

## Diagnosis and Management of Common Bile Duct Stones

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### ABSTRACT

Symptomatic common bile duct (CBD) stones can present in many ways. Biliary colic, obstructive jaundice, cholangitis and acute pancreatitis are among the common presentations.

Diagnosing CBD stones also can be confirmed by a lot of diagnostic tests. MRCP and EUS are recent techniques that have sensitivity higher than 90%. Nevertheless ERCP is still a standard procedure to detect and treat CBD stones. Recently laparoscopic CBD exploration has become possible but its limitation are the size of the stones and expertise of surgeon.

Usually lithotripsy is required for a large stone. Mechanical lithotripsy has been used worldwide and yields with a very effective result. Lately, there are many special devices can be used to crack the stones. Laser, electrohydrolic probe, and extracorporal shock wave can fragment stones equally effective. Choosing one technique over the others is depended on local expertise and availability. Nevertheless, combinations of these may be necessary in some circumstances.

**Key words :** CBD stones, lithotripsy, management

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### Clinical Features of Patient with Common Bile Duct Stones

The most common leading complaints of patient with common bile duct stones (CBD) is biliary colic. Biliary colic is typically last longer than colic from other organs. In general, this lasts longer than 30 minutes and locates at the epigastric or right upper quadrant of the abdomen. Some patients may have radiation pain to there scapulas. This typical pain may not be present in elderly with CBD stones. If the stone becomes permanently obstructing the bile flow to duodenum, patient will develop obstructive jaundice. The level of bilirubin usually ranges between 2 to 5 mg/dl and rarely exceeds 12 mg/dl<sup>(1)</sup>. This may be due to the nature of CBD stones causing intermittent bil-

iary obstruction compared to permanent block of bile flow from biliary stricture. The only circumstance that bilirubin can rise up higher than 12 mg/dl is impact CBD stones at the ampulla level. With ball-valve mechanism from CBD stones, duodenal juice can be sucked during the period of upward movement of stones in the bile duct. This juice sometimes contains significant amount of organism. Whenever the stones rolling downward to the biliary orifice and blocking this outflow, colonized form of bacteria may transform into infected one and later patient develops cholangitis. Another presentation of CBD stones patient is acute biliary pancreatitis. The patient usually has multiple attacks of biliary colic prior to the episode of pancreatitis. Laboratory findings include elevated level of

serum transaminase, lipase and amylase. Transient spike in these enzyme levels suggests passing stone<sup>(1)</sup>.

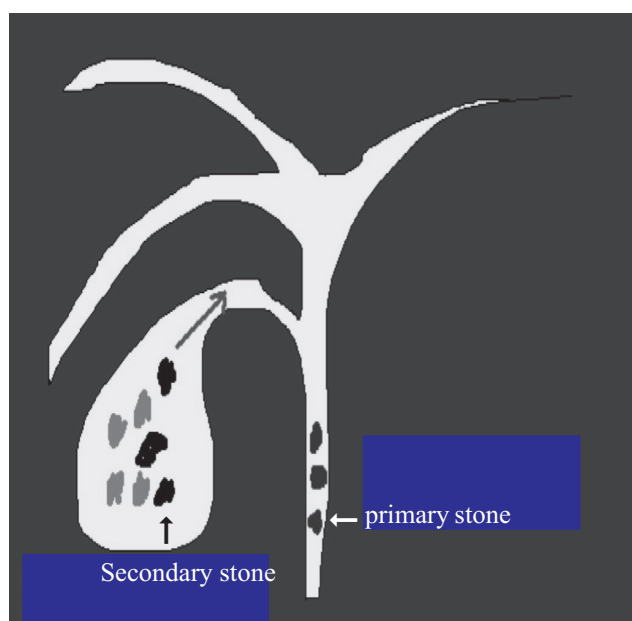
Up until now, there is no report on natural history of asymptomatic stone. The incidence of CBD stone is 15 % of patient who found to have stones in the gallbladder. Conversely, patients with CBD stones, 95% also have gallbladder stones<sup>(2)</sup>.

