

REVIEW

The Modern approach to choledocholithiasis

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ABSTRACT

Choledocholithiasis, defined as the presence of calculi within the common bile duct, represents a frequent clinical challenge in surgical and endoscopic practice. Although gallstone disease is common, concomitant bile duct stones are detected in a clinically significant proportion of patients, particularly with advancing age. Clinical manifestations range from biliary colic to life-threatening complications, such as acute pancreatitis and cholangitis. This narrative review provides an expanded overview of contemporary diagnostic and therapeutic strategies, emphasizing individualized and multidisciplinary patient management.

Keywords: choledocholithiasis, common bile duct stones, ERCP, MRCP, endoscopic ultrasound.

Introduction

Choledocholithiasis refers to the presence of gallstones within the common bile duct and represents a clinically significant manifestation of gallstone disease. While most gallstones remain confined to the gallbladder, migration into the bile duct may occur spontaneously or during surgical manipulation. The prevalence of choledocholithiasis increases with age and is higher in

patients with long-standing symptomatic cholelithiasis¹. The clinical spectrum of choledocholithiasis is broad, ranging from transient biliary colic to severe and potentially life-threatening complications, such as acute pancreatitis and ascending cholangitis. In patients with suspected or confirmed bile duct stones, timely risk stratification is essential, as delayed biliary

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decompression in severe cases may lead to significant morbidity, while selected patients may benefit from single-stage endoscopic or surgical management strategies^{2,3}. Imaging plays a central role in diagnosis and therapeutic decision-making⁴.

Pathophysiology and stone characteristics

Bile duct stones may be classified as primary or secondary according to their origin and underlying pathophysiological mechanisms. Primary stones develop *de novo* within the biliary tree and are typically associated with biliary stasis, chronic infection, or anatomical abnormalities of the bile ducts^{1,4}. These stones are more frequently encountered in elderly patients and in populations with a higher prevalence of biliary tract infections. In contrast, secondary bile duct stones originate in the gallbladder and migrate into the common bile duct, accounting for the majority of cases in Western populations⁵.

The stones' characteristics, such as size, number, and composition, have important clinical implications. Smaller stones may pass spontaneously, resulting in transient obstruction and fluctuating biochemical abnormalities, whereas larger or impacted stones are more likely to cause persistent obstruction, acute cholangitis, or pancreatitis^{2,6}. Recognition of these differences is essential for selecting the appropriate diagnostic and therapeutic strategy.

Management of common bile duct stones

Management strategies should be guided by accurate risk stratification, integrating clinical, biochemical, and imaging findings. Patients with clear evidence of biliary obstruction and infection require urgent biliary decompression^{2,4}. Endoscopic retrograde cholangiopancreatography (ERCP) remains the most commonly employed therapeutic modality, allowing both stone extraction and biliary drainage. However, given its invasive nature and

potential complications, ERCP should be reserved primarily for patients with a high likelihood of bile duct stones or confirmed stones on non-invasive imaging^{3,4}. In centers with appropriate expertise, laparoscopic common bile duct exploration offers an effective surgical alternative, enabling single-stage management in conjunction with cholecystectomy³.

Diagnostic imaging in suspected choledocholithiasis

Non-invasive imaging modalities play a pivotal role in the evaluation of patients with an intermediate probability of choledocholithiasis. Magnetic resonance cholangiopancreatography (MRCP) allows detailed visualization of the biliary tree without exposure to ionizing radiation or iodinated contrast agents, making it particularly suitable for diagnostic purposes⁴.

Endoscopic ultrasound provides even higher sensitivity for detection of small bile duct stones and biliary sludge, especially in cases where MRCP findings are inconclusive^{4,5}. Although EUS is minimally invasive, it remains highly operator-dependent and may not be universally available. The selective use of MRCP or EUS enables accurate confirmation or exclusion of bile duct stones, thereby reducing unnecessary ERCP procedures and minimizing procedure-related morbidity⁵.

Endoscopic versus surgical management

Endoscopic and surgical approaches to the management of bile duct stones should be viewed as complementary rather than competing strategies. Endoscopic retrograde cholangiopancreatography is widely available and familiar to most clinicians, allowing effective stone extraction and biliary drainage in a single session. However, ERCP is associated with procedure-related complications, including pancreatitis, bleeding, and perforation, which must be considered when selecting patients for intervention^{3,4}.

