Fortnightly Review

The treatment of gall stones

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History

Alexander of Tralles (525-605), a physician of the Byzantine Empire, left the earliest known writings on gall stones, describing calculi in human livers.[1] Our oldest physical evidence of human gall stones—30 stones in the intact gall bladder of a mummified Egyptian priestess from around 1500 BC[2]—was lost when the museum of the Royal College of Surgeons in London was bombed during the second world war.

A multiplicity of non-surgical treatments have been used, including prayer, magic, the application of poultices and pigeons, phlebotomy, ingestion of herbs and potions, and attempts at gall stone dissolution. Most would now fall outside those approved by the mainstream of modern medicine. Francis Glisson (1597-1677) described the capsule of the liver but also experimented with dietary remedies for his own gall stones. Orgardney described in vitro dissolution of gall stones with turpentine but refrained from trying it in patients. Gall stone dissolution, though now much more effective than it was, is still associated with high failure and recurrence rates and is used in only a small proportion of cases.

The history of surgery for gall stones is fairly short. Cholecystotomy was reported and recommended by Jean-Louis Petit in 1743 after he had mistakenly opened the gall bladder when attempting to drain what he thought was an abdominal wall abscess.[3] Adhesions between the gall bladder and the abdominal wall prevented leakage into the peritoneal cavity and the patient survived. Petit also recommended the removal of gall stones by this method when pericholecystic adhesions were thought to be present. In 1798 Richter suggested percutaneous tube cholecystotomy for drainage of gall bladder empyema without peritoneal contamination[4], and in 1859 Thudicum improved on both ideas by sewing the gall bladder to the abdominal wall, later opening it to extract the stones.[5] In 1868 Bobbs carried out the first open cholecystotomy to remove calculi.[6] His patient survived to live another 30 years. The first cholecystectomy was carried out in 1882 by Carl von Langenbuch.[7] The safety and success of this operation were soon established and cholecystectomy remains the treatment of choice for symptomatic gall stones.

Until the age of abdominal surgery there was no generally effective treatment for gall stones, whether medical, "natural," or otherwise. Surgeons and their patients faced gall stone disease across barriers of pain, sepsis, and a prohibitive death rate. The coalescence of scientifically sound and humane surgery with effective and safe anaesthesia, analgesia, and antibiotics has changed our relation with this disease for ever.

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Summary points

- Gall stones are the commonest digestive cause of hospital admission in Western societies
- Upper abdominal pain is the commonest presenting symptom and abdominal ultrasound scanning the most cost effective diagnostic tool
- The principles of treatment and patient selection have not been changed by laparoscopic surgery
- Asymptomatic gall stones uncommonly warrant intervention
- Symptomatic gall stones are best treated by removal of the stones and by elimination of the risk of recurrence

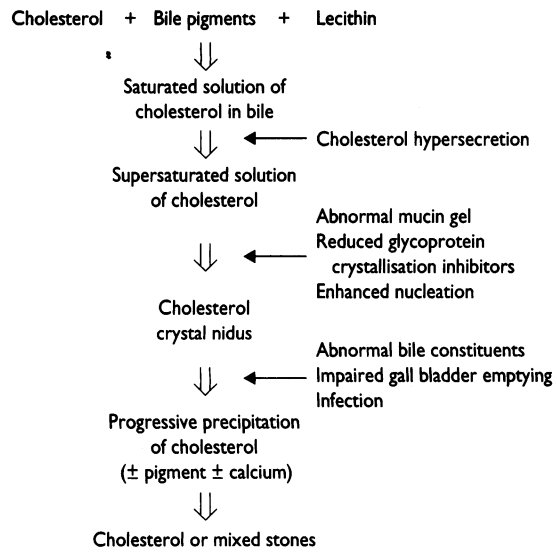
Epidemiology

Gall stones occur in all societies and races, in young and old people of both sexes, and in all states of health. They are, however, increasingly prevalent with age and three times more common in females.[8] In Western societies gall stones are currently the most common digestive cause of hospital admission. The National Institutes of Health consensus development conference statement on gall stones and laparoscopic cholecystectomy in 1993 gave figures indicating the magnitude of the gall stone disease problem facing the Western world.[9] Of the adult population of the United States, 10-15%—over 20 million people—are afflicted, leading to over a million new diagnoses a year and over 600 000 cholecystectomies a year.

Though gall stone disease is already a major problem in Western society, its major growth will be seen in indigenous groups within those societies and in developing countries as dietary practices change toward Western patterns.[10-14] The rapidly rising incidence of gall stones, particularly of cholesterol stones, will increasingly tax already overburdened and under-resourced health systems. Countries which are already industrialised but which are now adopting Western dietary patterns are also showing increases in the incidence of gall stones.[15]

Pathogenesis

Supersaturation of bile with cholesterol, mucin gel abnormalities, and other changes enhancing nucleation result in crystal formation.[16,17] These, along with impaired gall bladder motility and bile stasis, are



Pathophysiology of gall stone formation

the major factors in the genesis of cholesterol gall stones and mixed gall stones.

