HISTORICAL OVERVIEW

In the 1970s and 1980s, endoscopic retrograde cholangiopancreatography (ERCP) transformed the diagnostic approach to suspected biliary disease and jaundice (see Chapters 20 and 29). Similarly, in the years since it was first performed in humans (Classen & Demling, 1974; Kawai et al, 1974), endoscopic sphincterotomy (ES) has had a dramatic impact on the management of biliary disease, specifically in the treatment of common bile duct (CBD) stones. Approximately 150,000 endoscopic biliary sphincterotomies are performed annually in the United States, and the widespread availability of this procedure has made endoscopic stone extraction the primary modality for the management of choledocholithiasis. Interest in ERCP and endoscopic sphincterotomy as definitive therapy for CBD stones grew in the 1990s after the introduction of laparoscopic cholecystectomy. Patient-related factors, clinical judgment, availability of expertise, and current evidence from clinical trials must be combined to decide on an endoscopic, percutaneous, or surgical approach. Although ERCP as a diagnostic modality has been replaced by noninvasive imaging modalities such as magnetic resonance cholangiopancreatography (MRCP) (see Chapter 19), it remains the major nonoperative tool for the management of biliary diseases such as choledocholithiasis and obstructive jaundice.

INDICATIONS FOR ENDOSCOPIC THERAPY

Patients with choledocholithiasis may present with asymptomatic stones on noninvasive imaging or direct cholangiography or with a variety of clinical symptoms, such as cholestasis, pain, cholangitis, and pancreatitis (see Chapter 32). In the early days of ES—at a time when few endoscopy centers could offer the technique and criticisms by surgical experts were common—it was considered justifiable only in elderly postcholecystectomy patients with recurrent or retained bile duct stones who were at high risk of serious complications from open surgical CBD exploration or reexploration (Blumgart & Wood, 1978). The impressive successes of ES in this group, combined with expanded availability, a low rate of complications, and strong patient preference, has led to ERCP becoming the primary modality for the management of CBD stones. The endoscopist now must consider several clearly defined conditions for which endoscopic management may be indicated in patients with definite or suspected bile duct stones (Early et al 2012; Maple et al, 2011):

1. Acute cholangitis
2. Visualized CBD stone on abdominal ultrasound, endoscopic ultrasound (EUS), computed tomography (CT), MRCP, or intraoperative cholangiogram
3. High suspicion of CBD stones: cholelithiasis, dilated CBD, and abnormal liver biochemical tests
4. Worsening gallstone pancreatitis
5. Recurrent CBD stones or gallstone pancreatitis, nonsurgical candidate for cholecystectomy

ENDOSCOPIC TECHNIQUES

An endoscopy service to treat CBD stones must have access to an appropriate endoscopy facility and high-quality fluoroscopy. The endoscopy team must be fully cognizant of all basic ERCP maneuvers, less frequently used techniques, and potential complications and their management. It is essential to explain the nature of the procedure to the patient and to outline the purpose, benefits, advantages, alternatives, and potential hazards.

Upon successful deep biliary cannulation with the sphincterotome, a cholangiogram is initially performed, which defines the ductal anatomy and the extent of the stone burden. ES is usually the first therapeutic step in stone extraction. Balloon dilation of the biliary sphincter is an alternative to ES, but this has fallen out of favor due to increased risks of severe post-ERCP pancreatitis (Baron & Harewood, 2004; Bergman et al, 1997; Disario et al, 2004). Standard pull-type sphincterotomes allow a vertical incision to be made from the papillary orifice in a cephalad direction along the intramural course of the CBD for a variable length (average, 10 to 15 mm), depending on local anatomy, the degree of CBD dilation, and the size of stone to be removed (Fig. 36C.1). The incision is produced by the controlled application of monopolar electrocautery delivered by a generator specifically designed for endoscopic use. It is fundamental to ES technique that complete control of wire tension and electrocautery be maintained at all times. “Smart” generators incorporate a pulsed generator (Erbe, Tubingen, Germany; ConMed Endoscopic Technologies, Billerica, MA) with feedback-controlled power output, thus avoiding a “zipper effect” and reducing pancreatitis and bleeding.

Occasionally, a precut sphincterotomy, also referred to as an access papillotomy, is needed to initiate ES when the standard instrument cannot be inserted deeply. This incision is often needed when cannulation has been prevented by an impacted stone. The needle-knife is more useful in this situation because the intramural CBD is usually grossly distended and easily incised, starting from the papilla and extending cephalad. Needle-knife fistulotomy is a variant of this technique; the incision is begun above the papilla to form a choledochoduodenal fistulotomy. This technique is similar in efficacy to precut sphincterotomy, but more often it requires mechanical lithotripsy (ML) and may have a lower rate of pancreatitis (Mavrogiannis et al, 1999). Patients with Billroth II partial gastrectomy
FIGURE 36C.1. Endoscopic retrograde cholangiopancreatography showing cholangiography with dilated bile duct, a single duct stone just below the endoscope, a guidewire, and a sphincterome in position during sphincterotomy (arrows).

(Fig. 36C.2) and Roux-en-Y bypass operations present special problems to the endoscopist, and numerous methods have been described to obtain successful cannulation (Lin et al., 1999; Wright et al., 2002) and removal of CBD stones (Bergman et al., 2001).

It is standard practice to attempt stone extraction from the CBD immediately after ES. The two accessory instruments used most commonly for this are the Dormia-type basket (Fig. 36C.3) and the Fogarty-type balloon (Figs. 36C.4 and 36C.5), which are greater than 90% successful in clearing the CBD. Occlusion cholangiography is performed after stone extraction to confirm complete ductal clearance.

**Difficult Stones**

The most difficult circumstances encountered during endoscopic stone removal result from technical difficulties with achieving deep biliary cannulation or in performing ES. These difficulties are sometimes because of an inaccessible papilla related to aberrant anatomy or unfavorable duodenal or papillary structures, such as a periampullary diverticulum, or prior surgery, such as Billroth II or Roux-en-Y reconstruction. Techniques have been described for the unique challenge of selective bile duct cannulation in a patient with a Billroth II partial gastrectomy (Lin et al., 1999). The performance of ES is also a challenge because the visualized anatomy is inverted. In especially difficult cases, needle-knife sphincterotomy with a stent, nasobiliary drain, or guidewire used as a guide for cutting may be an option, or specially designed reverse-direction accessories. The literature on techniques of cannulation and
sphincterotomy in Roux-en-Y reconstructions is limited (Wright et al, 2002), but some success has been reported with balloon enteroscopy or overtube-assisted ERCP (Kikuyama et al, 2009; Koornstra et al, 2008).