### Types of CBD Stones

CBD stones can be classified according to origin of stone or component of the stones. Stones from the gallbladder are usually made of cholesterol. Patient with chronic hemolysis can develop black stone easily. This stone is either made of calcium palmitate or carbonate. The stone that develop after repeat bacterial infection in the hepatobiliary system contains more of calcium bilirubinate (Table 1). This stone is usually

**Table 1** Types of CBD stones according to their ingredients

Characteristics	Brown	Black
Color	Earthy, muddy	Black, dark
Consistency	Soft, amorphous	Hard
Surface	Smooth, shiny	Dull
Ca bilirubinate	10-60%	10-60%
Chemical content	Calcium palmitate	Calcium carbonate or phosphate



**Figure 1** Primary and secondary stone by their origin

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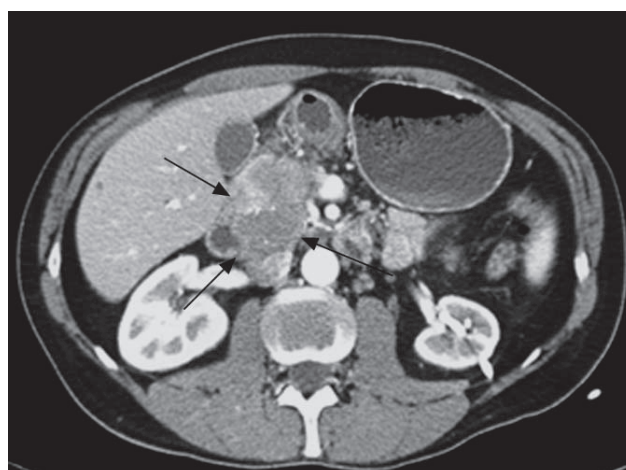
brown and discovered more in the CBD than gallbladder. The stone that migrated down from the gallbladder is usually called secondary stone. In contrast stone that form in the common duct is classified as primary stones. (Figure 1)

### Images for Diagnosis of CBD Stones

Currently, there are many modalities to diagnose CBD stones. Ultrasonography seems to be the most widely available among all these. Its sensitivity to detect CBD stones seems to be less than gallbladder stones. Einstein et al reported the overall sensitivity of ultrasonography for CBD stones to be only 50%. By subgroup analysis, they demonstrated a better sensitivity for a stone larger than 6 mm to be more than 75%<sup>(3)</sup>.

There are many techniques using computed tomography (CT scan) to detect CBD stones. The regular CT scan technique does not give a significant higher yield to detect CBD stones than ultrasonography (Figure 2). It was reported to be only 60% by Cabada et al<sup>(4)</sup>. With advancement in CT technology, the technique called helical CT cholangiography can increase the sensitivity CBD stones detection to be as high as 95%<sup>(4)</sup>.

Among other non-invasive imaging tests available today, Magnetic Resonance Cholangiopancreatography (MRCP) is the most popular due to its excellent sensitivity (Figure 3). The sensitivity to detect CBD stone by this test can be as high as 100%. There are many series over the last 2 years reported the specificity, positive predictive value and negative predictive value of MRCP for CBD stones detection MRCP



**Figure 2** CBD detected by CT scan (white arrow)



**Figure 3** MRCP demonstrated CBD stones (white arrow)

to be 96-100%, 91-100% and 93-89% respectively<sup>(5-8)</sup>. (Table 2)

Recently endoscopic ultrasonography has been accepted as a new tool to diagnose stones in biliary tree. Since EUS faces less air between the probe and bile duct than transcutaneous ultrasonography. Therefore, EUS can yield a higher rate of stone detection than transcutaneous ultrasonography. EUS can be performed by two different techniques. One is directly apply to the gastrointestinal lumen that adjacent to biliary system. The other is intraductal ultrasonography. This technique has to be performed after ERCP able to selectively place the guide wire into the bile duct.

