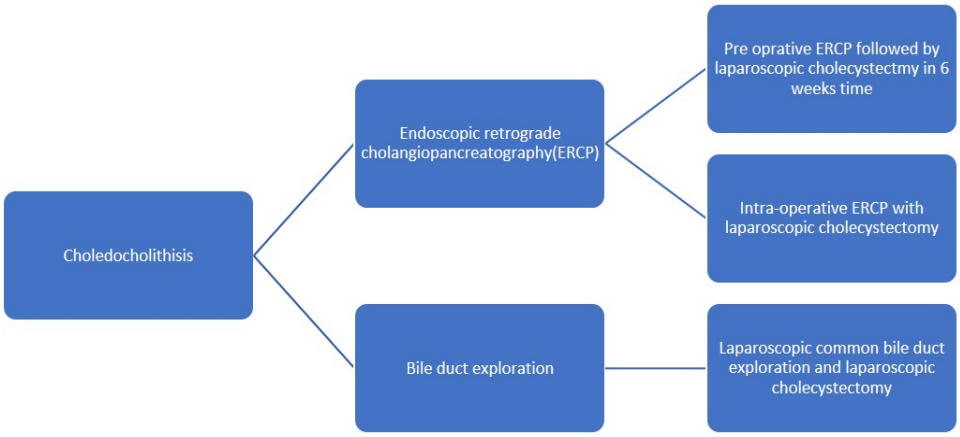

Figure 1: Image showing the algorithm of management of choledocholithiasis.

In this chapter, we examine the management of choledocholithiasis, focusing on the role of endoscopic retrograde cholangiopancreatography (ERCP) and surgical interventions, including laparoscopic common bile duct exploration. We investigate the indications and complications associated with these procedures. Additionally, we discuss the common management algorithm for choledocholithiasis. Our literature review was conducted using PUBMED, the Cochrane Database of Clinical Reviews, Google Scholar, and Semantic Scholar, targeting randomized controlled trials, systematic reviews, meta-analyses, observational studies, and cohort studies from 1990 to 2025. All articles obtained were in full-text form. The following keywords were employed: ”choledocholithiasis,” ”endoscopic retrograde cholangiopancreatography,” ”laparoscopic bile duct exploration,” ”open bile duct exploration,” and ”bile duct stones.” Articles were restricted to the English language, and studies involving pediatric and pregnant patients were excluded. Case reports and commentaries were also excluded from this review.

2. Discussion

Pre-operative endoscopic retrograde cholangiopancreatography (ERCP) followed by laparoscopic cholecystectomy

The most prevalent treatment modality for patients with choledocholithiasis, commonly implemented in hospitals, is the two-stage procedure. This approach initially involves performing an endoscopic retrograde cholangiopancreatography (ERCP) to extract stones from the common bile duct, followed by a laparoscopic cholecystectomy after a period of six to eight weeks. During ERCP, a sphincterotomy is conducted to facilitate the passage of residual stones, and in cases involving complex stones, endoscopic balloon dilatation may be employed. Potential complications associated with this procedure include acute pancreatitis and acute cholangitis [9–12].

The European Society of Gastrointestinal Endoscopy (ESGE) advises performing an endoscopic sphincterotomy to facilitate the drainage of residual stones. For larger stones, endoscopic balloon dilatation is recommended; however, this procedure carries an increased risk of acute pancreatitis. Stone clearance can be achieved in up to 80% of cases [13]. A prospective study by Zhou et al. compared three modalities for the treatment of choledocholithiasis and found that endoscopic retrograde cholangiopancreatography (ERCP) followed by laparoscopic cholecystectomy is the most prevalent treatment option. This approach is associated with a reduced incidence of complications, such as bile leakage, when compared to other surgical procedures [14].

A meta-analysis conducted by Zhu et al. compared this modality with laparoscopic common bile duct exploration in the management of choledocholithiasis. The study concluded that there was no significant difference in morbidity and mortality between the two intervention groups. Similar findings were reported in meta-analyses by [15, 16] which compared two-stage versus single-stage management for common bile duct stones [15–17]. Additionally, a retrospective study by [18] comparing endoscopic retrograde cholangiopancreatography (ERCP) and laparoscopic cholecystectomy with laparoscopic common bile duct exploration found no significant differences in stone clearance, length of hospital stay, or incidence of acute pancreatitis [18].

Successful clearance of common bile duct stones can be achieved in approximately 90% of cases when performed by experienced practitioners. However, challenges arise in cases involving large stones, complex stone formations, or altered anatomy due to previous upper gastrointestinal surgeries [14]. A meta-analysis conducted by Dong et al. compared sphincterotomy combined with balloon dilatation to sphincterotomy alone, concluding that endoscopic balloon dilatation is both safer and more effective for managing common bile duct stones. This approach is also associated with a reduced incidence of bleeding and acute pancreatitis [19].

Laparoscopic common bile duct exploration and cholecystectomy

This procedure entails the laparoscopic exploration and removal of common bile duct stones, followed by cholecystectomy, conducted in a single session. Access to the common bile duct stones can be obtained via the cystic duct or directly through the common bile duct. A choledochoscope is introduced to facilitate the extraction of the stones. The procedure concludes with the performance of a cholecystectomy. This approach is considered safe and is associated with reduced costs compared to preoperative endoscopic retrograde

cholangiopancreatography (ERCP); however, it necessitates proficiency in advanced laparoscopy [20–23].

Laparoscopic common bile duct exploration is also applicable for patients who have experienced unsuccessful endoscopic retrograde cholangiopancreatography (ERCP). In a retrospective study conducted by Kim et al this procedure demonstrated a success rate of 98% and a morbidity rate of 3.4% [24]. Furthermore, Wang et al. conducted a retrospective study comparing the closure of the choledochotomy with T-tube insertion. The study concluded that there were no significant differences in terms of mortality, bile leakage, retained stones, and hospital readmissions. The primary closure of the choledochotomy was deemed safe [25].