When ES has been successfully performed, extraction may be hindered by a variety of stone factors—including size, number, consistency, shape, and location of stones—and ductal factors such as contour and diameter at the level of and distal to the stones, and the presence of coexisting pathology (e.g., stricture or tumor). Stones that are likely to be more difficult to extract and may require adjuvant techniques to remove them are those that appear larger than the endoscope on radiographic imaging (usually >15 mm); stones that are numerous or hard in consistency; stones that are square, piston shaped, or faceted that tightly fit the bile duct or that are packed against each other; intrahepatic stones; or stones located proximal to a stricture or narrowed distal bile duct or in a sigmoid-shaped duct.

Methods that have been developed to dilate the papillary orifice, reduce stone size, and facilitate endoscopic removal include endoscopic papillary large balloon dilation (EPLBD), ML, intracorporeal lithotripsy with laser or electrolydraulic probes, extracorporeal shock-wave lithotripsy (ESWL), and chemical contact dissolution therapy. Treatment options must be discussed jointly by the endoscopist, surgeon, and interventional radiologist when difficulties are encountered (Fig. 36C.6).

Endoscopic Papillary Large Balloon Dilation

EPLBD in conjunction with ES has greatly improved the rates of ductal clearance of difficult stones without the need for advanced ERCP lithotripsy techniques. The first report of EPLBD (12 to 20 mm) with ES was described in 2003, when a retrospective review demonstrated that 38 out of 40 patients with large stones previously unable to be removed with standard techniques had successful ductal clearance with acceptable complication rates (Ersoz et al, 2003). A prospective study that randomized 90 patients to either ES with EPLBD or ES with ML had similar rates of ductal clearance (97.7 % vs. 91.1%, P = .36) but a significantly higher rate of complications in the ML group (20% vs. 4.4%), which included 6 patients with cholangitis and 1 with perforation (Stefanidis et al, 2011). The rates of pancreatitis and postsphincterotomy bleeding were the same in both groups (2%).
Further research has shown that endoscopic sphincterotomy with EPLBD can obviate the need for ML. A recent review of seven studies included 902 patients and compared ES with EPBLD versus ES with standard techniques (Madhoun et al, 2014). The authors found no differences in ductal clearance between the EPBLD and standard-techniques groups (98% vs. 95%, P = .6), but patients in the EPBLD group needed less ML. The use of EPBLD had a risk reduction of 0.58 (0.32 to 0.74) in terms of adverse events.

Although the studies mentioned in the previous sections demonstrate the safety of EPLBD, there has been concern for the rare but serious complications, such as bleeding, perforation, and pancreatitis related to stretching the ampullary orifice to such a large size. A recent review of 33 publications that included 2924 total procedures compared the complication rates of EPBLD with a large ES, with limited ES, and without ES (Kim et al, 2013). The rate of adverse events was less than 10% in each group and not significantly different between the three groups. The rates of severe complications such as pancreatitis (all <4%) and perforation (all <0.5%) were acceptable and also not significantly different among the three groups. The rate of bleeding, however, was highest in the large ES group, at 4.1%, which was significantly higher than the limited-ES and no-ES groups (1.3% vs. 1.9%, respectively).

A multicenter retrospective study that included 946 patients who underwent EPBLD for CBD stones greater than 10 mm in size sought to determine the predictive factors of adverse events in EPBLD (Park et al, 2013). Based on their findings, authors gave these recommendations for safe EPBLD: (1) Indication should be patients with a dilated CBD without distal CBD strictures. (2) Avoid full-ES immediately before LBD to prevent perforation and bleeding. (3) Inflate the balloon gradually to recognize an occult stricture. (4) Discontinue balloon inflation if resistance is met in the presence of a persistent balloon waist. (5) Do not inflate the balloon beyond the maximal size of the upstream dilated CBD. (6) Do not hesitate to convert into alternative stone removal methods, such as ML or electrohydraulic lithotripsy (EHL), if there is difficulty in removing stones.

If performed correctly (with an incomplete ES and then EPBLD to the size of the CBD), ES with EPBLD is a safe and effective method for removal of multiple or large stones in the CBD, which leads to shorter procedure times with decreased use of advanced lithotripsy techniques.

**Mechanical Lithotripsy**

Removal of large CBD stones is a challenge for the most skilled endoscopists. ML (see Chapter 27) (Leung & Tu, 2004; Leung et al, 2001) remains an excellent option for stones that cannot be removed by conventional techniques because it can be used safely and effectively during the initial endoscopic procedure. Mechanical lithotripters are modifications of standard Dormia baskets and possess great tensile strength (Fig. 36C.7). The reinforced basket is opened in the CBD, and the stone is entrapped within the braided wires. This procedure can be performed through the endoscope instrumentation channel, or it can be done after the endoscope has been removed from the patient and a metal sheath has been extended over the inner Teflon catheter. The end of the metal sheath is attached to a winding mechanism, which retracts the basket when cranked and impales the stone against the rigid distal end of the metal sheath leading to stone fracturing. The stone fragments can be removed with the same basket or a standard retrieval basket or balloon. In experienced centers, this technique allows removal of more than 90% of difficult bile stones that are refractory to standard extraction techniques, but multiple procedures may be required to achieve complete ductal clearance (Akcakaya et al, 2009; Chang et al, 2005; Shaw et al, 1993; Van Dam & Sivak, 1993).

**Other Lithotripsy Modalities**

For the 5% of patients with biliary stones resistant to ES and ML, other methods are available, including intracorporeal techniques (laser or electrohydraulic probes) and ESWL (Adamek et al, 1996). The choice between these methods or surgery depends largely on availability and local expertise.

**Electrohydraulic Lithotripsy**

Since its development during the 1950s in the former Soviet Union as a method to fragment rocks during mining, EHL has been adapted for medical use in the treatment of nephrolithiasis and, more recently, biliary tract calculi. The electrohydraulic probe consists of two coaxially isolated electrodes at the tip of a flexible catheter, which is capable of delivering electric sparks in short, rapid pulses leading to sudden expansion of the surrounding liquid environment and generating pressure waves that result in stone fragmentation (Picus, 1990). Direct cholangioscopy with either mother-daughter cholangioscopes (Hixson et al, 1992) or single-operator cholangioscopy (SOC) systems, such as the SpyGlass (Boston Scientific, Natick, MA) direct visualization system, are used to target the stones to facilitate stone contact with the electrode and to avoid ductal trauma or perforation (Aljebreen et al, 2014; DiSario et al,
Continuous saline irrigation is used with the bipolar electrode placed at the surface of the stone to provide a media for shock-wave energy transmission, to flush away debris, and to maintain adequate visualization (DiSario et al., 2007). Reports document complete stone clearance after multiple sessions in 86% of patients (Adamek et al., 1996; Arya et al., 2004; Hixson et al., 1992; Siegel et al., 1990), and in a prospective nonrandomized trial, EHL was comparable to ESWL in stone clearance (Adamek et al., 1996).

