Common Bile Duct Exploration

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Epidemiology/Diagnosis

As stated in previous chapters, about 10–20% of patients with cholelithiasis present with choledocholithiasis [1]. 1–2% of patients who undergo a cholecystectomy will present with retained stones postoperatively if intraoperative cholangiography is not done [2]. Open common bile duct (CBD) exploration was the conventional method of stone extraction in the operating room; however, with the advent of laparoscopic surgery, newer options have been developed [3]. CBD stones can present anywhere along a spectrum from silent (incidentally noted), to biliary colic, to obstruction of the ampulla of Vater, and all the way to obstructive jaundice and ascending cholangitis [2].

A patient's laboratory analysis can be abnormal with elevated liver enzymes and elevated bilirubin. If there is an infection, they can present with a leukocytosis. Ultrasound may show choledocholithiasis or may just show dilation of the biliary ducts (intrahepatic or common bile duct). Choledocholithiasis is highly suggested in patients with biliary pain, cholelithiasis, jaundice, and a dilated bile duct >8 mm [2]. MRCP (magnetic resonance cholangiopancreatography) is almost 100% specific and >90% sensitive for common bile duct stones and is noninvasive; however, once choledocholithiasis is found, intervention is still needed [2]. Endoscopic retrograde cholangiopancreatography (ERCP) can also diagnose choledocholithiasis and can clear stones in about 75% of patients during their first ERCP and about 90% after repeat ERCP [2].

Ultrasound is routinely used for the evaluation of biliary disease, while MRCP and ERCP are employed more selectively. Ultrasound has been noted to have a sensitivity of only 32% for CBD stones making MRCP an important adjunct [4]. ERCP is a great option for patients with cholangitis and biliary pancreatitis or if the surgeon has limited experience with duct exploration. Otherwise, cholangiography during laparoscopic cholecystectomy is a good option [2]. However, one study found that if cholangiography is employed on all patients intraoperatively, 1/3rd of the CBD stones found will pass spontaneously within 6 weeks of surgery; and therefore it may be more prudent to employ selective intraoperative cholangiography [5]. While there are many signs and symptoms of choledocholithiasis, about 40–50% of patients with choledocholithiasis will be asymptomatic [6] (Fig. 20.1).

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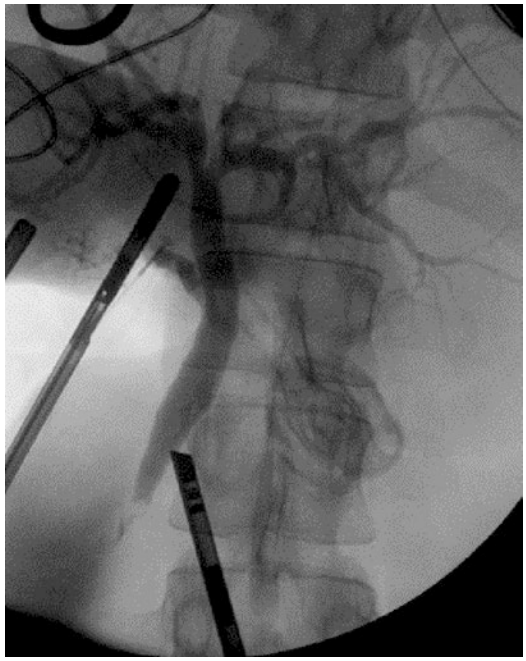

Fig. 20.1 Choledocholithiasis seen on intraoperative cholangiogram. There is a positive meniscus sign at the common bile duct stone and absence of filling of the small bowel

