OVERVIEW

Choledocholithiasis is identified in 10% to 18% of patients undergoing cholecystectomy, either preoperatively, intraoperatively, or postoperatively (Dasari et al, 2013) (see Chapters 32 and 37). The majority of cases of choledocholithiasis are secondary, the result of stones that originally formed in the gallbladder. Primary choledocholithiasis, 10% to 15% of cases (with a higher incidence in Asian countries), results from the formation of stones within the common bile duct (CBD) (Ko & Lee, 2002). Choledocholithiasis can lead to a variety of clinical manifestations, including biliary colic, obstructive jaundice, ascending cholangitis (see Chapter 43), and pancreatitis (see Chapters 54 and 55). These clinical scenarios can vary significantly in presentation and morbidity, ranging from minimal to critical illness and death. If left untreated, chronic choledocholithiasis can also cause inflammatory strictures, recurrent infections, or cirrhosis.

The management of choledocholithiasis has changed radically over the last several decades. Historically, stones in the CBD were removed at the time of open surgical exploration. Even after the introduction of endoscopic retrograde cholangiopancreatography (ERCP) in the 1970s, laparotomy remained the mainstay for CBD exploration (Kroger et al, 1975). At that time, the tools and techniques used for surgical clearance of the CBD were superior to those available via ERCP, and as long as a laparotomy was used to perform the cholecystectomy, minimally invasive treatment of choledocholithiasis was unnecessary. It was not until the introduction of the laparoscopic cholecystectomy in the late 1980s that the role for an associated less invasive method of treating choledocholithiasis became a priority.

During the initial adoption of laparoscopic cholecystectomy, most general surgeons did not have the skill set, experience, or equipment to facilitate a laparoscopic CBD exploration. As the skills, experience, and tools have developed, the advantages and disadvantages of laparoscopic CBD exploration versus ERCP have been a frequent source of debate. The objective of this chapter is to discuss minimally invasive surgical techniques for managing choledocholithiasis, including indications and technical aspects of laparoscopic trans cystic, transcholedochal, and transduodenal CBD exploration, as well as laparoscopic biliary-enteric bypass procedures and laparoscopic-assisted ERCP.

INDICATIONS

The standard of care for the management of most CBD stones is minimally invasive: using either laparoscopic, endoscopic, or percutaneous techniques. The minimally invasive techniques used and the sequence in which they are used depend on the specific clinical scenario. In addition, the capability and experience of the available personnel will affect the treatment algorithm. The most common clinical scenarios encountered by surgeons include known or suspected stones prior to cholecystectomy, the diagnosis of stones intraoperatively, and stones identified subsequent to cholecystectomy.

CLINICAL SCENARIOS

Preoperative Choledocholithiasis

Ascending cholangitis (see Chapter 43), gallstone pancreatitis (see Chapters 54 and 55), symptomatic cholelithiasis with evidence of choledocholithiasis on imaging or serum liver function tests, are all potential indicators that CBD stones are present. For CBD stones suspected at the time of initial clinical presentation, the decision making is often based on surgeon preference and institutional capabilities. When CBD stones are highly likely or established with noninvasive imaging, the two primary therapeutic strategies are ERCP followed by laparoscopic cholecystectomy or laparoscopic cholecystectomy with intraoperative cholangiogram. In the latter case, laparoscopic CBD exploration or postoperative ERCP are performed if CBD stones are identified on the cholangiogram.