Surgical management, most commonly laparoscopic common bile duct exploration, offers the advantage of single-stage treatment when performed in conjunction with cholecystectomy. This approach may reduce hospital stay and avoid repeated anesthesia, but it requires advanced surgical expertise and appropriate equipment. Consequently, the optimal treatment strategy should be individualized, and based on the patient's characteristics, the stone burden, and institutional experience^{3,7}. Intraoperative near-infrared fluorescence imaging using indocyanine green (ICG) has emerged as a useful adjunct in the assessment of biliary anatomy during minimally invasive surgery. ICG fluorescence enables real-time visualization of the extrahepatic bile ducts and may facilitate identification of critical biliary structures, thereby potentially reducing the risk of bile duct injury. Although ICG does not directly detect bile duct stones, it can support safer surgical decision-making during cholecystectomy and bile duct exploration, particularly in cases with complex or unclear anatomy⁸.

The timing of interventions

The timing of diagnostic and therapeutic interventions is a critical determinant of outcome in patients with choledocholithiasis. In the presence of acute cholangitis, early biliary decompression is essential and should not be delayed for additional diagnostic testing, as delayed intervention is associated with worse clinical outcomes^{2,4}.

In clinically stable patients without signs of infection, a more measured approach may be appropriate. Delaying invasive intervention in favor of non-invasive imaging allows for confirmation of persistent obstruction and helps avoid unnecessary procedures. Nevertheless, prolonged delays in definitive management may increase the risk of recurrent symptoms or complications, underscoring the importance of close clinical monitoring and timely reassessment^{4,5}.

Multidisciplinary approach

The management of choledocholithiasis increasingly relies on close collaboration between surgeons, gastroenterologists, radiologists, and anesthesiologists. A multidisciplinary approach facilitates integration of clinical findings, imaging results, and procedural expertise, enabling selection of the most appropriate diagnostic and therapeutic pathway for each patient^{3,4}.

Such collaboration is particularly valuable in complex clinical scenarios, including patients with altered anatomy, severe pancreatitis, or significant comorbidities. Development of institution-specific protocols through multidisciplinary consensus may further enhance consistency of care and optimize patient outcomes^{8,9}.

Special clinical situations

Choledocholithiasis associated with acute pancreatitis

Gallstone-induced acute pancreatitis frequently involves transient bile duct obstruction. Patients with concomitant cholangitis require urgent endoscopic intervention^{6,10}. In contrast, patients with improving clinical and biochemical parameters often experience spontaneous stone passage and may be managed conservatively, with MRCP or EUS guiding the need for delayed intervention¹⁰.

Choledocholithiasis after cholecystectomy

Choledocholithiasis may occur after cholecystectomy due to retained stones, overlooked stones, or de novo formation within the bile duct. Diagnostic evaluation can be challenging, as physiological bile duct dilation is common following cholecystectomy, particularly in elderly patients. Advanced imaging modalities are therefore recommended to confirm the presence of bile duct stones before invasive treatment is undertaken^{9,11}.

Table 1. Clinical approach to suspected choledocholithiasis

Clinical scenario	Estimated likelihood of CBD stones	Preferred diagnostic or therapeutic approach
Clear biliary obstruction, cholangitis	High	Urgent biliary decompression, most commonly by ERCP
Persistent cholestasis without infection	High	Endoscopic or surgical bile duct exploration
Equivocal laboratory and imaging findings	Intermediate	MRCP or EUS
Normal liver tests and no duct dilation	Low	Proceed directly to cholecystectomy
Post-cholecystectomy biliary symptoms	Variable	MRCP or EUS

Conclusion

Choledocholithiasis represents a common yet complex clinical condition requiring nuanced and individualized management. Advances in diagnostic imaging and minimally invasive therapeutic techniques have increased the treatment options available, shifting emphasis toward patient-centered and expertise-driven decision-making. Accurate risk stratification, appropriate timing of intervention, and effective multidisciplinary collaboration remain central to achieving optimal outcomes^{3,4,8}.

Disclosure statement

The authors report there are no competing interest to declare.

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