Treatment Options

Treatment options include preoperative ERCP, PTHC (Percutaneous Transhepatic Cholangiogram), laparoscopic cholecystectomy with laparoscopic common bile duct exploration, open bile duct exploration, and postoperative ERCP. Smaller stones (usually <4 mm) are likely to pass on their own or to flush easily after administration of 1–2 mg of IV glucagon intraoperatively [6]. ERCP is a good option for patients with difficult anatomy, and it is still an option in those who have had a Roux-en-Y gastric bypass though it may require surgical assistance for access through the remnant stomach [7]. 86% of providers noted they would choose ERCP if the CBD stones are found preoperatively, while 30% would choose laparoscopic common bile duct exploration (LCBDE) if the stones are found intraoperatively [8, 9]. There are a few contraindications to laparoscopic common bile duct exploration to include a hostile porta hepatis, lack of technical skill, and the absence of common bile duct pathology [6]. In the hands of an experienced provider, laparoscopic common bile duct exploration has a success rate of about 90% [6]. A meta-analysis from 2006 looked at ERCP vs LCBDE vs open common bile duct exploration and found that open surgery resulted in significantly reduced number of retained stones compared to ERCP, while ERCP and LCBDE were similar [10]. However, this study used data from the early days of endoscopy. Laparoscopic CBD exploration has shown comparable stone extraction rates to ERCP; however, the length of hospital stay is shorter, and physician fees are lower in patients who undergo stone extraction via common duct exploration at the time of cholecystectomy [11–13]. A retrospective study from 2017 showed that laparoscopic cholecystectomy with postoperative ERCP was more successful at stone clearance than LCBDE (98% vs 88.6%); however, the LCBDE group had a fewer number of procedures (1.1 vs 2.0; $P < 0.001$) per patient [14]. The laparoscopic transductal approach to LCBDE has shown a higher clearance rate than the transcystic approach and ERCP (100% vs 93.7% vs 92.3%), respectfully [12]. One study attempted to identify factors that predict converting to an open common bile duct exploration from a laparoscopic exploration, and they found that prior antibiotic use, previous ERCP attempt, and abnormal biliary anatomy had a 90% likelihood of failed laparoscopic common bile duct exploration [15].

Laparoscopic Common Bile Duct Exploration

Once an intraoperative cholangiogram is done to confirm the presence of stones in the common bile duct, a decision can be made on whether or not a common bile duct exploration needs to be done. Some of the decisions can be based on size of the ducts, locations of the stones, and size of the stones (see Table 20.1). 1–3 mm stones that are few in number can often be managed by duct irrigation and glucagon administration, which relaxes the sphincter of Oddi. A second cholan-

Table 20.1 Contraindications

Transcystic	Larger stones (>6 mm), intrahepatic stones, cystic duct <4 mm, cystic duct entrance to CBD posterior or distal
Transcholedochal	Small CBD <6 mm, marked inflammation, poor suturing ability of the provider
Either approach appropriate	One or multiple small stones, cystic duct >4 mm, CBD >6 mm, cystic duct entrance to CBD is lateral, and mild inflammation

giogram should be done to ensure that the stone or stones have cleared the duct and that contrast enters the duodenum. If this fails or if the stones are >4 mm, then a formal CBD exploration is needed. One should prepare for a CBD exploration preoperatively by ensuring all of the equipment to do an exploration is in the room. As this is not a commonly performed procedure, trying to find the proper equipment intraoperatively will only serve to cause delays and frustration. The equipment needed are:

- Choledochoscope with saline bag to flush the scope and allow better visualization
- 0.028 or 0.035 inch guidewire
- Over the wire dilators or balloon dilators
- Wire baskets
- Balloon catheters (4*f* Fogarty embolectomy catheters can be used)

There are two access points for laparoscopic CBD exploration: the transcystic approach and the transcholedochal approach. As stated before, there are several factors that have been identified that can influence your approach to a LCBDE, whether it be transcystic or transcholedochal (Figs. 20.2, 20.3, and 20.4, imaging courtesy of Dr. Franklin Goldwire, TAMC GI Department) [6, 7].

Using a cystic ductotomy, the transcystic approach is accomplished passing the guidewire down into the common bile duct using fluoroscopic guidance. Next a balloon or bougie-type dilator is placed over the guidewire to dilate the cystic duct to about 4 mm. The dilator is removed, and the choledochoscope is introduced over a wire or freely by pushing it into the duct after dilation [6]. Through the working port of the choledochoscope, the stones can then be removed with a wire basket or a Fogarty balloon catheter. There is a risk of dragging stones into the common hepatic duct or pushing stones through the sphincter of Oddi and causing trauma (injury, pancreatitis, bleeding, etc.) [6]. A wire basket can also be used to ensnare the stone once it is found. Once the stone is captured in the basket, both the basket with the stone

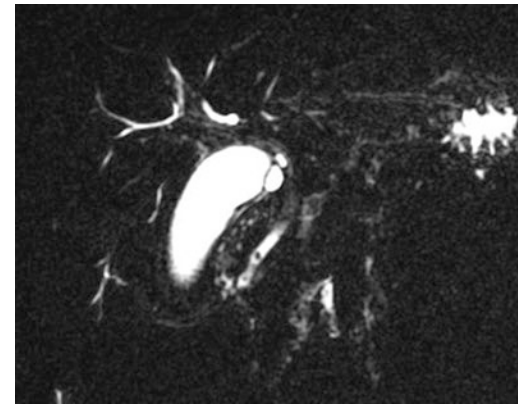

Fig. 20.2 This MRCP shows a patient with choledocholithiasis with at least two stones in the distal common bile duct with minimal inflammation. The common bile duct on this study measured 6 mm. She is likely a good candidate for either approach (large CBD size, mild inflammation, multiple small stones)