Bile acids help to hold cholesterol in solution. Cholesterol hypersecretion is linked to a reduction in bile acid formation, leading to a reduction in cholesterol solubility and an increase in cholesterol crystal formation, particularly in the comparatively stagnant gall bladder bile. Other important factors are being identified, including glycoprotein inhibitors of cholesterol crystallisation,[18] ascorbic acid,[19] biliary proteins and vesicular cholesterol concentration,[20] biliary immunoglobulins,[21] and prostaglandins.[22] Diet,[23,24] rapid weight loss,[25,26] major surgery,[27] and intestinal transit abnormalities[28] have also been implicated in gall stones.

Pigment stone formation results from supersaturation of the bile with calcium bilirubinate, an unconjugated bile salt.[29] This occurs predominantly in disease states associated with increased red cell turnover, with episodes of nucleation and pigment stone formation then exacerbated by chronic infection of gall bladder bile.

The tangled story of gall stone pathogenesis is slowly being unravelled. None of these new insights, however, has yet translated into reliably effective medical treatments or preventive strategies.

Patterns of presentation

Patients with gall stones fall into three groups—those who have symptoms, those who do not have symptoms, and those whose condition is complicated by, for example, cholecystitis, pancreatitis, or obstructive jaundice.

Asymptomatic gall stones—Many gall stones are asymptomatic and many go undiagnosed. Increasingly, asymptomatic stones are discovered incidentally during investigations of other problems. This trend reflects the increasing use of abdominal imaging, particularly ultrasonography, in the investigation of non-specific abdominal symptoms. Most gall stones that are asymptomatic remain so. Roughly 10% of patients with asymptomatic stones will develop symptoms within five years of diagnosis and roughly 20% by 20 years.[30,31] The rate of symptom development is maximal in the early years after diagnosis. This then tapers off to give an annual rate of 1-2% of asymptomatic patients becoming symptomatic.[32] Small bile duct stones may also be asymptomatic and may pass spontaneously, but choledocholithiasis increases the rate of symptom development and the incidence of complications such as obstructive jaundice and pancreatitis to around 20% over five years.[33]

Operative cholangiogram obtained with image intensifier showing stone in common bile duct

Symptomatic gall stones—Symptoms are the most reliable factors indicating the prognosis and hence the necessity for treatment of gall stone disease. The most common symptom of gall stones is intermittent pain in the right upper quadrant of the abdomen, classically but not exclusively after a meal and lasting one to several hours. This is known as biliary "colic." It is frequently mild but can be severe, requiring medical attention and narcotic analgesics. Once gall stones are symptomatic, worsening of symptoms is likely and the risk of progression to more severe disease such as acute cholecystitis or pancreatitis is increased, roughly a quarter of patients developing complications over the next 10-20 years.[30]

Complicated gall stones—Cholecystitis and choledocholithiasis, with or without cholangitis or pancreatitis, are the most common complications of gall stone disease.[34] Acute cholecystitis caused by cystic duct obstruction by stones or stone fragments frequently requires hospital admission and can lead to abscess formation, gall bladder perforation, or mucocele of the gall bladder. The chronic low grade inflammation caused by gall bladder stones, infection of gall bladder bile, and intermittent duct obstruction results in scarring, contracture, and loss of function of the gall bladder wall—the picture of chronic cholecystitis. Gall bladder cancer is an uncommon long term outcome.

Diagnosis

The least invasive, safest, and most cost effective diagnostic modality currently available is abdominal ultrasound scanning. In skilled hands the sensitivity and specificity of ultrasonography in the detection of gall bladder stones (cholecystolithiasis) exceed 90%. Stones in the common bile duct (choledocholithiasis) are more difficult to detect, as the stones may be behind the duodenum and obscured by overlying duodenal gas. Raised liver function values, particularly serum bilirubin concentration and alkaline phosphatase activity, and a dilated common bile duct on ultrasonography suggest the possibility of choledocholithiasis. Should these changes persist and stones still not be seen on ultrasonography, endoscopic retrograde cholangiopancreatography should be considered.

Only about 10% of gall stones are calcified, leading to a low detection rate on abdominal radiography and computed tomography. Oral cholecystography (Graham's test) requires the patient to take an oral contrast agent. The detection of gall stones by this test is made unreliable by failure of patient compliance, by impaired liver function and consequent failure to excrete contrast into the bile, or by impaired gall bladder function leading to failure to concentrate the contrast within the gall bladder. Intravenous cholecystography, particularly with high quality tomography of the bile duct, can be used as an alternative to endoscopic retrograde cholangiopancreatography in the preoperative screening of the common bile duct in patients with histories suggestive of choledocholithiasis and who are being considered for laparoscopic cholecystectomy.