In general, ERCP, which is available in essentially all urban settings and in a growing number of smaller communities, is more widely available than surgeons skilled at laparoscopic CBD exploration (see Chapters 20 and 29). ERCP is also highly effective, with successful clearance of the CBD in more than 95% of cases (Kum & Goh, 1996). In most centers, CBD stones up to 1.5 cm can be extracted, and centers that use lithotripsy can extract stones as large as 3 cm in diameter (Lenze et al, 2014). Therefore, in settings where laparoscopic CBD exploration is not available, the debate centers on preoperative versus postoperative ERCP. The central argument against an ERCP-first strategy is that 80% of known or suspected CBD stones will have passed prior to the intervention, making the risks and cost of the intervention unnecessary (Urbach et al, 2001). The risks of ERCP include acute pancreatitis (3% to 7%), bleeding (0.3% to 1.4%), ascending infection (1.4%), and perforation (0.6%). The mortality associated with ERCP is 0.2% to 0.9% (Orenstein et al, 2014). Proponents of performing preoperative ERCP argue that, if ERCP is unsuccessful, a CBD exploration can be performed at the time of cholecystectomy without requiring a third procedure.

In most patients, our preferred strategy is laparoscopic cholecystectomy with selective intraoperative cholangiogram (see Chapter 23). Laparoscopic CBD exploration or ERCP is performed when CBD stones are identified. However, in patients...
with cholangitis, ongoing pancreatitis, or persistent hyperbili-
rubinemia (>4 U/dL), we recommend preoperative ERCP
(Chan et al, 2009). This allows for both clearance of the bile
duct and assessment of additional or alternative pathologies,
such as impacted stones, strictures, or malignancy. In the case
of ascending cholangitis, broad-spectrum antibiotics and urgent
biliary decompression with ERCP is typically the best option,
as it is the least invasive and both diagnostic and therapeutic
(Hui et al, 2001). If ERCP is unavailable or not possible (e.g.,
history of Roux-en-Y gastric bypass), percutaneous transhe-
patic biliary decompression should be considered (see Chapter
30). Surgical options, laparoscopic or open, are indicated when
less invasive methods are not immediately available and the
patient’s condition warrants immediate biliary decompression
(see Chapter 36A). In both cholangitis and pancreatitis, once
the patient has sufficiently recovered, cholecystectomy should
be completed during the same hospitalization as early recur-
rence of symptoms is common, and can lead to significant
morbidity (Chang et al, 2000; Li et al, 2010).

Endoscopic ultrasound (see Chapter 16) and magnetic re-
sonance cholangiopancreatography (MRCP) (see Chapter 19)
are additional diagnostic tools that may be helpful in these situa-
tions. Endoscopic ultrasound is highly sensitive for CBD
stones, without the risk of pancreatitis, allowing ERCP to be
used selectively (Artifon et al, 2009). MRCP is a relatively
accurate and noninvasive test that can identify the presence or
absence of choledocholithiasis, as well as provide anatomic
delineation prior to surgery. Some centers advocate MRCP to
avoid the risk of unnecessary ERCP; however, this may be
associated with an increase in cost.

Intraoperative Choledocholithiasis (See Chapters 31
and 36A)

When choledocholithiasis is diagnosed on intraoperative chol-
angiogram, and the surgeon’s experience and diameter of the
cystic duct are favorable, our preference is to proceed with
transcystic CBD exploration. If clearance cannot be achieved
via the transcystic route, the options are to proceed with tran-
scholedochal CBD exploration versus a postoperative ERCP.
Intraoperative ERCP, although uncommonly used, is also avail-
able at some institutions (Moreels, 2014; Schreiner et al, 2012).
Our preference is to proceed with postoperative ERCP if the
stones are less than 2 cm and do not appear to be impacted.
ERCP avoids complications associated with a transcholedochal
exploration, including biliary stricture and bile leak (Verbess
& Birkett, 2008). When the probability of endoscopic clearance
is questionable or low, we proceed with a transcholedochal
exploration.

A number of retrospective studies have shown that laparo-
scopic cholecystectomy with CBD exploration as a single oper-
ative procedure is more cost-effective and results in shorter
hospital length of stay than laparoscopic cholecystectomy and
ERCP (Cuschieri et al, 1999; Nathanson et al, 2005; Rogers
et al, 2010). A recent prospective randomized controlled trial
found that both options were highly effective and equivalent in
overall cost, although the hospital length of stay was lower for
laparoscopic CBD exploration (Rogers et al, 2010).