The overall sensitivity, specificity, positive value, and negative predictive value for CBD stones by EUS are higher than 97%<sup>(9,10)</sup>.

### Invasive Tests for Diagnosis and Treatment of CBD Stones

Endoscopic retrograde cholangiopancreatography (ERCP) is currently the diagnostic and therapeutic of choice for patients who confirmed CBD stones. Because of its invasive nature, the indication has to be strong enough before considering patient for ERCP. It has been suggested that the probability of stone to be higher than 80% and the successful selective biliary cannulation by the endoscopist to be more than 85%, for ERCP can be safely performed and yielded the excellent results<sup>(11)</sup>.

The benefit of ERCP is highest in patient with acute cholangitis. This is considered to be one of the emergency indications. The advantage of ERCP in this setting over other therapeutic modalities is the quick biliary drainage by stent insertion.

Patient with concomitant gallbladder stones, ERCP can provide a short course of treatment by combining it with laparoscopic cholecystectomy. But apply this treatment strategy for all patients including patient with very low possibility of CBD stones will waste a lot of medical expense unnecessarily. Many experts recommended performing ERCP post laparoscopic cholecystectomy whenever intraoperative cholangiogram demonstrates residual CBD stones. In advanced center for laparoscopy, laparoscopic common bile duct exploration (LCBDE) is possible. This technique involves in intraoperative cholangiography and ultrasonography. The benefit of cholangiography over ultrasonography in this situation is more reliably gives details biliary anatomy.

The limitation of LCBDE is a CBD stone larger than 8 mm<sup>(12)</sup> since it is necessary to dilate cystic duct prior to remove the stones. Most surgeons become uncomfortable dilating the cystic duct beyond 8 mm in diameter. Stones larger than this are more appropriately dealt with lithotripsy or choledochotomy. Using

**Table 2** Efficacy of MRCP for CBD stones detection

Authors	Number of Patients	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value
Griffin 2003	133	84%	96%	91%	93%
Boraschi 2002	95	90%	96%	95%	93%
Kats 2003	202	100%	96%	N/A	N/A
Topal 2003	366	95%	100%	100%	98%

**Table 3** Results of therapy for CBD stones (Modified from syllabus book for The Society for surgery of the alimentary tract 2002 post graduate course)

Method	Success (%)	Hospitalization (days)	Return to work (days)
LCDBE*	85-100	4-7	14-30
Open CBDE	90-100	5-8	20-42
ERCP85-95	2-3	7-14	

\*LCDBE= laparoscopic common bile duct exploration

transcystic duct approach, the common bile duct can be cleared in 90% of patients (Table 3). In the remaining 10% of patients with unfavorable anatomy, operative choledochotomy or ERCP with advanced instrument for lithotripsy will be necessary.

CBD stones that cannot be removed laparoscopically force the decision as to whether the patient should be open and managed traditionally or be subjected to post operative ERCP for stone removal. Open choledochotomy in young patients carries a very low risk but does lead to more pain and longer recovery period than ERCP and LCDBE (Table 3). There may never be a randomized prospective trial comparing open choledochotomy with post operative ERCP for stone removal for unsuspected stones discovered during laparoscopic cholecystectomy. Therefore, the decision will rest with the surgeon and expert biliary endoscopist of the individual institution. To avoid failure of selective biliary cannulation by ERCP, it may be prudent to place a catheter into the duodenum via the cystic duct when postoperative endoscopic management of CBD stones by ERCP is planned.

### Options for Large CBD Stones Management

Traditionally CBD stones smaller than 1cm. are removed by standard techniques such as ERCP with biliary sphincterotomy. Whenever the stones become larger than 1 cm. the biliary orifice may not be large enough to extract the stones on one pass of balloon sweeping, these stones will require lithotripsy in order to be removed through the relative small orifice.