The largest study of EHL performed to date is a retrospective review of 94 patients with difficult biliary stones referred to a tertiary hospital (Arya et al., 2004). The authors used a mother-daughter cholangioscope and achieved fragmentation in 96% of the patients, with an eventual stone clearance rate of 90%. Seventy-six percent of these patients required only one EHL session, and most patients did not need additional sessions to help clear residual stones or debris. Complications included cholangitis (14%), pancreatitis (1%), and hemobilia (1%) that was successfully treated with epinephrine. Another retrospective review of 26 patients examined EHL for difficult biliary stones by using a single-operator duodenoscope-assisted cholangioscope (Farrell et al., 2005). All of the patients achieved complete ductal clearance without any complications, and 58% of the patients only needed one session of EHL. A recent retrospective review studied 13 patients who underwent EHL with the SpyGlass SOC and demonstrated a ductal clearance rate of 100% with a mean number of EHL procedures at 1.6 per patient (Aljebreen et al., 2014). There was only one complication of cholangitis, treated conservatively with antibiotics.

Laser Lithotripsy

Reports of the use of a holmium:yttrium-aluminum-garnet (holmium:YAG) laser lithotripsy for choledocholithiasis was first published in 1998 (Burdick et al., 1998; Das et al., 1998). During holmium laser therapy, continuous ductal irrigation with normal saline is needed to provide a medium for the transfer of energy and to help clear stone fragments (Lee et al., 2012). Despite the fragmentation of stones, standard techniques such as balloon sweep or mechanical lithotripsy may still be required to completely clear the duct of all debris. A study published in 2007 described how the holmium laser can fragment stones regardless of their composition, whether they are cholesterol, pigment, or calcium stones (Yates et al., 2007). The holmium laser has a high absorption coefficient in water and therefore has a better safety margin and has more than 100 times the energy absorption than the neodymium laser (Maydeo et al., 2011). Despite the safety profile, to prevent bile duct injury, it is necessary to use direct visual control while performing holmium laser lithotripsy, which also allows real-time assessment of any biliary injuries (Hochberger et al., 2003; Sauer et al., 2013).

Cholangioscopy was classically performed using mother-daughter scopes with two endoscopists, but several recent studies demonstrate the safety and efficacy of the SpyGlass SOC for laser lithotripsy with the holmium:YAG laser. A prospective study in 2011 examined 60 patients with choledocholithiasis who either failed therapy with conventional methods or were referred for management of potentially difficult stone removal (Maydeo et al., 2011). Complete ductal clearance using the Spyglass SOC system with the holmium:YAG laser was achieved in 50 patients (83.3%) in one session, and the remaining patients achieved ductal clearance after one additional session. Complications included fever in 3 patients (although these patients were already admitted with cholangitis), postprocedure pain requiring hospital admission in 4 patients, and a biliary stricture in 1 patient who developed a stricture proximal to the stone, which was successfully treated with dilation using a 10-Fr biliary stent for 3 months. The authors were not sure if the stricture was caused by the laser therapy or the stone itself. Holmium laser therapy has also been
used to treat patients with cystic duct stones (CDS) and Mirizzi syndrome (MS) using the Spy Glass SOC. A retrospective study at a single center described 34 patients: 31 with MS, 3 with CDS (Bhandari et al, 2016). All of the Mirizzi syndrome patients had successful removal in one session, and 2 of the CDS patients needed a second session for stone removal.

**Extracorporeal Shock-Wave Lithotripsy**

ESWL with a variety of lithotripsy machines is now an accepted alternative to endoscopic fragmentation of difficult bile duct stones. In contrast to intracorporeal techniques, direct contact with the stone is unnecessary. Most centers localize stones with fluoroscopic focusing during contrast perfusion of the bile duct through an endoscopically placed nasobiliary catheter or percutaneous drain (Gordon et al, 1991; White et al, 1998). Ponchon and colleagues (1990) reported ESWL success with an ultrasound localization system, although it was less effective when multiple stones were present. Several large series (Bland et al, 1989; Gilchrist et al, 1997; Sackman et al, 2001; Sauerbruch & Stern, 1989) indicated success rates for ESWL stone fragmentation of 53% to 91% and duct clearance in 58% to 90%. Minor complications are common and include biliary pain, hemobilia, transient liver function test elevations, and cutaneous petechiae. Overall, with the use of endoscopic techniques such as ML, EHL, laser lithotripsy, and ESWL, one report showed successful stone removal in 98% of 217 patients, with only 5 patients requiring surgery (Schumacher et al, 1998). However, given the high efficacy of current EHL technology/Spyglass SOC, ESWL is rarely used for bile duct stones.

**Endoprosthesis Placement**

In the few situations in which stone extraction is incomplete or impossible, a nasobiliary tube or, more commonly, an endoprosthesis (Fig. 36C.8) must be inserted to provide biliary decompression and prevent stone impaction in the distal CBD. This is a temporizing therapy to allow the patient’s clinical condition to improve, until complete stone clearance is achieved via additional endoscopic maneuvers or surgery (see Chapters 29 and 36).

Nasobiliary tubes are rarely tolerated beyond a few days. Furthermore, problems with tube placement, such as accidental dislodgment, have led to the alternative therapy of temporary biliary endoprosthesis placement (Kil et al, 1989; Rustgi & Schapiro, 1991). In a poor-risk surgical patient, ES and long-term placement of a plastic biliary endoprosthesis has been proposed as a nonsurgical alternative (Cotton et al, 1987; Foutch et al, 1989; Nordback, 1989; Soomers et al, 1990). Of 84 patients intentionally treated with permanent plastic stents for endoscopically irretrievable stones and followed for a mean of 3 years, 49 (58%) developed biliary complications, and 9 died as a result of complications. Most of the patients had a long, symptom-free interval, however, before complications developed, supporting stenting only as a short-term treatment (Bergman et al, 1995; Maxton et al, 1995). In a randomized study with a shorter mean follow-up (1.5 years) that compared placement of a plastic biliary stent with ES as definitive therapy with stone clearance by means of the basket, balloon, or mechanical lithotripter, the patients with stents had a significantly greater rate of cholangitis (36%) than the patients managed by a conventional endoscopic duct clearance approach (14%). The high risk of long-term complications does not support the concept of permanent plastic stent therapy except for patients with severe comorbidity and a short life expectancy.