Postoperative Choledocholithiasis

Choledocholithiasis identified after a cholecystectomy or when
there is not a plan to perform a cholecystectomy is typically
managed with ERCP; however, occasionally endoscopy is
unsuccessful or cannot be performed due to altered anatomy.
ERCP fails to cannulate the CBD in 1% to 2% of cases. In this
situation, laparoscopic CBD exploration is necessary. Similarly,
if stone extraction fails due to the size of the stones, laparo-
scopic exploration is a reasonable next step. In the case of
impacted or large stones that cannot be removed endoscopically
or surgically, biliary-enteric bypass should be considered (see
Chapter 36A).

Laparoscopic CBD exploration or laparoscopic-assisted
ERCP may be the only options in patients with a history of
gastrointestinal surgery. With the introduction and rapid expan-
sion of Roux-en-Y gastric bypass procedures, it is becoming
increasingly common to have patients present in whom an
ERCP is either challenging or not possible.

TECHNIQUES

Laparoscopic Transcystic Common Bile
Duct Exploration

The primary method for performing laparoscopic CBD explo-
ration is through the cystic duct. Transcystic exploration is
typically performed using a standard laparoscopic cholecystec-
tomy trocar configuration. An additional trocar may be placed
in the midclavicular line to facilitate access to the cystic duct
(Fig. 36B.1A). The gallbladder is left in situ to provide liver
retraction and countertraction on the cystic duct, allowing

![FIGURE 36B.1. A, Trochar placement for transcystic and transchole-
dochal common bile duct (CBD) exploration. B, Trochar placement for
transduodenal CBD exploration and biliary-enteric bypass.](image-url)
easier passage of wires, catheters, and the cholangioscope. The first and easiest step in facilitating passage of stones through the ampulla is pharmacologic relaxation of the sphincter of Oddi by using glucagon (Petelin, 1993). After giving 1 mg of intravenous glucagon and waiting 3 minutes, the duct is vigorously irrigated with saline or contrast in an attempt to flush the stones through the ampulla (Ponce et al, 1989). This technique is most successful for sludge and stones less than 4 mm (Kroh & Chand, 2008).

If flushing is unsuccessful, two additional techniques are used: dilation of the ampulla and cholangioscopy. Ampullary dilation is performed by passing a wire through the cystic duct and into the duodenum under fluoroscopic guidance. A 4- to 6-mm diameter, 4-cm long ureteral balloon is advanced over the wire and positioned across the ampulla. After fluoroscopic confirmation of the balloon’s position, it is inflated, dilating the ampulla (Fig. 36B.2A). Following dilation, the balloon is removed, and the duct is again vigorously irrigated. Finally, a cholangiogram is performed to assess for residual stones.

If ampullary dilation is unsuccessful, cholangioscopy is the next step. Some surgeons prefer to proceed straight to cholangioscopy without attempting ampullary dilation because it allows direct visualization of the bile duct and stones. A cholangioscope or ureteroscope is passed transcystically into the common duct (Fig. 36B.2B). If the cystic duct is too small, the same balloon used for ampullary dilation can be used to gently dilate the cystic duct until it is large enough to allow the cholangioscope to pass. Once the stones are identified, they can be gently pushed through the ampulla with the tip of the cholangioscope, or they can be snared. To snare the stones, we recommend a helical stone retrieval basket, which is passed through the working channel of the cholangioscope. Under direct visualization, the basket is passed beyond the stone. Once the basket is distal to the stone, it is opened and withdrawn until the stone is captured; the snare is then closed, and the stone is removed through the cystic duct. Care is taken to avoid causing injury with the snare, as it is a stiff instrument, and ductal perforation or penetration into the pancreas is possible. Some authors recommend blind or fluoroscopically guided wire basket stone capture and extraction; in our experience, this has proven less successful and has a higher risk of injury. There are two options to manage large stones that cannot be extracted through the cystic duct. Large stones that are soft, can often be crushed by tightening the snare around them, and the debris can then be snared individually or pushed through the ampulla into the duodenum. For large stones that are too hard to crush, a laser or mechanical lithotripsy catheter can be passed through the cholangioscope to fracture the stone under direct visualization. Finally, in bile ducts with significant inflammation or strictures, a biopsy should be considered. Malignancy may be an inciting event in the development of ductal debris or ductal obstruction. Complications of transcystic CBD exploration, as observed by Paganini and colleagues (2007), include bile leak (1%), acute pancreatitis (0.5%), and rupture of the cystic duct (6.8%).

