The management of bile duct stones

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Bile duct stones are almost always associated with gallbladder stones and coexist with gallbladder stones in approximately 10% of patients. The frequency of coexisting bile duct stones increases with advancing age. In patients with stones in both the gallbladder and bile duct, therapeutic options for the latter include laparoscopic or open exploration of the bile duct, and pre-operative and post-operative endoscopic sphincterotomy and stone extraction. Endoscopic sphincterotomy remains the treatment of choice for bile duct stones after cholecystectomy. However, management algorithms in individual institutions will be influenced by surgical and endoscopic expertise and by other factors such as overall costs. After surgical or endoscopic removal of bile duct stones, estimates of the lifetime risk of recurrent stones range from 5%-20%. Increased life expectancy and the apparent absence of simple preventative measures indicate that the burden of bile duct stones on health expenditure is likely to increase in many countries. [Indian J Gastroenterol 2004;23:102-106]

Gallstones are a relatively common disorder in most populations. The usual sequence of events is the development of stones in the gallbladder, after which they may migrate into the bile duct. These bile duct stones are usually called secondary stones. However, as many bile duct stones are relatively large, it is likely that they can substantially increase in size within the bile duct and, perhaps because of bile stasis, result in additional primary bile duct stones. Primary stones also occur in the rare setting of gallbladder agenesis and seem likely in at least some patients with bile duct stones without gallbladder stones. Another issue is that of bile duct stones that are diagnosed many years after cholecystectomy. Whereas some stones may well have been overlooked at the time of surgery, the majority of these stones appear to be primary stones that have formed within the bile duct.

Approximately 10% of patients with gallbladder stones have coexisting bile duct stones. For patients younger than 60 years, however, the frequency ranges from 4%-7%. This increases to 18% for those aged 70-79 years and over 30% for those over 80 years. Indeed, increasing life expectancy in many countries seems likely to be associated with an increase in the number of patients with symptomatic gallstones, particularly stones in the bile duct.

A variety of clinical, biochemical and imaging variables have been used to predict the presence of bile duct stones. Cholangitis and jaundice are strong predictors, whereas pancreatitis is a weaker predictor as bile duct stones often pass spontaneously into the duodenum after the induction of pancreatitis or within a few weeks. Other weaker predictors include elevated plasma levels of bilirubin and liver enzymes (without jaundice) and dilatation of the bile duct on an ultrasound study. Ultrasonography demonstrates stones in the bile duct only in 30%-50% of cases. The sensitivity and specificity of newer imaging techniques such as cholangiography with computed tomography, magnetic resonance cholangiography (MRC), endoscopic ultrasound (EUS) and laparoscopic ultrasound are outside the scope of this review but there are encouraging reports of the diagnostic accuracy of MRC and EUS.

Natural history of bile duct stones

The natural history of asymptomatic bile duct stones has not been studied. For patients with asymptomatic gallbladder stones, risks for the development of symptomatic bile duct stones (jaundice, cholangitis or pancreatitis) were low (<3%), even after follow up for 20 years. For patients with minor symptoms from gallbladder stones who were followed up for 10 years without surgery, 7.5% developed complications from bile duct stones such as jaundice or pancreatitis. Additional patients had recurrent pain which might have been due to either gallbladder stones or bile duct stones. Of those patients whose symptoms were severe enough to warrant biliary surgery, 27% were found to have stones in the bile duct.

An additional area of uncertainty is the frequency of spontaneous passage of bile duct stones into the duodenum. This appears to be common in patients with gallstone pancreatitis but may also occur in other acute biliary disorders without pancreatitis. The possibility that spontaneous passage of bile duct stones is a common event in patients with asymptomatic gallbladder stones has not been studied.

Historical perspective

Historical aspects of the management of bile duct stones have been reviewed by Morgenstern. The first cholecystectomy has been attributed to Dr Karl Langenbuch, a surgeon in Berlin, in 1882. Within a decade, cholecys-
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tectomy was being combined with exploration of the bile duct in selected patients with jaundice or cholangitis. By 1900, additional surgical procedures had been described including cholecysto-enterostomy, choledocho-duodenostomy, and operative sphincteroplasty. At a similar time, operative drainage of the bile duct using a T-tube was described by another German surgeon, Dr Hans Kehr.

The first description of operative cholangiography has been attributed to Dr P Mirizzi in Argentina. In 1931, he described the intraoperative injection of lipiodol through the cystic duct. This procedure increased the detection of unsuspected bile duct stones and decreased the frequency of unnecessary bile duct explorations. Subsequently, percutaneous transheaptic cholangiography was described but the procedure was not widely adopted until the introduction of the Chiba needle by Dr K Okuda in Japan in 1973. More recently, sophisticated radiological equipment has been installed in operating suites to provide both fluoroscopic and static images of the bile duct.

Developments in radiological techniques were associated with the evolution of endoscopic techniques for direct visualization of the bile duct. Although rigid choledochoscopy had been described in the 1940s, it was not until the 1960s that optical systems were good enough to promote their widespread use. Within a decade, some of these instruments had been replaced by flexible fiberoptic choledochoscopes. Flexible choledochoscopes have also been used to extract retained bile duct stones through the T-tube tract, and to perform diagnostic and therapeutic procedures after percutaneous transheaptic passage into the bile duct.