The trans-cystic approach is predominantly employed for common bile duct exploration; however, in cases involving large or challenging stones, the trans-biliary approach is utilized. A T-tube is not necessary, and primary closure is typically performed, as it is both safe and effective. The recurrence rate following laparoscopic common bile duct exploration is lower compared to endoscopic retrograde cholangiopancreatography (ERCP) [26–28]. Despite its advantages, laparoscopic common bile duct exploration is often underutilized due to its steep learning curve, the requirement for specialized instruments, increased operative time, and the perception that ERCP is superior [29]. An additional benefit of this procedure is the preservation of the duodenal papilla, which is not cannulated, thereby reducing the risk of acute pancreatitis and duodenal reflux [30].

A meta-analysis conducted by Wu et al. evaluated the safety and efficacy of primary closure versus T-tube drainage in laparoscopic common bile duct exploration. The findings indicated that primary closure was safe and associated with a reduced risk of bile leakage, as well as decreased morbidity and mortality [31]. Similarly, a meta-analysis by Nie et al. compared laparoscopic common bile duct exploration with preoperative endoscopic retrograde cholangiopancreatography (ERCP), concluding that the former was safe and linked to reduced morbidity, fewer retained stones, and a lower risk of acute pancreatitis. These conclusions were corroborated by additional meta-analyses conducted by [32–35].

Table 1: Comparison of preoperative endoscopic retrograde cholangiopancreatography (ERCP) versus Laparoscopic common bile duct exploration

Study	Study type	N=numbers	Pre- ERCP Success Rate (%)	Laparoscopic CBD exploration Success Rate (%)	Pre-ERCP Morbidity Rate (%)	Laparoscopic CBD exploration Morbidity Rate (%)
Nagaraja et al [16]	Systemic review	166	73.1%	86.3%	14.8%	17.3%
Singh et al [35]	Systemic review	1513	82.2%	88.1%	13.9%	14.6%
Yan et al [18]	Retrospective study	60	93.8%	96.4%	3.6%	3.6%

Intra-operative endoscopic retrograde cholangiopancreatography (ERCP) and cholecystectomy: The rendezvous procedure

This procedure is conducted in a single session, during which a laparoscopic cholecystectomy is performed. Cannulation of the common bile duct is achieved via the cystic duct, and a guidewire is advanced to the Ampulla. Subsequently, an endoscopic retrograde cholangiopancreatography is performed, utilizing the guidewire to cannulate the common bile duct and facilitate the removal of stones. Upon completion of this procedure, the cholecystectomy is finalized [36–38].

Lin et al. conducted a meta-analysis comparing the rendezvous procedure with pre-operative endoscopic retrograde cholangiopancreatography (ERCP) and laparoscopic cholecystectomy. Their findings indicated that the rendezvous procedure was associated with a reduced morbidity rate, a lower incidence of acute pancreatitis, shorter hospital stays, but a longer operative time [39]. Similarly, a meta-analysis of randomized controlled trials by Liao et al. also compared the rendezvous procedure with pre-operative ERCP and laparoscopic cholecystectomy, concluding that the rendezvous procedure was associated with reduced morbidity, a decreased pancreatitis rate, and a lower risk of retained stones [40].

Poh et al. and Muhammedoglu et al. conducted a randomized controlled trial comparing intra-operative endoscopic retrograde cholangiopancreatography (ERCP) with laparoscopic common bile duct exploration. Their findings indicated that while both procedures were effective in treating common bile duct stones, intra-operative ERCP was more effective in reducing the incidence of retained stones [41, 42].

The primary limitation of the rendezvous procedure is the extended duration of anesthesia required. Additionally, the procedure necessitates the patient to be in the supine position during surgery, with subsequent repositioning needed for endoscopy. However, a notable advantage of this procedure is the decreased risk of bile leakage and acute pancreatitis. The clinical condition of the patient is also a critical consideration, as presentations involving septic shock or acute cholangitis contraindicate this procedure. The success of the rendezvous procedure is contingent upon the collaboration between the surgical and endoscopic teams, which may significantly influence the outcome [43–45].

3. Conclusions

According to the available evidence, the two-stage procedure involving preoperative endoscopic retrograde cholangiopancreatography (ERCP) followed by laparoscopic cholecystectomy remains the most prevalent approach for managing choledocholithiasis. This preference is attributed to the relative ease of coordination between the surgeon and endoscopist, as well as the reduced risk factors, which permit the subsequent performance of laparoscopic cholecystectomy. Conversely, laparoscopic common bile duct exploration followed by cholecystectomy offers advantages such as decreased costs and shorter hospital stays. However, it is an advanced laparoscopic technique that necessitates specialized training and carries the risk of bile leakage. Additionally, this procedure requires extra equipment, potentially increasing the overall cost.

The rendezvous procedure, which entails performing endoscopic retrograde cholangiopancreatography (ERCP) in conjunction with laparoscopic cholecystectomy, is an effective single-step approach. However, it necessitates the surgeon's ability to cannulate the cystic duct

and the endoscopist's capability to conduct the procedure in the supine position. Successful execution of this procedure relies heavily on the collaboration between the surgeon and the endoscopist. Consequently, the choice of procedure for managing choledocholithiasis is contingent upon the expertise available at the respective hospital and the logistical considerations involved. Ensuring the availability of these procedures in regional hospitals is crucial to avoid placing undue burden on patients and to streamline the management of choledocholithiasis.

Article Information

Conflict of Interest: None

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