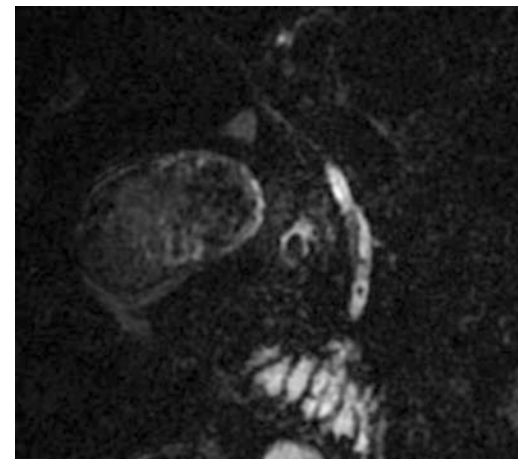

Fig. 20.3 This MRCP shows a patient with choledocholithiasis with multiple distal common bile duct stones. He was found to have a non-dilated common bile duct with the largest diameter being 4 mm. He would be a better candidate for a transcystic approach due to the small CBD size

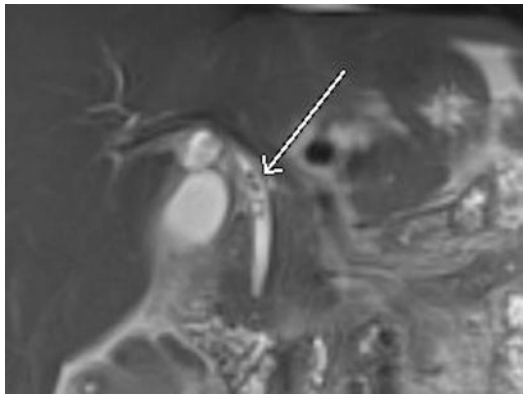

Fig. 20.4 This MRCP shows a patient with choledocholithiasis with multiple small stones in the proximal common bile duct. Her common bile duct measured 7 mm. She is likely a better candidate for a transcholedochal approach because of the size of her CBD and the possibility of more proximal stones. (Imaging courtesy of Dr. Franklin Goldwire, TAMC GI Department)

and the choledochoscope are removed together [2]. This approach is not appropriate for stones in the common hepatic duct above the cystic duct insertion point [2]. This approach may require an additional port placed halfway between the subxiphoid and right subcostal ports; this port needs to be valveless in order to pass the choledochoscope [6]. Sometimes a stay suture placed into the cystic duct distal to the ductotomy, if there is room, can help to manipulate the duct allowing easier passage of the guidewire, choledochoscope, and other instruments. A liver retractor can also be place to hold the liver as well as the biliary tree in place, freeing up an instrument arm for the surgeon or assistant. Finally this can also be attempted under fluoroscopic guidance only and not through the choledochoscope. However this will likely cause more exposure to radiation and contrast.

For a transcholedochal approach, an incision is made on the CBD. This is best when the transcystic approach is contraindicated as noted in Table 20.1 and the anatomy is easily identifiable laparoscopically. A longitudinal incision is made in order to prevent damage to the blood supply to the CBD which are located at the 3 and 9 o'clock positions along the duct [6]. The length of the incision should be at least as large as the largest stone within the duct. Stones will usually fall out of the duct at this time, but flushing may help extract additional stones [6]. The choledochoscope is then fed distally to look for additional stones which can be removed using the techniques discussed in the transcystic approach. The choledochoscope can also be used to examine the hepatic ducts if stones are noted there. Complete clearance of the CBD with flow going into the duodenum should again be confirmed by cholangiogram or by the choledochoscope being seen in the duodenum. The choledochal incision is then closed with 4-0 or 5-0 absorbable sutures. Placement of a T-tube, biliary drains, or a biliary stent is controversial, but a meta-analysis has shown a lower complication rate if T-tubes are not placed and no additional benefit with drain or stent placement [6, 16]. Primary duct closure has shown fewer overall complications compared to T-tube placement, especially with bile peritonitis, and thus, it is recommended to be the preferred option due to increased risk of infection [17, 18]. T-tube placement is recommended to decompress the CBD if there is a distal obstruction or if the CBD diameter is small, <8 mm, in order to decrease the risk of bile duct stricture [4, 16]. Drain placement is not necessary unless there is concern for increased pressure (stricturing, edema of the papilla, inflammation, retained stones, etc.) and a closed suction drain is really only necessary if one is worried about a bile leak [6, 16, 19–21].