Another major step forward was the introduction of endoscopic retrograde cholangiopancreatography (ERCP) and endoscopic sphincterotomy. Although sphincterotomy was first described in 1973, the procedure became widely available only in the early 1980s. Subsequently, sphincterotomy became a common procedure for patients with bile duct stones prior to cholecystectomy, and became the procedure of choice for removal of bile duct stones after cholecystectomy.

Laparoscopic cholecystectomy was introduced in the late 1980s, and by the mid-1990s replaced open cholecystectomy as standard treatment for gallbladder stones. A particular concern, however, was the development of complications in patients with coexisting bile duct stones. Initially, many patients underwent ERCP prior to laparoscopic cholecystectomy to exclude bile duct stones. Subsequently there was a more rational use of ERCP as well as the development of laparoscopic exploration of the bile duct. The latter procedure, in particular, is still in an evolutionary phase but individual surgeons claim laparoscopic extraction of bile duct stones in up to 90% of patients. These results are comparable to those achieved with endoscopic sphincterotomy and open exploration of the bile duct.

Bile duct stones with gallbladder stones

The management of patients with known bile duct stones as well as gallbladder stones will vary between countries and between institutions. Factors that influence decision-making processes within institutions include the availability of experienced surgeons and endoscopists, costs of hospitalization, costs of endoscopic and laparoscopic equipment, and patient preference. In many Western countries, patients expect laparoscopic surgery and the associated benefits such as reduced pain, a shorter duration of hospitalization, and a more rapid return to full activity. In contrast, open operations are likely to remain standard treatment in many developing countries as endoscopic services are limited and laparoscopic equipment is expensive.

Laparoscopic cholecystectomy and laparoscopic exploration of the bile duct appear to be the procedures of choice in institutions where surgeons have high success rates for extraction of bile duct stones. In this setting, residual stones can be managed by endoscopic sphincterotomy and stone extraction. For surgeons with lower success rates for laparoscopic stone extraction (currently the majority), decisions for individual patients will be made on the basis of clinical and radiological findings. For example, pre-operative endoscopic sphincterotomy and stone extraction will often be preferred in patients with jaundice, cholangitis, or large bile duct stones. Such patients may be at higher risk for complications such as biliary fistulae if there is failure of laparoscopic stone extraction. For laparoscopic surgeons who rarely explore the bile duct, pre-operative ERCP will be more widely used but should be restricted to patients with a high probability for bile duct stones. For criteria such as elevated levels of liver enzymes (without jaundice) and/or dilatation of the bile duct on an ultrasound study, ERCP will be normal in up to 50% of patients.

For many surgeons in developing countries, standard therapy will be open operation with cholecystectomy and exploration of the bile duct. If surgery is difficult and residual stones seem likely, options include a choledoco-duodenostomy or operative sphincteroplasty at the time of surgery or post-operative endoscopic sphincterotomy with stone extraction.

Bile duct stones discovered intraoperatively

Most surgeons attempt intraoperative cholangiography at the time of laparoscopic or open cholecystectomy. This is usually achieved by the injection of contrast material through a catheter in the cystic duct. Satisfactory cholangiograms are obtained in approximately 90%
of patients, with positive and negative predictive values for bile duct stones of greater than 90%. Some centers also perform intraoperative ultrasonography, although the results appear to be similar to those with static or fluoroscopic cholangiography.¹²

When the intraoperative cholangiogram reveals bile duct stones, some laparoscopic surgeons will proceed to laparoscopic duct exploration. Those with incomplete training in the latter technique will either convert to an open operation with duct exploration or arrange for postoperative ERCP. The latter option appears to be more frequent than the former in most Western institutions. Other techniques such as intraoperative ERCP and antegrade sphincterotomy have been described but have not been widely adopted.¹⁴

**Bile duct stones after cholecystectomy**

In most centers, bile duct stones that have been diagnosed months or years after cholecystectomy are treated by endoscopic sphincterotomy and stone extraction. If performed by experienced endoscopists, success rates for stone extraction are high (95%) while morbidity and mortality rates are low.¹⁵ In some centers, the majority of these procedures are performed as day cases with avoidance of additional costs from overnight hospitalization.

If ERCP and endoscopic sphincterotomy are not available, options include laparoscopic and open exploration of the bile duct. The latter is preferred under most circumstances and, depending on the operative findings, may be accompanied by choledochoduodenostomy or operative sphincteroplasty.