The success rate of a laparoscopic transcystic approach to choledocholithiasis by experienced surgical teams is 80% to 90% (Kroh & Chand, 2008). There are a number of reasons a transcystic CBD exploration can fail. In some cases, the cystic duct is too small, tortuous, or even obliterated, and passage of a catheter into the CBD is difficult or impossible. Occasionally, the cystic duct inserts into the very distal common duct or at an acute angle, making access to the proximal common duct challenging. Large stones, impacted stones, and significant inflammation can all increase the difficulty of transcystic bile duct clearance. In such cases, the surgeon must decide whether to proceed with transcholedochal exploration or defer to postoperative ERCP. If the CBD is less than 1 cm in diameter, and in the absence of large impacted stones, our preference is to proceed with postoperative ERCP due to the high rate of success and less potential morbidity.

**Laparoscopic Transcholedochal Common Bile Duct Exploration**

Laparoscopic choledochotomy is indicated when the transcystic approach fails or in the presence of multiple, large, or impacted stones. Choledochotomy should be avoided if the CBD is less than 1 cm in diameter (Verbesey & Birkett, 2008). The CBD is accessed by exposing the second portion of the
duodenum and mobilizing the duodenum down to the level of the pancreas. Excessive mobilization of the CBD should be avoided to preserve blood supply to the proximal duct. Stay sutures may be placed on either side of the choledochotomy (preserving the 3 and 9 o’clock blood supply) to allow for traction on the CBD. A longitudinal choledochotomy is then made on the distal CBD; the choledochotomy should be long enough for removal of the largest stone and passage of the choledochoscope. Typically, a 1-cm incision is sufficient to meet both of these goals.

A choledochoscope is passed directly into the bile duct, and a thorough exploration of the proximal and distal duct is performed (Fig. 36B.3). Stones may be flushed out of the ductotomy, removed directly with atraumatic graspers, or extracted using a snare passed through the cholangioscope as described in the transcystic approach. There is a mechanical advantage to removing impacted stones directly through a choledochotomy, although stones impacted in the head of the pancreas may require a transduodenal approach.

After clearance of the duct and completion of the exploration, the ductotomy is closed primarily or occasionally over a T-tube. Historically, T-tubes have been used to decompress the biliary tree and were thought to minimize bile leaks. They also allow postoperative percutaneous access to the CBD. T-tubes, however, have potential morbidity, including inadvertent displacement, erosion, cholangitis, nutritional deficiencies from bile loss (Gurusamy et al, 2013). In addition, T-tubes can cause pain and be problematic to manage.

If clearance of the duct has been achieved with confidence and there are no concerns for distal obstruction, our preference is to primarily close the choledochotomy without a T-tube. Several randomized trials have concluded that primary closure of the duct does not result in a higher rate of bile leaks (Zhang et al, 2009). These studies have uniformly shown a decreased length of hospital stay, shorter operative times, lower hospital expenses, and earlier return to normal activity in patients who did not have a T-tube (Mangla et al, 2012). In addition, due to the high success rates of duct clearance by choledochotomy, the need for T-tubes to provide percutaneous access for retained stones is not commonly necessary (Zhang et al, 2009).

