Large CBD Stones and its Impact on Successful Stone Extraction and the Possible Adverse Events During Ercp Procedure

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Abstract

Choledocholithiasis is the presence of stones within the common bile duct (CBD). It is estimated that common bile duct stones are present in anywhere from 1-15% of patients with cholelithiasis. The present-day treatment of bile duct stones is endoscopic retrograde cholangiopancreatography (ERCP), or in some cases, laparoscopic cholecystectomy with bile duct exploration. In most US centers, when bile duct stones present, ERCP is usually followed by laparoscopic cholecystectomy). Bile duct stone management has changed dramatically in the last two decades when open surgery has been replaced by per-oral endoscopic procedures. Nowadays, therapeutic endoscopic retrograde cholangiopancreatography (ERCP) is performed worldwide as the first approach in the management of extrahepatic bile duct stones and is superior to surgical or percutaneous approaches, although it can be challenging in some cases. The main problem that has to be solved regarding endoscopic extraction of large bile duct stones is extraction of something larger than the orifice through which access has been achieved. This is obtained by either enlarging the ampulla of Vater (cutting, dilation) or reducing the size of the stone that has to be extracted (fragmentation, crushing) using adequate devices and second problem is the size of the stone itself. For large stones in the CBD (single stone diameter ≥ 1.5 cm or ≥ 3 stones with diameters ≥ 1.0 cm), it is difficult to completely remove the stones by conventional EST or EPBD procedure. And then, endoscopic papillary large balloon dilation (EPLBD), mechanical lithotripsy (ML), or other lithotripsy methods such as electrohydraulic lithotripsy (EHL), laser lithotripsy (LL), and extracorporeal shock wave lithotripsy (ESWL) are often required to achieve complete stones removal. However, these methods increase the time and complexity of the ERCP procedure, thereby increasing the risk of complications.

Keywords: Large CBD stone, ERCP procedure

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Etiology

Choledocholithiasis occurs as a result of either the formation of stones in the common bile duct or the passage of gallstones that are formed in the gallbladder into the CBD. Bile stasis, bactibilia, chemical imbalances, increased bilirubin excretion, pH imbalances, and the formation of sludge are some of the factors which lead to the formation of these stones. Less commonly, stones are formed in the intrahepatic biliary tree, termed primary hepatolithiasis, and may lead to choledocholithiasis. Stones that are too large to pass through the ampulla of Vater remain in the distal common bile duct, causing obstructive jaundice that may lead to pancreatitis, hepatitis, or cholangitis. Gallstones are differentiated by their composition (3).

Cholesterol stones are composed mainly of cholesterol, while black pigment stones are mainly made of pigment, and brown pigment stones are composed of a mix of pigment and bile lipids. Cholesterol stones make up approximately 75% of the secondary common bile duct stones in the United States, while black pigment stones comprise the remainder. Primary common bile duct stones are usually brown pigment stones. Obstruction of the CBD by gallstones leads to symptoms and complications that include pain, jaundice, and sepsis (3).

Epidemiology

Choledocholithiasis has been found in 4.6% to 18.8% of patients undergoing cholecystectomy. The incidence of choledocholithiasis in patients with cholelithiasis increases with age. Cholelithiasis is more common in female patients, pregnant patients and those with high serum lipid levels. Cholesterol stones are typically found in obese patients with low physical activity or

patients that have recently intentionally lost weight. Black pigment stones are found in patients with cirrhosis, patients receiving total parental nutrition, and in those who have undergone an ileal resection. Nucleating factors, such as bacteria, are the source of the brown pigment primary common bile duct stones (4).

Pathophysiology

Bile made in the liver and stored in the gallbladder can lead to gallstone formation. In some patients with gallstones, the stones will pass from the gallbladder into the cystic duct and then into the common bile duct. Most of the choledocholithiasis cases are secondary to the gallstones passage from the gallbladder into the CBD. Primary choledocholithiasis, which is the formation of stones within the common bile duct is seen less commonly. Primary choledocholithiasis occurs in the setting of bile stasis, which results in intraductal stone formation. The size of the bile duct increases with age (5).

Older adults with dilated bile ducts and biliary diverticula are at risk for the formation of primary bile duct stones. Less common sources of choledocholithiasis include complicated Mirizzi syndrome or hepatolithiasis. Bile flow is obstructed by stones within the common bile duct, which leads to obstructive jaundice and possibly hepatitis. Stagnant bile can also lead to bactibilia and ascending cholangitis. Cholangitis and sepsis are more common in patients with choledocholithiasis than other sources of bile duct obstruction because a bacterial biofilm typically covers common bile duct stones. The pancreatic duct joins the common bile duct near the duodenum, and therefore, the pancreas may also become inflamed by the obstruction of pancreatic enzymes. This is termed gallstone pancreatitis (5).