The fully covered self-expanding metal stent (FC-SEMS) was intended to improve patency of metal stents by preventing tissue ingrowth in malignant bile duct obstruction. However, the silicone covering on the stent has allowed for delayed stent removal and thus has subsequently been successfully used in an off-label fashion for benign biliary diseases, such as benign biliary strictures and complex bile duct stones (Deviere et al, 2014; Tarantino et al, 2012). It has been postulated that the friction between the stones and the stent reduces the stone size, and radial dilating force of the stent across the papilla further assists in the clearance of choledocholithiasis (Garcia-Cano et al, 2013; Katsinelos et al, 2003). A retrospective review studied 36 patients with complex biliary stones who had incomplete ductal clearance despite the use of advanced extraction techniques (Cerecice et al, 2011). All patients had successful biliary drainage after the initial SEMS was placed. Thirty-three patients (94%) had complete ductal clearance after a mean of 2.2 ERCP sessions. There were no immediate or delayed complications related to FC-SEMS placement or removal, and only 4 patients had spontaneous migration of stents that were deemed clinically insignificant. Another retrospective review evaluated 29 patients with long-term FC-SEMS placement for the management of difficult CBD stones that could not be removed by standard or advanced techniques (Garcia-Cano et al, 2013). All patients had successful procedures in terms of biliary drainage, and the stents were left in place for a median of 200 days. After ERCP, 13 of the patients refused repeat procedures, and therefore only 16 patients returned for successful stent removal. Complete ductal clearance was achieved in 15 of 16 (93.7%) patients after the second ERCP. The 13 patients who refused repeat ERCP were followed for more than
6 months without any complications related to stent placement. In patients in whom complete ductal clearance is not feasible on the index ERCP, FC-SEMS placement can greatly improve the chances of success on the subsequent ERCP while also minimizing the need for advanced lithotripsy techniques.

**Dissolution Therapy**

Contact chemical dissolution of stones has been attempted by perfusing the CBD with solvents administered via an indwelling nasobiliary tube, percutaneous transhepatic catheter, choledocostomy tube, or an existing T-tube. The initial results with these agents were disappointing because of incomplete stone dissolution and complications. A semisynthetic vegetable oil, monoocanoin, composed of 70% glycero1-1-monooctanoate and 30% glycerol-1,2-dioctanoate, was used experimentally for the dissolution of CBD stones beginning in 1977. Results collected from 222 clinicians treating 343 patients with CBD stones between 1977 and 1983 reported a success rate for complete stone dissolution of only 25.6% and an additional partial success rate of 28% (Palmer & Hoffmann, 1986). Serious adverse events leading to discontinuation of treatment occurred in 5% of patients, including hemorrhage from duodenal ulceration, acute pancreatitis, jaundice, pulmonary edema, acidosis, anaphylaxis, septicemia, and leukopenia, but no deaths were reported. The use of organic solvents, such as the aliphatic ether methyl tert-butyl ether (Allen et al, 1985), also has been disappointing, with complete stone dissolution achieved in only 30% to 45% and an unacceptable complication rate related to systemic absorption from spillover of solvent into the duodenum and intrahepatic bile ducts (Brandon et al, 1988; Diaz et al, 1992; Kaye et al, 1990; Murray et al, 1988; Neoptolemos et al, 1990). Expectations of developing a solvent-chemolating agent (ethylendiaminetetraacetic acid) for pigment stones have not been realized. As a result of its low efficacy and morbidity, contact dissolution therapy has not assumed an important role in patients with refractory CBD stones, and newer agents with better methods for instillation are awaited.

**RESULTS OF ENDOSCOPIC THERAPY**

Successful endoscopic treatment of CBD stones requires an adequate ES, which is now achieved in greater than 90% of attempts in most reported series, with noticeable improvement as experience increases (Blumgart & Wood, 1978; Cotton, 1984; Cotton & Vallon, 1981; Geenen et al, 1981; Leese et al, 1985; Schumacher et al, 1998; Seifert et al, 1982; Siegel, 1981). Most experts now would expect to extract stones in at least 90% of successful sphincterotomies. Failure to extract or pass stones may be due to the size or number of stones within the duct or unfavorable duct diameter, usually in its retropancreatic segment. Stones 10 mm in diameter do not give rise to many problems, but in general, with size greater than 15 to 20 mm, the chance of retention increases. Interpretation of success rates necessitates care because centers with greater expertise are more likely to be referred difficult cases that may be failures from attempts elsewhere, biasing results. Patient groups also vary considerably from unit to unit and country to country, reflecting different referral patterns, selection of patients, and attitudes toward endoscopic therapy. Results from centers around the world (Cotton, 1984; Cotton & Vallon, 1981; Freeman et al, 1996; Geenen et al, 1981; Leese et al, 1985; Nakajima et al, 1979; Reiter et al, 1978; Safrany, 1978; Schumacher et al, 1998; Seifert et al, 1982; Sherman et al, 1991; Siegel, 1981; Vaira et al, 1989) with individual and collected series of 430 to 9041 patients range from 75% to 96% for duct clearance, with a median value of 91%.

**Complications of Endoscopic Therapy**

Despite the disparate indications and selection of patients among centers, the overall incidence of ERCP-related complications seems to be remarkably consistent, between 5% to 10% (Andruilli et al, 2007; Cotton, 1984; Cotton & Vallon, 1981; Freeman et al, 1996; Geenen et al, 1981; Leese et al, 1985; Masci et al, 2001; Seifert et al, 1982; Siegel, 1981; Vandervoort et al, 1996). A recent review of all major prospective ERCP trials (16,855 patients) reveal the following specific complication rates: acute pancreatitis, 3.5% (range, 1.0% to 8.7%); cholecystitis or cholangitis, 1.4% (range, 0% to 5%); acute hemorrhage from sphincterotomy site, 1.3% (range, 0.3% to 6.2%); perforation, 0.6% (range, 0% to 6.2%), with a small numbers of other rare complications, such as impacted basket and gallstone ileus. Complication rates must be interpreted with caution because definitions of hemorrhage, acute pancreatitis, cholangitis, and perforation often differ, although many studies use consensus definitions (Cotton et al, 1991).