Generally, mechanical lithotripsy is the most common standard practice. It involves the concept of capturing the stones with a basket and pulling the basket wire that containing the stones against the metallic sheath. The final result is usually end up with multiple

fragments of stones or broken basket wire. This procedure can be performed outside or inside the duodenoscope. The success rate of this technique has been reported to be close to 80%. Failure of this technique will be high if patient has abnormal duct configuration (sigmoid structure) and/or a relative smaller duct compared to CBD stones size<sup>(13)</sup>.

Patient with large CBD stones who failed mechanical lithotripsy usually undergoes for surgery for open common bile duct exploration. One who is not fit for surgery has to go for non-surgical treatment.

Extracorporeal shock wave lithotripsy (ESWL) has been used for many years by urologist for kidney stones. Sackman et al reported a high success rate of this technique to be 90% for CBD stones. Of these 10% of them had spontaneous passage of stone fragments after ESWL without additional endoscopic removal<sup>(14)</sup>.

Electrohydrolic lithotripsy (EHL) and Laser lithotripsy can aid stones fragmentation by intraductal power transmission to blast the stones. EHL needs to be performed under direct vision either by percutaneous choledochoscopy or by ERCP-mother-baby system. Without direct choledochoscopy, there is a significant risk of bile duct perforation from the EHL probe. Adamek et al reported a stone clearance rate by this technique to be around 75%<sup>(15)</sup>. Unlike EHL system, Laser lithotripsy can be performed under fluoroscopic guidance without a need for direct vision. The power generator of this Laser system can detect and absorb laser power to prevent penetration whenever it hits soft tissue, which usually means bile duct wall in this situation. Prat *et al* reported free bile duct obtained in 88% of patient who underwent Laser lithotripsy<sup>(16)</sup>. Procedure related morbidity was 12.5% for minor complications such as transitory fever and transitory hemobilia.

For the most difficult CBD stones combined treatment including ESWL, EHL and intracorporeal laser lithotripsy was finally successful in 94% of patients<sup>(15)</sup>.

Another approach for difficult CBD stones is long-term biliary stenting. Jain *et al* inserted biliary stents in patients with large CBD stones. Twenty percent of them had small stones that were easily extracted with balloon on later ERCP. In addition, only 20% of them required long-term biliary stenting<sup>(17)</sup>.

### Risk Factors for Recurrent CBD Stones

Majority of patients with CBD stones underwent cholecystectomy not long after successful bile duct



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clearance. Patient who has gallbladder left in place may have a significant risk of stone migrating down to CBD again or an attack of cholecystitis. Costamagna *et al* followed 334 CBD stones patients who underwent ERCP for stone removal and some of them did not undergo for cholecystectomy. They demonstrated the risk for recurrent CBD stones and cholecystitis to be 11.1% and 5.8% respectively<sup>(18)</sup>. A similar result was reported from a group from Japan. Sugiyama *et al*<sup>(19)</sup> demonstrated the chance for recurrent CBD stones and cholecystitis to be 10.4% and 1.5% respectively. Another study from Japan reported a result of 10 year-follow up after endoscopic removal of CBD stones. They found that approximately 12% of patients develop recurrent CBD stones after endoscopic stone removal, but retreatment with ERCP is effective. Therefore, careful follow-up is necessary after endoscopic treatment for choledocholithiasis particularly for patients with a dilated bile duct or brown pigment stones<sup>(19)</sup>.

In summary, patients with CBD can be managed differently according to the size of stones and condition of patient. Surgery still plays a major role for large CBD stones management. Patient who is unfit for surgery may undergo to various types of lithotripsy depend up on available technique. The rate of recurrent CBD stones and gallbladder attack is obviously significant especially in patient with gallbladder in situ. Therefore, it is recommend to perform cholecystectomy after complete CBD clearance unless there is contraindication for cholecystectomy.

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