History and Physical examination

The treating provider must assess the patient by conducting a thorough history and physical examination. This includes asking about the onset, timing, and severity of the patient's abdominal pain, in addition to any previous occurrences of similar pain. The pain is colicky, located in the right upper quadrant of the abdomen, and moderate in severity. The pain is intermittent and recurrent. A thorough review of systems will reveal that the patient may have noticed a yellowing of his eyes or skin, experienced pruritus, and possibly nausea or vomiting. Jaundice occurs when the stones obstruct the CBD, and conjugated bilirubin enters the bloodstream (6).

A history including, clay-colored stools and urine turning tea-colored is found in such patients. Jaundice can occur in episodes. A patient with cholangitis also may have a fever, chills, and possibly altered mental status (Charcot triad or Reynold's pentad). Gallstones are responsible for approximately half of all cases of pancreatitis. Pancreatitis is precipitated when CBD obstruction is at the level of the ampulla of Vater. Pancreatic pain is located in the epigastric and midabdominal areas and is continuous (as compared to colicky in choledocholithiasis) and radiates to the back. Nausea and vomiting are also present. Some patients

have intermittent pain, which results due to transient blockage within the common bile duct. Transient blockage occurs when due to floating stones or debris within the bile duct **(6).**

The provider should examine the patient with particular attention to the general appearance, skin, vital signs, and abdomen. Tenderness is noted in the right upper quadrant of the abdomen. Systemic signs such as fever, hypotension, and flushed skin, if present is indicative of infection, or sepsis. Courvoisier sign is the presence of palpable gallbladder on the exam and is seen when gallbladder dilation develops due to the obstruction of the common bile duct. Note should be made for any hyperthermia, diaphoresis, jaundice, scleral icterus, tachycardia, hypotension, tachypnea, or right upper quadrant abdominal tenderness **(7).**

Diagnosis

Diagnostic tools are reported as summarized in a chronological order (1) Preoperative; and (2) Intraoperative, from the least to the most invasive.

In order to understand why there is still no consensus concerning CBDS diagnosis and so many examinations have been and are continuing to be proposed, the following statements should be considered: The prevalence of gallbladder stones in the general population is up to 20%. of these patients, up to 20% have synchronous CBDS. CBDS are asymptomatic in up to half of these latter cases **(8).**

This data mean that up to 2% of the general population may have unknown CBDS during their lifespan; CBDS may cause potentially life-threatening complications, such as acute cholangitis or acute pancreatitis, and therefore should be diagnosed and treated. Accuracy, invasiveness, potential therapeutic use and costs of the most common imaging techniques used to identify CBDS increase together in a parallel way: they are minimal for transabdominal ultrasonography (US) and maximum for ERC, where the counterpart of intrinsic therapeutic implications (endoscopic sphincterotomy) is non-negligible morbidity/mortality **(7).**

These latter considerations contraindicate the systematic, pre-cholecystectomy use of imaging techniques other than transabdominal US as first-line imaging, and ERCP as second-line examination, unless a clear indication is given by jaundice, cholangitis or high risk of synchronous CBDS **(9)**

Table 1: Common bile duct stones diagnosis and management: Current evidence (9)

Biliary lithiasis affects 10% to 20% of general population and is associated with CBDS in up to 20% of cases
Clinical symptoms, liver/pancreas serology and transabdominal ultrasounds may define the “risk of carrying CBDS”, and identify:

"Low risk" patients, to be directly referred to laparoscopic cholecystectomy
"Intermediate risk" patients, needing intraoperative cholangiography, endoscopic ultrasounds or magnetic resonance cholangiography before laparoscopic cholecystectomy
"High risk" patients requiring endoscopic retrograde cholangiography
CBDS may be managed by endoscopic sphincterotomy or surgery (laparoscopic or open). This latter has seemingly slightly better results, counterbalanced by invasiveness (open surgery) or the need of specific instrumentation and advanced laparoscopic skills (laparoscopic surgery). Lithotripsy may help endoscopic CBDS retrieval or may be performed extra-corporeally in selected, unfit patients
CBDS management will be more and more multidisciplinary and tailored not only on a specific patient but also on the available resources of a specific environment to have the best possible management

Treatment / Management

The treatment for choledocholithiasis is the removal of the obstructing stones via endoscopic means. An ERCP can be performed under general anesthesia, with the patient in either prone, left lateral, or supine position, though prone is the most common position used. The endoscopist will then place a duodenoscope into the second portion of the duodenum and advance a catheter and guide wire into the common bile duct. A sphincterotome then is used to cut the papilla, using cautery, and enlarge the ampulla of Vater. Often, the stones will be released with this maneuver. A variety of snares and baskets can be used to grasp the stones and remove them if needed. A balloon catheter also can be used to sweep the common bile duct to remove any stones. The endoscopist also can place a stent in the common bile duct, which will serve two purposes. First, any remaining stones will be softened, and potentially easier to remove with a second ERCP. Second, the stent will allow bile drainage to occur, preventing obstructive jaundice **(10)**.