Our preference is to close the ductotomy with simple interrupted sutures, spaced evenly to avoid duct ischemia. We generally use a 5-0 monofilament, slowly absorbable suture. If a T-tube is used, the ductotomy is closed around the base of the tube by using a few sutures adjacent to the side of the T-tube, and the tube is exteriorized through a lateral trocar site. A final cholangiogram through the T-tube is performed at the conclusion of the case. Tubes are left in place for 3 weeks to promote formation of an inflammatory tract around the tube. The T-tube can then be gently removed, and the tract will collapse and seal spontaneously. If stones are discovered postoperatively, percutaneous stone extraction via the T-tube is successful in 95% of cases (Burhenne, 1980). Surgical drains are not placed routinely unless there is an increased risk of bile leak or when a T-tube is used. Once the patient is tolerating a diet and there is no evidence of obstruction, we clamp the T tube. The surgical drain is removed if there is no evidence of a bile leak after the T-tube has been clamped.

The overall success rate of laparoscopic choledochotomy is 83% to 96%, with a morbidity rate of 5% to 10%, and mortality rate of 1% (Verbessy & Birkett, 2008). As mentioned previously, this procedure is not without complications. Bile leak (reported as high as 14%) and postoperative CBD strictures are the most feared complications (Nathanson et al, 2005). Choledochotomy has similar rates of pancreatitis (7.3% vs. 8.8%), retained stones (2.4% vs. 4.4%), reoperation (7.3% vs. 6.6%), and overall morbidity (17% vs. 13%) as ERCP (Nathanson et al, 2005). Major advantages of the transcholedochal approach include easier access to both the upper and lower ductal systems, and extraction of any size stones. Conversion to an open procedure must be considered in difficult cases, although challenging laparoscopic cases are frequently also challenging open cases; referral to a specialty center should always be considered before converting to a laparotomy. In patients with a high risk of recurrent stone disease or formation of a biliary stricture, due to inflammation or a small duct, a definitive bypass should be considered.

**Laparoscopic Transduodenal Sphincterotomy and Common Bile Duct Exploration**

For impacted stones refractory to clearance by endoscopy or CBD exploration, laparoscopic transduodenal exploration with sphincterotomy is an alternative modality for duct clearance (see Chapter 36A). This procedure can typically be performed with a 4 or 5 trocar technique, and we have found it useful to place the trocars lower than the typical approach to cholecystectomy. An additional camera trocar in the right lower quadrant will also provide a better angle for visualization of the ampullary reconstruction (see Fig. 36B.1B).

To gain access to the duodenum, the right colon is mobilized, and a Kocher maneuver is completed. With the duodenum elevated, a surgical sponge posterior to the head of the pancreas may be useful. This will elevate the duodenum and absorb enteric fluids leaking into the field once the duodenotomy is created. A longitudinal incision is made in the antimesenteric wall of the second portion of the duodenum with electrocautery or ultrasonic shears, to expose the major duodenal papilla. If the papilla is not easily located, and the cystic and CBDs are patent, a cholangiogram catheter or wire can be inserted via the cystic duct and passed through the ampulla to aid in identification. Once the papilla is identified, the CBD is intubated with a wire or silicone tube.
Inflammator y, Infective, and Congenital

To perform a laparoscopic choledochoduodenostomy we use a trocar placement similar to that described for the transduodenal sphincterotomy (see Fig. 36B.1B). A Kocher maneuver is performed to mobilize the duodenum enough to perform a tension-free anastomosis to the CBD. The degree of Kocherization ultimately depends on individual anatomy and mobility of the duodenum. Next, approximately 2 cm of the anterior surface of the distal CBD is exposed. The dissection plane should remain anterior to the duct to avoid injury of the blood supply to the proximal duct. A thorough laparoscopic ultrasound examination should be performed to identify the CBD and verify the location of any stones. A 1.5-cm supraduodenal, longitudinal choledochotomy is made in the anterior wall of the duct by using electrocauter y or ultrasonic shears. A choledochoscope is then inserted through the choledochotomy, and a thorough examination is performed. Biopsies should be taken if there are any concerns for a neoplastic process. A 1-cm longitudinal duodenotomy is made in the adjacent postbulbar duodenum. The duodenotomy is created shorter than the ductotomy due to the inevitable stretching of the duodenotomy (Fig. 36B.5A).