Post-ERCP pancreatitis is defined as a rise in serum amylase to at least three times the upper limit of normal with accompanying typical pain of pancreatitis, leading to either a hospital admission or prolongation of current hospitalization. It is important to recognize that isolated asymptomatic hyperamylasemia after ERCP is a common and expected finding. Post-ERCP pancreatitis is managed like any typical bout of acute pancreatitis (see Chapters 55 and 56), and although most attacks are mild and self-limited, clinicians must remain vigilant for severe pancreatitis. Wire-guided cannulation decreases the rate of post-ERCP pancreatitis by approximately 50% compared with conventional contrast-guided approaches (Tse et al, 2013). Risk factors for post-ERCP pancreatitis include suspected sphincter of Oddi dysfunction, prior history of post-ERCP pancreatitis, female patients, young age, difficult cannulation, and contrast injections into the pancreatic duct (Freeman et al, 1996, 2001; Neoptolemos et al, 1989; Vandervoort et al, 2002). Prophylactic pancreatic ductal stent placement and periprocedural administration of rectal nonsteroidal antiinflammatory drugs, such as diclofenac and indomethacin, each reduce the risk of post-ERCP pancreatitis by 50% (Elmunzer et al, 2012). The combined protective effect of pancreatic stents and rectal nonsteroidal antiinflammatory drugs is the subject of ongoing study. A new, highly potent protease inhibitor, nafamostat mesylate, has shown significant efficacy in early trials; however, larger clinical studies are needed (Park et al, 2011).

Postsphincterotomy bleeding is often recognized immediately after the sphincterotomy, but some patients may have delayed bleeding. Although there is a paucity of data, use of antiplatelet agents does not appear to increase the risk of bleeding. Controlled sphincterotomy technique with the use of blended current, while avoiding the “zipper” cut, is a recommended method to prevent bleeding. In patients with delayed bleeding, symptoms are similar to any routine upper gastrointestinal bleed, including hemodynamic changes and melena. Mild cholestasis may be evident due occlusion of the biliary orifice with blood clots. Mild to moderate bleeding can often be controlled with endoscopic techniques, including balloon
tamponade of the sphincterotomy site, injection of dilute epinephrine (1:10,000), bipolar cautery, and placement of hemostatic clips (Grimm & Soehendra, 1983; Leung et al, 1995; Wilcox et al, 2004). Temporary placement of FC-SEMS can provide durable hemostasis through long-term tamponade of the bleeding site, with efficacy demonstrated in a small case series (Debenedet et al, 2013). In rare cases of major arterial hemorrhage, endoscopic view of the papillary area is obscured by blood, precluding any further endoscopic therapies. In these patients, angiography with superselective embolization of the active bleeding site has been shown to be highly effective (Maleux et al, 2014). Accordingly, surgical management for post-ERCP bleeding has become uncommon in hospitals with interventional radiology services.

Duodenal perforation is relatively rare and is either a small retroperitoneal perforation related to the sphincterotomy or a large duodenal perforation from the shaft of the scope. The perforation may be asymptomatic and noticed only as retroperitoneal gas (Fig. 36C.9) or extravasation of radiographic contrast material, but even in a symptomatic patient, conservative treatment is often effective, with spontaneous resolution and avoidance of potentially difficult surgery. Occasionally, this complication presents late after ES with a retroperitoneal collection of bile or pus in the flank or inguinal region (Leese et al, 1985; Neoptolemos et al, 1984) and requires percutaneous or surgical drainage.

Cholangitis is confined almost completely to patients in whom CBD clearance has not been achieved, and measures should be directed at providing adequate bile drainage (e.g., by nasobiliary catheter or endoprosthetic) and administering parenteral antibiotics. Gallstone ileus is a rare complication, but its recognition needs to be emphasized because symptoms may be obscure in elderly patients, and they occur many days after ERCP and stone release; treatment is along standard surgical lines (see Chapter 43).

The impaction of an extraction basket occurs rarely in experienced hands because many endoscopic maneuvers have been learned to prevent or salvage this situation. These maneuvers include (1) avoiding basket closure during initial attempts to extract a large stone to prevent impaling the basket wires in the stone surface, (2) converting the standard basket into a crushing type by replacing the handle with a mechanical lithotripter, and (3) extending the ES incision by removing the duodenoscope over the impacted basket catheter and reintroducing it alongside the catheter, introducing a second duodenoscope, or passing a sphincterotome along the same instrument channel as the impacted basket catheter when using large-channel (3.7 mm or 4.2 mm) endoscopes.

Death after ERCP is a rare event, with a mortality rate directly attributable to the procedure ranging between 0% and 0.94%, with an average of 0.3% (Andruilli et al, 2007), with roughly equal distribution of causes between hemorrhage, pancreatitis, cholangitis, and perforation.

**Long-Term Morbidity**

Long-term follow-up of 1 to 15 years after ERCP with ES in postcholecystectomy patients (Cotton, 1984; Escourrou et al, 1984; Hawes et al, 1990; Ikeda et al, 1988; Rosch et al, 1981; Seifert et al, 1982; Sivak, 1989) has demonstrated that more than 90% of patients are well on symptomatic review, and 7% to 11% have significant symptoms secondary to recurrent stones (5%), with or without stenosis of the ES site (1.5% to 3%) and cholangitis (2%). Most of these long-term complications are amenable to further endoscopic treatment.

**LAPAROSCOPIC AND PERCUTANEOUS APPROACHES TO BILE DUCT STONES**

**Laparoscopic Common Bile Duct Exploration**

Laparoscopic CBD exploration (see Chapter 36B) was first performed in the early 1990s and typically performed at experienced tertiary referral centers (Khoo et al, 1996; Martin et al, 1998; Rhodes et al, 1995). Ductal exploration may be accomplished through the cystic duct or directly through a choledochotomy. The transcystic route is the least invasive and generally does not require any ductal manipulation or drainage procedure, whereas choledochotomy requires either closure of the duct over a T-tube or primary closure of the choledochotomy with or without a biliary stent placed in an antegrade fashion without need for a T-tube (Huang et al, 1996; Rhodes et al, 1995). Bile duct clearance rates average 90%, with a median rate of conversion to open operation of 4% (Tranter & Thompson, 2002). Complication rate is 2.5%, with a median mortality rate of 1% (Strasberg et al, 1995).