If the stones are large, stuck, or there are many stones within the biliary tree, surgical removal is indicated. A laparoscopic or open common bile duct exploration is needed to remove any stones that cannot be removed via endoscopic methods. An elective cholecystectomy is also

recommended, during the same hospital admission, to prevent future episodes of choledocholithiasis **(11, 12)**.

Cholecystectomy in patients with choledocholithiasis remains controversial, but most experts recommend it. Arguments can be made against cholecystectomy in patients who cannot tolerate surgery well (e.g., due to age, medical problems), as long as the organ is asymptomatic **(13)**.

Cholecystectomy is not indicated for primary CBD stones. Other surgical options include open choledochotomy, Trans-cystic exploration (a technique to clear the CBD of stones during laparoscopic cholecystectomy), percutaneous extraction, and extracorporeal shock wave lithotripsy. The choice of treatment for choledocholithiasis found during surgery being done for cholelithiasis or cholecystitis includes intraoperative common bile duct exploration, intraoperative ERCP, and postoperative ERCP. The intraoperative procedure can be performed if consent was obtained preoperatively. Otherwise, ERCP is recommended at a later time, but during the same hospitalization **(13)**.

There are no medications that will cure choledocholithiasis. However, a one-time dose of 50 mg to 100 mg rectal indomethacin can be used to prevent post-procedure pancreatitis if the pancreatic duct was manipulated during an ERCP. Antibiotics are typically not needed for choledocholithiasis unless the patient also has associated cholecystitis or cholangitis **(10)**.

Large CBD stone(s) and its impact on successful stone extraction and the possible adverse events during ERCP procedure

The main problem that has to be solved regarding endoscopic extraction of large bile duct stones is extraction of something larger than the orifice through which access has been achieved. This is obtained by either enlarging the ampulla of Vater (cutting, dilation) or reducing the size of the stone that has to be extracted (fragmentation, crushing) using adequate devices and second problem is the size of the stone itself **(14)**.

It is not clear and there is no consensus in the literature of the definition of “large stone”. Some authors use the term “difficult stone” when referring to a large stone size, although actually “difficult” could mean multiple, intrahepatic, barrel-shaped, impacted stones or the presence of another comorbidity. Stricture below the stone, stenosis of the intrapancreatic CBD or difficult anatomic access to the papilla caused by duodenal diverticula are conditions which increase the rate of unsuccessful stone retrieval. Overall, only a small number of “difficult stones” are “large stones”. Regardless of the chosen endoscopic procedure, the large stone issue is still a concern due to high failure rates, even for experienced endoscopists **(14)**.

Many authors define a stone larger than 10-15 mm in diameter as “large”. Others support that a stone with a diameter equal to the CBD diameter is large **(14)**.

Therefore, definition of a large stone should include the lower CBD diameter so that any stone exceeding that should be called “large”, regardless of the stone size. Overall, only a small number of “difficult stones” are “large stones” **(15).**

For a common bile duct (CBD) stone ≤ 10 mm in diameter, the complete stone clearance rate for conventional EST and balloon/basket extraction can be as high as 90% **(16).**

However, for large stones in the CBD (single stone diameter ≥ 1.5 cm or ≥ 3 stones with diameters ≥ 1.0 cm), it is difficult to completely remove the stones by conventional EST or EPBD procedure. And then, endoscopic papillary large balloon dilation (EPLBD), mechanical lithotripsy (ML), or other lithotripsy methods such as electrohydraulic lithotripsy (EHL), laser lithotripsy (LL), and extracorporeal shock wave lithotripsy (ESWL) are often required to achieve complete stones removal. However, these methods increase the time and complexity of the ERCP procedure, thereby increasing the risk of complications **(17).**

Although previous studies have confirmed the efficacy and safety of EST combined with EPLBD for the treatment of large CBD stones especially in elderly patients, there have been few studies on the optimal choice of the treatment strategy for large CBD stones in high-risk elderly patients with chronic diseases (American Society of Anesthesiologists Physical Status classification ≥III). **(18).**

For difficult CBD stones that cannot be removed endoscopically or for high-risk patients who cannot tolerate surgery and endoscopic stone removal, endoscopic biliary stent placement is a safe and effective treatment option **(19).**

After a period of biliary plastic stent drainage, CBD stones can decrease in size or become brittle, which is conducive to further endoscopic stone removal **(20).**

Prognosis

The prognosis of choledocholithiasis depends on the presence of complications and their severity. Approximately 45% of patients with choledocholithiasis remain asymptomatic. Of all patients who refuse surgery or are unfit to undergo surgery, only 55% experience varying degrees of complications. Less than 20% of patients experience recurrence of symptoms even after undergoing therapeutic procedures. If treatment is initiated at the right time, the prognosis is deemed favorable under general circumstances **(10).**

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