Impacted stones can present a unique challenge. If they are not able to be extracted with the above techniques, fragmentation can be attempted by laser or electrohydraulic lithotripsy if that is available [6]. Cholangioscopy-guided laser lithotripsy has increased the rate of stone extraction in those with stones larger than 1 cm [22]. Another option is postoperative ERCP. Hepatic duct stones are another challenging entity, and they cannot be managed with a transcystic approach due to the difficulty making the upward turn from the cystic duct to the hepatic ducts. A transcholedochal approach is favored; however, if the CBD is too small, ERCP is a safer option [6]. Finally, if the ducts cannot be cleared at the time of surgery, an antegrade ampullary stent can be placed

to allow for decompression and to facilitate a postoperative ERCP. While converting to an open bile duct exploration in this scenario is an option, it is discouraged if the cholecystectomy can be done laparoscopically and a postoperative ERCP is available as the latter has less morbidity than an open exploration [6].

Open Common Bile Duct Exploration

This is a good option for patients already undergoing an open cholecystectomy and those with impacted stones at the ampulla, which pose a difficult problem for endoscopy and laparoscopic routes. Either a right upper quadrant subcostal incision or a midline incision can be utilized. The liver is retracted superiorly and the duodenum inferiorly, and a Kocher maneuver is performed to better visualize the distal CBD. A longitudinal incision is made on the duct for the same reasons as for the laparoscopic approach. Most stones will fall out on their own or with some manual manipulation. Saline irrigation and a Fogarty catheter can be used if stones still remain. As with the laparoscopic approach, if these maneuvers fail, choledochoscopy and basket retrieval can be used. The choledochotomy can be closed primarily or over a T-tube for the same reasons as the laparoscopic approach.

If the CBD exploration fails to remove the impacted stones, one can perform lithotripsy or a duodenotomy with sphincterotomy of the ampulla of Vater. Again, the main point of all of these explorations is to decompress the biliary tree and control the cholangitis, if present. This can also be done with T-tube placement into the CBD. Additionally this can be considered a stabilizing maneuver, and one who is not experienced with an anastomosis involving the CBD can stop here. If the biliary tree is dilated, drainage can be accomplished through a choledochoenterostomy with either a choledochoduodenostomy or a Roux-en-Y choledochojejunostomy [2]. This, however, should be done by someone with good experience performing hepatobiliary surgery.

Postoperative Management

LFTs should not be checked postoperatively unless the patient is having symptoms because the levels can remain elevated over a week after the procedure [23]. A cholangiogram is done at 24–48 hours postoperatively if a T-tube was placed during the procedure. If the cholangiogram is clear, the drain is clamped but typically remains in place for 10–14 days. Note that silastic T-tubes tend to cause less of a reaction than do latex ones; as such they may not be amenable to removing within 14 days. If the cholangiogram is abnormal (stones are present), leave the drain open for 1–2 weeks, and repeat the cholangiogram. If that cholangiogram is normal, the T-tube can be removed; however, if it is still abnormal, interventional radiology can be consulted to perform a percutaneous transhepatic cholangiogram, or an ERCP can be done [6].

Complications

For LCBDE, retained stones occur in about 0–5% [20]. This is lower when biliary endoscopy is used as compared to using the basket blindly. Bile leaks occur in about 2.3–16.7% of patients [6]. Bile duct strictures occur in about 0–0.8% of patients, pancreatitis occurs in about 0–3% of patients, and there is a risk of postoperative infections as well [6, 9, 24]. T-tube drainage complications include fluid and electrolyte disturbances, inconvenience of carrying the drainage bag, local pain, bile leakage once removed, biliary peritonitis, premature dislodgement, and wound infection [4].

Conclusion

Laparoscopic common bile duct explorations are not routinely performed by many general surgeons, but competency in this skill can be helpful when ERCP and PTHC are not readily available or when these modalities fail. Preparation is key to success. There are two generally accepted

ways to approach a CBD exploration: either the transcystic or transcholedochal approach. Stone size, stone location, and duct morphology will dictate which approach to take. Completion cholangiography should always be done.

Resources

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