Multiple randomized clinical trials have been performed comparing single-stage laparoscopic CBD exploration at the time of cholecystectomy versus a two-stage approach with ERCP preceding or following laparoscopic cholecystectomy (Cuschieri et al, 1996; Ding et al, 2014; Rhodes et al, 1998; Rogers et al, 2010). The results of these trials have been strikingly similar, demonstrating similar ductal clearance rates for both groups (75% to 95%) with comparable rates of complications and mortality. In studies that examined hospital parameters, the single-stage surgical approach offered lower length of stay and reduce hospital costs. Length of stay and associated hospital costs can be reduced with improved coordination between the surgeon and the endoscopist. Although the single-stage approach appears at least equivalent to the two-stage approach, implementation of this strategy is restricted to centers...
with significant expertise in laparoscopic bile duct exploration. Conversely, most facilities have ready access to ERCP services, and thus a two-stage approach is the most common strategy in the United States.

**Percutaneous Approach**

In the 5% to 10% of patients for whom the endoscopic approach is unsuccessful at clearing the CBD of stones, two nonsurgical approaches are available: a **rendezvous procedure** and a **complete percutaneous procedure** (see Chapter 30). If the papillary region can be reached endoscopically, yet deep biliary cannulation is unable to be achieved, then the rendezvous procedure may be used. Although typically used for patients with obstructive jaundice from pancreaticobiliary malignancy, this technique can be used for choledocholithiasis in patients with surgically altered anatomy, such as a Bilroth II, or in patients with challenging papillary anatomy, such as a large periampullary diverticulum. This involves a two-stage procedure with the introduction of a percutaneous guidewire through the bile ducts and papilla into the duodenum in the first stage, followed by an ERCP (Dowsett et al., 1989; Martin, 1994; Tomizawa et al., 2014; Verstandig et al., 1993). In one report of rendezvous procedures for choledocholithiasis, 0.9% (15/1735) of ERCPs were unsuccessful at biliary cannulation, usually owing to duodenal diverticula or Bilroth II anatomy (Calvo et al., 2001). Three patients underwent surgery, and 93% of the remaining patients underwent a successful rendezvous procedure. There was one complication with a retroperitoneal perforation that required surgical management, and during follow-up, only one patient developed recurrent choledocholithiasis, requiring a repeat rendezvous procedure. In the multicenter prospective trial of endoscopic biliary sphincterotomy complications (Freeman et al., 1996), the combined endoscopic-percutaneous approach was a risk factor for the development of complications, with a high rate of complications at 22.6% and with 6.5% classified as severe. EUS-guided rendezvous procedures are emerging as a viable alternative to percutaneous approaches for bile duct access in patients with unsuccessful biliary cannulation (Iwashita et al., 2012) (see Chapter 29).

The complete percutaneous approach is labor intensive and typically requires multiple sessions. It has been established as treatment for hepatolithiasis (Yeh et al., 1995) (see Chapters 39 and 44), but it may be used for choledocholithiasis. The procedure involves initial establishment of a transhepatic fistula, followed by stone extraction under fluoroscopy or cholangiography 7 to 8 days after the fistula forms. In a series of 31 patients with failed endoscopic procedures, percutaneous biliary access was achieved in all patients, and stone clearance was complete in 87% after a mean of 5.6 sessions (Van der Velden et al., 2000). All patients underwent balloon dilation of the papilla, and most patients required additional means of stone fragmentation, including ML, EHL, and ESWL. Complications including pancreatitis and bacteremia occurred in 9.7% and did not require surgical intervention. The 4 patients who did not respond to percutaneous management underwent surgery.

**SPECIFIC CLINICAL SCENARIOS**

**Pregnancy**

Symptomatic choledocholithiasis during pregnancy poses a diagnostic and therapeutic challenge. Biliary tract stone disease occurs in approximately 1.5% of pregnancies (Ellington et al., 2015). Endoscopic treatment can be performed safely in pregnant patients (Jamidar et al., 1995; Kahaleh et al., 2004; Simmons et al., 2004; Tham et al., 2003) using techniques to minimize fluoroscopy. A recent retrospective study using the Nationwide Inpatient Sample demonstrated a higher risk of post-ERCP pancreatitis in pregnant patients (12%) compared with control patients (5%); multivariable analysis confirmed pregnancy was an independent risk factor for post-ERCP pancreatitis (Inamdar et al., 2016).

**Patients With Gallbladder in Situ**

In elderly patients or in patients with significant comorbidity, a deliberate decision often is made to leave the gallbladder in situ after ERCP and CBD stone removal. The short- and long-term results and complications of ERCP with ES in patients with gallbladders do not differ from those in postcholecystectomy patients (Kaw et al., 2002). The risk of deferring cholecystectomy was examined in a study of 120 patients with known gallstones who underwent successful ERCP with bile duct clearance; the study excluded patients who were not surgical candidates, and patients were randomized to laparoscopic cholecystectomy within 6 weeks after ERCP or a wait-and-see policy with median 2.5-year follow-up. Nearly half the patients in the wait-and-see group developed biliary-related problems, including biliary pain and cholecystitis, which led to cholecystectomy or repeat ERCP or both, whereas none of the patients in the cholecystectomy group experienced biliary-related problems. The wait-and-see group also had a higher rate of conversion to an open procedure at the time of surgery (Boerma et al., 2002). A meta-analysis of randomized trials comparing the wait-and-see approach with elective cholecystectomy confirmed these findings, with a higher risk of biliary pain (relative risk, 14.6), cholangitis (relative risk, 2.5) in patients who deferred cholecystectomy (McAlister et al., 2007). The risk of these future biliary complications needs to be balanced with operative risk in patients with significant underlying comorbidity.