Electrocautery or ultrasonic shears are then used to create a sphincterotomy at the 11 o’clock position on the papilla (Makary & Elariny, 2006). This facilitates a transduodenal CBD exploration by using cholangiocatheters, balloons, or a choledochoscope. Once clearance of the CBD is achieved, the mucosa of the bile duct is sutured to the duodenal mucosa with interrupted 5-0 monofilament slowly absorbable sutures (Fig. 36B.4) (Makary & Elariny, 2006). The duodenotomy is then closed to complete the case. The risk of complications from transduodenal sphincterotomy is reported to be similar to ERCP (Carboni et al, 2001). We use surgical drains selectively, and if used, they are removed within a few days of the operation if there is no evidence of bile leak.

Laparoscopic Biliary-Enteric Bypass

In patients at moderate to high risk for recurrent CBD stones, or in patients with distal strictures, biliary-enteric bypass may provide the most durable result. The two primary options for bypass are choledochoduodenostomy or Roux-en-Y hepaticojejunostomy. Currently, there are inadequate comparative data to recommend one technique of biliary-enteric anastomosis over another (see Chapters 31 and 36A). There are a number of retrospective studies comparing the two anastomoses that show equivalent outcomes and morbidity (Luu et al, 2013; Narayanan et al, 2013; Santore et al, 2011). Choledochoduodenostomy has been criticized in the past due to concern of reflux of enteric contents into the CBD leading to chronic inflammation and recurring bouts of cholangitis, referred to as the sump syndrome (Khajanchee et al, 2012; Tang et al, 2003). Results of analysis by several authors suggest that symptoms associated with sump syndrome may actually be a mechanical problem associated with a narrow anastomosis (de Almeida et al, 1996; Degenheim, 1974; Madden et al, 1970).

Our current preference is laparoscopic choledochoduodenostomy as it is technically easier, leads to a more physiologic reconstruction, and importantly, allows direct access to the biliary system should further evaluation or manipulation of the duct be necessary (Moraca et al, 2002; O’Rourke et al, 2004). However, choledochoduodenostomy may not be possible in the setting of significant duodenal inflammation or inadequate duodenal mobility after kocherization. In these cases, we proceed with laparoscopic Roux-en-Y hepaticojejunostomy.

To perform a laparoscopic choledochoduodenostomy we use a trocar placement similar to that described for the transduodenal sphincterotomy (see Fig. 36B.1B). A Kocher maneuver is performed to mobilize the duodenum enough to perform a tension-free anastomosis to the CBD. The degree of Kocherization ultimately depends on individual anatomy and mobility of the duodenum. Next, approximately 2 cm of the anterior surface of the distal CBD is exposed. The dissection plane should remain anterior to the duct to avoid injury of the blood supply to the proximal duct. A thorough laparoscopic ultrasound examination should be performed to identify the CBD and verify the location of any stones. A 1.5-cm supraduodenal, longitudinal choledochotomy is made in the anterior wall of the duct by using electrocautery or ultrasonic shears. A choledochoscope is then inserted through the choledochotomy, and a thorough examination is performed. Biopsies should be taken if there are any concerns for a neoplastic process. A 1-cm longitudinal duodenotomy is made in the adjacent postbulbar duodenum. The duodenotomy is created shorter than the ductotomy due to the inevitable stretching of the duodenotomy (Fig. 36B.5A).
We perform a single-layer, interrupted choledochoduodenostomy with 4-0 absorbable sutures. The posterior sutures are tied internally, whereas the anterior layer is tied externally. There are several techniques that facilitate creation of the anastomosis. Tying the sutures as they are placed can limit access during placement of the subsequent sutures, however leaving too many sutures untied can lead to tangling of the sutures. To avoid these problems, we typically place 2 to 3 sutures at a time, tying the deeper sutures after the shallower sutures are placed. Alternating dyed and undyed sutures, as well as clipping the suture tails also helps in identification of the sutures and prevents tangling (Fig. 36B.5B). Final inspection of the anastomosis should confirm that there is no leakage of bile from the anastomosis, and no tension on the duodenum or duct. Similar to laparoscopic sphincterotomy, drains are used selectively and removed early. We also use upper gastrointestinal contrast studies selectively before starting a diet in patients who are at high risk of an anastomotic leak.