Bile duct stones that are diagnosed on a T-tube cholangiogram soon after cholecystectomy and duct exploration are usually treated by endoscopic sphincterotomy, but an alternative approach is extraction through the T-tube tract after 4-6 weeks. Infusion of gallstone-dissolving agents such as mono-octanoin through the T-tube is no longer performed because of inferior results and significant toxicity.¹⁶

**Unusual clinical settings**

**Large bile duct stones**

Large bile duct stones (Fig 1), usually greater than 1.5 cm in diameter, can present a significant challenge to the endoscopist or the laparoscopic surgeon. Such stones occur in approximately 10% of patients and are more frequent in the elderly. Radiological features predictive of a difficult extraction for the endoscopist include impacted stones and stones associated with a narrow distal bile duct. If extraction with routine baskets seems difficult, many endoscopists will use mechanical lithotripsy (crushing baskets), with success rates for stone clearance of approximately 80%.¹⁷ Use of mechanical lithotripsy avoids the potential embarrassment of an entrapped basket within the bile duct. For stones where endoscopic techniques have been unsuccessful, endoscopic stents almost always facilitate bile flow and minimize the risk of complications such as cholangitis. When stents are inserted, a second attempt at stone extraction is often successful. If the second attempt fails, options include open exploration of the bile duct or, in rare cases, the long-term use of stents. With the latter option, however, complications have been reported in up to 40% of patients after 3 years, particularly cholangitis.¹⁸

Despite initial enthusiasm, the use of extracorporeal lithotripsy for large bile duct stones has not been widely adopted. This may reflect the broad acceptance of mechanical lithotripsy as the treatment of choice for most of these patients. Experimental procedures for difficult bile duct stones include laser-induced shock-wave lithotripsy and electrohydraulic lithotripsy, with or without cholangioscopy (mother-baby scope system).

**Intrahepatic stones**

Stones in intrahepatic ducts are rare in Western countries but are more common in some parts of Asia. This disorder has also been called Oriental cholangihepatitis and recurrent pyogenic cholangitis. Management options include endoscopic sphincterotomy and stone extraction, percutaneous cholangioscopy and stone extraction, and various surgical procedures. Detailed discussions of these management options have been described elsewhere.¹⁹
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Mirizzi syndrome

Mirizzi syndrome is defined as compression of the bile duct by gallstones that are impacted in the cystic duct or in the neck of the gallbladder (Hartmann’s pouch). It seems likely that many of these patients are best treated by laparoscopic or open operations but high success rates for endoscopic therapy have been claimed with the combined use of mechanical lithotripsy and electrohydraulic lithotripsy.

Stones in the cystic duct

Occasionally, stones will be outlined in the cystic duct at the time of ERCP. A minority will pass into the gallbladder with injection of contrast but the majority remain in situ. While endoscopic extraction can be attempted in some of these patients, the majority have impacted stones that are best left for the surgeon. In patients with cystic duct stones after cholecystectomy, endoscopic extraction is usually successful except in the small group with impacted stones in a narrow and tortuous cystic duct stump.

Stones and strictures

Postoperative biliary strictures may be complicated by the development of proximal bile duct stones. In general, results from surgical management of strictures have been superior to those of endoscopic management; although endoscopic results may be better with an aggressive stent policy. A biliary fistula with a bile duct stone and a bile duct stricture with proximal stones are shown in Fig 2.

Recurrent bile duct stones

There is a significant risk of recurrent bile duct stones for all methods of stone extraction. For those who have not had a cholecystectomy, recurrent stones may be due to migration from the gallbladder. After cholecystectomy, “recurrent” stones may have been overlooked at the time of duct clearance or may reflect the formation of new primary stones. Presumably, the latter becomes more likely as the interval between duct clearance and recurrent stones increases. This interval may be 30 years or more for a minority of patients. The lifetime risk of recurrent bile duct stones after surgical exploration of the bile duct has been estimated at 10%-20%.

After endoscopic sphincterotomy and stone extraction, the risk of recurrent stones ranges from 5%-15% after 10-15 years, at least in those who have previously had a cholecystectomy. Factors associated with an increased risk of recurrent stones include a dilated bile duct, a previous history of multiple stones, the presence of periampullary duodenal diverticula, and narrowing or stenosis of the endoscopic incision. However, these associations predispose to recurrent bile duct stones remains unclear but bile stasis and bacterial infections seem to play a role.

Most patients with recurrent bile duct stones are treated or re-treated by endoscopic sphincterotomy. For those who have repeat exploration of the bile duct, the operation should be accompanied by a surgical drainage procedure such as cholecdocho-duodenostomy, operative sphincteroplasty or cholecdocho-jejunostomy. Randomized trials indicate that cholecdocho-duodenostomy is the procedure of choice provided that the bile duct is dilated enough (usually greater than 15 mm) to create a satisfactory stoma. With this procedure, the incidence of further bile duct stones appears to be low.

Prevention

There is little information on the possibility of drug therapy for the prevention of recurrent bile duct stones. In particular, chenodeoxycholic acid and ursodeoxycholic acid have not been studied in this setting, perhaps because of the failure of chenodeoxycholic acid to dissolve bile duct stones. Furthermore, there are no data on the potential benefit of drugs that reduce plasma and biliary concentrations of cholesterol, such as HMG-CoA reductase inhibitors.

References


Fig 2: Post-operative cholangiogram on left shows bile duct stone with biliary fistula through cystic duct stump (arrow). Cholangiogram on right shows stricture in common hepatic duct (arrow) with proximal bile duct stones.


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