**Suspected Choledocholithiasis**

In patients with suspected choledocholithiasis, it is imperative to perform a risk assessment for the presence of CBD stones prior to cholecystectomy. The following algorithm accounts for the relative efficacy, safety, and cost-effectiveness of each procedure and imaging study (Tse et al., 2004). Patients with any very strong predictor of CBD stones (visualized CBD stone on imaging, cholangitis or bilirubin > 4) or two strong predictors of CBD stones (dilated CBD > 6 mm, bilirubin between 1.8 and 4) should undergo preoperative ERCP. Moderate predictors are any other abnormal liver function tests, age older than 55 years, and gallstone pancreatitis. Patients without any very strong, strong, or moderate predictors are deemed low risk for CBD stones and should proceed directly to cholecystectomy. All remaining patients are at intermediate risk for CBD stones and should either undergo preoperative MRCP or EUS, followed by ERCP if CBD stones are visualized. Alternatively, depending on local expertise, these intermediate-risk patients can proceed with laparoscopic cholecystectomy with intraoperative cholangiogram; patients can then proceed with laparoscopic bile duct exploration or undergo postoperative ERCP. In patients who undergo preoperative ERCP, it is important to minimize the time between the ERCP and cholecystectomy, to reduce the risk of recurrent CBD stones prior to surgery. Subsequent studies have found this algorithm to be moderately...
Acute Cholangitis

Acute cholangitis (see Chapter 43) resulting from CBD stones traditionally was managed by supportive measures and parenteral antibiotics, followed by early surgery if improvement was slow or absent. In early reports, the mortality from emergency surgery ranges from 12% to 16%, with higher rates for elderly patients (Boey & Way, 1980; Cotton, 1984; Thompson et al, 1982). The only randomized trial of emergency endoscopic versus surgical management of severe calculous cholangitis (Lai et al, 1992) showed a threefold difference in mortality rate (10% vs. 32%; P < .03) in favor of ERCP. In patients who are hemodynamically stable, it is reasonable to proceed with ES during ERCP with removal of all calculi. Care must be taken to minimize aggressive contrast injection (particularly during balloon-occluded cholangiography) to reduce the potential risk of bacteremia from the procedure. In patients with hemodynamic compromise, procedure duration can be minimized using a two-stage approach, placing a plastic biliary stent without sphincterotomy to achieve biliary decompression, which leads to resolution of cholangitis (Hui et al, 2003). After the patient’s clinical status has improved, a second ERCP can be performed with ES, allowing complete ductal clearance of CBD stones.

Gallstone Pancreatitis

Acute pancreatitis (see Chapters 55 and 56) resulting from gallstones in the ampulla of Vater was first reported by Opie in 1901. From his observations in this study, an “obstructive theory” was derived to explain the mechanism responsible for gallstone pancreatitis. Current evidence suggests that transient stone impaction in the common channel of the pancreatic duct and CBD causes increased pancreatic ductal pressure with associated inappropriate activation of pancreatic enzymes (Hirano et al, 1993). In support of the obstructive theory, gallstones can be recovered from the feces of 85% to 95% of patients (Acosta & Ledesma, 1974; Kelly, 1980a, 1980b), and the incidence of CBD stones is 80% in patients undergoing urgent operative or endoscopic intervention compared with a 5% to 30% incidence when the procedure is delayed (Acosta et al, 1978; Kelly, 1980a, 1980b; Ranson, 1979; Stone et al, 1981).

The Ranson, Imrie, Glasgow, and Acute Physiology, Age, and Chronic Health Evaluation (APACHE II) assessments provide well-established criteria for assessing the severity of pancreatitis and predicting local adverse events—such as necrosis, hemorrhage, infection, and pseudocyst formation—and systemic complications of acute respiratory distress syndrome, disseminated intravascular coagulation, distant fat necrosis, and renal failure (Banks, 1991). Stratifying patients by severity based on these criteria has been helpful in directing appropriate management. Most patients experience mild pancreatitis resulting from transient impaction of a stone in the ampulla, followed by spontaneous migration into the duodenum. These patients do well with conservative therapy alone and are unlikely to benefit from urgent intervention. In contrast, it has been proposed that more severe cases of pancreatitis result from persistent stone impaction or choledocholithiasis with infected bile, suggesting the possibility that early stone extraction by surgical or endoscopic techniques would halt progression of the acute event and prevent the development of future attacks in the short term.

Early surgical therapy in cases of acute biliary pancreatitis (ABP) has been challenged owing to the high operative morbidity and mortality. Results and conclusions from numerous series comparing early and late surgical therapy in gallstone pancreatitis are difficult to interpret. The mortality rates range from 2% to 67%, studies are retrospective with frequent comparisons to historical controls, and stratification for severity of illness has not been used (Acosta et al, 1978; Kim et al, 1988; Osborne et al, 1981; Ranson, 1979). In one study, Kelly and Wagner (1988) prospectively randomized 165 patients with gallstone pancreatitis to early or delayed surgery. In the group with severe pancreatitis, mortality was 48% after urgent operative intervention compared with 11% mortality rate in patients in whom surgery for gallstones was delayed for more than 48 hours. In contrast, patients with mild pancreatitis had mortality rates of 3.3% and 0%, respectively. Another study of moderate to severe gallstone pancreatitis with peripancreatic fluid collections confirmed these results, with complications in 44% of patients in the early surgery group compared with 6% in the delayed surgery group (Nealon et al, 2004).

The results of these aforementioned studies favor avoidance of early operative intervention in the acute phase of biliary pancreatitis, as the previous surgical dictum was that inflammation and edema from pancreatitis can distort biliary anatomy, which would complicate surgeries and predispose patients to bile duct injury (da Costa et al, 2015). However, recent robust clinical data have challenged this thought process, leading to a paradigm shift favoring cholecystectomy during the initial hospitalization for ABP, once the acute inflammatory process has improved.

A U.K. study retrospectively reviewed admissions to the hospital while awaiting an elective outpatient cholecystectomy after an episode of biliary pancreatitis (Cameron et al, 2004). Of the 58 patients awaiting laparoscopic cholecystectomy, 21% had unplanned readmissions if waiting for more than 28 days; no patients who had cholecystectomy within 28 days had recurrent admissions. The presence of a sphincterotomy did not affect readmission rates despite the fact that no patients with ES returned with ABP, as they instead returned with cholecystitis or biliary colic. These results were echoed by another European study that looked retrospectively at 80 patients with ABP who had ERCP with ES (Mador et al, 2014). Authors found a 60% rate of recurrent biliary complications (pancreatitis, symptomatic choledocholithiasis, colic) in patients who delayed cholecystectomy versus 2% in the group who underwent early cholecystectomy (P < .0001). A recent multiinstitutional randomized control trial of 266 patients with mild gallstone pancreatitis has been performed. In this study, 129 patients were randomly assigned to same-admission cholecystectomy within 3 days, whereas 137 were randomized to interval cholecystectomy within 25 to 30 days (da Costa et al, 2015). Readmission for gallstone related complications (pancreatitis, cholecystitis, cholangitis, jaundice, colic) were significantly more common in the interval group than the same-admission group (17% vs. 5%, P = .002). These results remained significant when comparing patients with endoscopic sphincterotomy in a subgroup analysis. As with the previous retrospective studies, there was no difference in length of stay,
difficulty of surgery, conversions from laparoscopic to open surgery, or health care use between the two groups.