Trocar placement for laparoscopic Roux-en-Y hepaticojejunostomy is similar to that used for sphincterotomy and choledochoduodenostomy, although a slightly lower placement may facilitate access to and division of the jejunum. Access to the common hepatic duct may require mobilization of the right colon and kocherization of the duodenum. Laparoscopic ultrasound examination is again used to facilitate identification of the portal structures. We typically prefer an end-to-side hepaticojejunostomy (Fig. 36B.6A), although this requires circumferential dissection and division of the duct distally. In cases where circumferential dissection is not possible or contraindicated (e.g., dense fibrotic scarring in the porta hepatitis), a side-to-side hepaticojejunostomy should be considered (Fig. 36B.6B).

To create the Roux limb, the jejunum is divided by using an endostapler, approximately 20 cm distal to the ligament of Trietz. The mesentry is then divided to allow the Roux limb to reach the bile duct without tension. The limb is preferentially passed antecolic; however, if this results in too much tension, it can be passed retrocolic through the transverse mesocolon just to the right of the middle colic vessels. The jejunojejunostomy is created in the infracolic position 30 to 40 cm distal to the future bilioenteric anastomosis.

The hepaticojejunostomy is created in a single layer by using 4-0 or 5-0 absorbable sutures. Depending on the size of the duct, this anastomosis may be created by using interrupted sutures (for ducts <1 cm), in a fashion similar to that described for the choledochoduodenostomy, or running sutures (for ducts >1 cm). Surgical drains are used selectively.

**Laparoscopic-Assisted Endoscopic Retrograde Cholangiopancreatography**

In patients who have undergone a previous Roux-en-Y gastric bypass procedure, access to the ampulla of Vater by using double- and single-balloon endoscopes can result in successful performance of ERCP in nearly 80% of patients (Moreels, 2013). However, the majority of centers do not currently have access to these technologies (Lopes et al, 2009). In these cases, laparoscopic access to the distal gastric remnant is necessary to perform an intraoperative ERCP and/or EUS. One study has shown this procedure to be more cost effective than double-balloon enteroscopy (Schreiner et al, 2012).

At laparoscopy, the gastric remnant is identified, and the front wall of the stomach is exposed. We place two sutures through the abdominal wall and through the stomach adjacent to the future gastrostomy site with a Keith needle or transfascial suture passing device. These sutures are used to retract and stabilize the stomach. A gastrostomy is then made in the location that will allow easy passage of the endoscope through the pylorus. A 15-mm radially dilating trocar with a balloon tip or a single-port device is inserted through the abdominal wall and directly into the gastrostomy. The endoscope can then be placed through the trocar or single-port device into the stomach to perform the ERCP. After the conclusion of the ERCP, the gastrostomy is closed with 3-0 absorbable suture. Surgical drains are rarely indicated after this procedure.

**CONCLUSION**

The first laparoscopic biliary surgery was performed almost 30 years ago. During the past three decades, substantial progress has been made in surgical expertise, experience, and technology. Our understanding of how and when to apply these minimally invasive tools has greatly reduced the suffering of patients with cholecodolithiasis. We now have the ability to...
diagnose biliary stone disease, differentiate it from neoplastic processes, and treat it with high levels of success and decreasing morbidity.

We have reviewed a wide range of approaches to the management of patients with CBD stones. In managing this group of patients, surgeons must assess their own surgical expertise and the capabilities of their team; they also must understand the tools and talent available within their institutions. Finally, this knowledge must be applied to the particular clinical scenario of each individual patient.

References are available at expertconsult.com.
REFERENCES