Because of this paradigm shift in the surgical management of biliary pancreatitis, along with the change in guidelines recommending cholecystectomy on the index admission, a retrospective review recently studied how the implementation of an acute-care surgery (ACS) service for biliary disease affected outcomes in biliary pancreatitis (Murphy et al, 2015; Tenner et al, 2013). The rate of index cholecystectomy increased from 2.4% to 67% (P < .001) after the implementation of the ACS service, which correlated with a decrease in readmission rate for biliary related disease from 16.8% to 7.3% (P = .04). Although an ACS service is not a new concept, the study demonstrates the importance of inpatient consultation and prompt evaluation by a surgical service that adheres to the current management guidelines.

The data regarding cholecystectomy in patients with severe ABP with complications such as multiorgan failure or necrosis are not as robust, and a recent Cochrane Review states that there is currently no evidence to support or refute early laparoscopic cholecystectomy for patients with severe acute pancreatitis (Gurusamy et al, 2013). Usually a delay in surgery in these patients is secondary to critical illness or while awaiting other surgical or endoscopic treatments for complications such as a cyst-gastrostomy for a pseudocyst or debridement of walled-off pancreatic necrosis. In patients who are too ill or have limiting comorbidities (severe coronary artery disease, cirrhosis) to tolerate any type of surgery, there is a potentially protective effect of an endoscopic sphincterotomy in preventing further biliary complications, although the data for the role of ES in lieu of a cholecystectomy for a high-risk patient in the absence of choledochocholithiasis are limited (May et al, 1991).

In the acute setting, an endoscopic approach to biliary pancreatitis offers the theoretical advantage of immediate relief of ampullary obstruction and ductal clearance without the risks of surgery. As animal models and human studies have suggested that the duration of biliary obstruction is a critical factor in determining the severity of pancreatitis, early resolution of obstruction with ERCP would theoretically ameliorate the course of the disease (Kapetanos et al, 2010). The timing of ERCP in ABP has been controversial, and until recently, many studies did suggest a role for early ERCP (Fogel et al, 2014). Three oft-quoted studies in previous guidelines and reviews gave the antecedent evidence that early ERCP (within 72 hours) and sphincterotomy definitively reduced complications in ABP.

The Leicester investigators (Neoptolemos et al, 1986) were the first to perform a controlled study to evaluate the efficacy of early ERCP in biliary pancreatitis. A group of 121 patients with suspected gallstone pancreatitis was randomized to ERCP with stone extraction within 72 hours of hospitalization or conventional nonendoscopic management. Patients with mild pancreatitis had similar outcomes regardless of treatment strategy. In the group of patients with severe pancreatitis, ERCP significantly reduced the morbidity from 61% to 24% and reduced the length of hospitalization from 17 days to 9.5 days, but mortality was not different between the two groups. It is noteworthy that biliary obstruction and jaundice were not exclusion criteria in this study, and 11 of the patients had concurrent cholangitis. A second study (Fan et al, 1993) prospectively randomized 195 consecutive patients with pancreatitis of any cause to urgent ERCP with ES or initial conservative treatment with selective ERCP only if there is clinical deterioration. Urgent ERCP resulted in a reduction of biliary sepsis from 12% in the conservatively treated patients to 0% in patients undergoing ERCP. Overall, no significant differences were found in the incidences of either local (10.3% vs. 12.2%) or systemic (10.3% vs. 14.3%) complications. In the subset of patients with severe pancreatitis and CBD stones, urgent ERCP resulted in a decrease in the combined incidence of local and systemic complications to 21% and mortality rate to 5.3% compared with the conservatively managed group, in which the rates were 68.8% and 25%, respectively. Patients with biliary obstruction and cholangitis were also included in this study. A third randomized trial (Nowak et al, 1995) studied 280 patients with ABP who all underwent urgent ERCP within 24 hours of onset of their disease; nearly 25% were found to have impacted stones at the papilla, which were treated by immediate sphincterotomy. The remaining 205 patients were randomized to conventional treatment or sphincterotomy regardless of the choangiographic findings. Compared with conventional treatment, the authors showed a significant advantage for patients treated endoscopically with respect to morbidity (17% vs. 36%; P < .001) and mortality (2% vs. 13%; P < .001). Further review of these findings is not possible, as the study was only published in abstract form.

Although the aforementioned studies support early ERCP in ABP, the patients included in these studies had associated conditions that would require an ERCP (cholangitis, jaundice), and therefore the question of a biliary sphincterotomy in all patients with ABP cannot be answered by these data. A randomized multicenter European study avoided these confounding variables by examining the role of early ERCP with sphincterotomy in patients with ABP without cholangitis or jaundice (Folsch et al, 1997). Two hundred thirty-eight patients were randomly assigned to early ERCP (within 72 hours) or conservative treatment. The overall mortality and complication rates were similar between the two groups regardless of the severity of pancreatitis, but the rate of serious respiratory failure was higher in the invasive group (P = .03). A recent meta-analysis of the seven known well-designed, randomized, controlled trials on this topic confirms these same findings (Uy et al, 2009).

According to the most recent high-quality published data, the current practice management guidelines state that early ERCP is not needed in patients with ABP who lack the laboratory or clinical evidence of ongoing biliary obstruction or cholangitis. In the absence of jaundice or cholangitis, noninvasive methods such as MRCP and EUS should be used to screen for choledocholithiasis (Fogel et al, 2014; Tenner et al, 2013).

**CONCLUSIONS**

Endoscopic management of choledocholithiasis is widely accepted as a highly effective therapy for CBD stones. Endoscopic techniques are well established, and accessories have been developed to enhance success and safety. ERCP with ES is the standard of care in the management of CBD stones in most clinical situations, regardless of the presence or absence of the gallbladder. Advancement in endoscopic techniques allows the management of complex bile duct stone disease. The endoscopic removal of stones in the perioperative period has been shown to be effective, minimizing the need for CBD exploration. Patients with acute cholangitis should be considered for urgent endoscopic management. ERCP is generally not
indicated in the management of gallstone pancreatitis in the absence of associated obstructive jaundice or cholangitis. Integrated endoscopic therapy for biliary disease is well established in centers where surgeons and endoscopists work closely together and provide each other with a suitable forum for critical evaluation of alternative therapeutic techniques. As arguments and clinical practice come full circle, it is tempting to suggest that the enthusiastic speculations of the early 1970s—that in stone disease, the surgeon should treat the gallbladder, and the endoscopist should treat the bile duct—has come to pass 4 decades later.

References are available at expertconsult.com.
REFERENCES