Acute cholecystitis is generally diagnosed on the basis of the history and physical signs supported by ultrasound scanning showing a thickened gall bladder wall and, usually, stones or debris in the gall bladder. Radionuclide biliary scanning is a valuable and sensitive tool for confirming the diagnosis, failure of uptake of the tracer by the gall bladder being strongly correlated with cystic duct obstruction and cholecystitis. Jaundice is associated with impaired tracer handling within the liver and so with a lower

sensitivity of the test, though modern radiopharmaceuticals and scanning devices can still allow useful images with bilirubin concentrations several times normal.

Treatment of stones in the gall bladder

"ALTERNATIVE" TREATMENTS

There is growing popular support for alternative, non-medical treatments. The natural course of gall stones, particularly of those that are asymptomatic, probably encourages belief in the efficacy of various treatments. The availability of medical treatments may actually encourage some gall stone patients to try alternative treatments first. There is, however, little scientific evidence to support claims that "folk," herbal, or naturopathic treatments really work.

MEDICAL AND NON-SURGICAL TREATMENTS

Most treatments within what could be described as mainstream or Western medicine are expensive and many are also invasive. However, they remain available for those dissatisfied with the outcome of alternative treatments. As with surgical treatments, most non-surgical treatments are dependent on the availability of advanced and expensive technology and some are quite invasive. However, they are suitable for only about one fifth of patients, have a higher gall stone recurrence rate, and are also not without risks. Non-surgical options available within mainstream medical practice include gall stone dissolution therapy, extracorporeal shock wave lithotripsy, and mechanical litholysis. All may be used with or without subsequent cholecystectomy.

GALL STONE DISSOLUTION AND EXTRACORPOREAL SHOCK WAVE LITHOTRIPSY

Gall stone dissolution may be achieved by oral bile acid treatment with chenodeoxycholic acid or ursodeoxycholic acid or by the use of solvents such as methyl tert-butyl ether instilled directly into the gall bladder or bile duct after endoscopic intubation. It is frequently employed in conjunction with extracorporeal shock wave lithotripsy or endoscopic techniques for gall stone removal. Extracorporeal shock wave lithotripsy uses computer focused shock waves produced outside the body by electromagnetic or ultrasound sources to fragment gall stones. Stone fragments are then passed out of the biliary tree into the duodenum.

Gall stones are most suitable for dissolution treatment when the gall bladder retains at least 50% of normal contractility and the stones are smaller than 1 cm diameter, occupy less than 40% of the gall bladder volume, are non-calcified (that is, are of the same density as the surrounding gall bladder fluid on computed tomography), and are of cholesterol or mixed type. Fewer than 30% of gall stones meet these criteria. Treatment with oral bile salts results in maximal stone dissolution over the first six months and beyond 12 months is not cost effective. Gall stone dissolution alone has a failure rate of over 50% overall and a recurrence rate if stones are eliminated of 25-50%.[35-38]

The selection requirements for extracorporeal shock wave lithotripsy are similar to those for dissolution therapy. Solitary radiolucent calculi of smaller than 2 cm diameter are the most suitable.[39,40] Passage of stone fragments through the cystic duct and across the papilla is painful, usually requiring narcotic analgesia. Extracorporeal shock wave lithotripsy is most effective when combined with oral bile salt therapy. It achieves a 90-95% stone clearance in appropriately selected patients[41] and carries a five year stone recurrence rate of between 15% and 50%, depending on the size and type of stones, degree of gall bladder scarring and dysfunction, and use of adjuvant oral bile acid therapy. The morbidity risk of extracorporeal shock wave lithotripsy is low and mortality is negligible. Jaundice and pancreatitis may occur but are usually mild and transient.[42]

Box 1—Principles of cholecystectomy

Aims	*Process*
• Remove stones	• Assess surgical risks. Consider alternatives
• Ensure normal bile flow	↓
• Eliminate recurrence risk	• Screen for common bile duct stone risk factors
• Avoid bile duct damage	↓
	• Access under general anaesthesia (laparoscopy/open)
	↓
	• Identify biliary anatomy (with or without cholangiography)
	↓
	• Clear common bile duct if necessary
	↓
	• Secure cystic duct
	↓
	• Remove gall bladder and contained stones

MECHANICAL LITHOLYSIS

Mechanical fragmentation of stones, by crushing with forceps or baskets or with laser or ultrasound devices, can also allow clearance of stones from the gall bladder and bile duct without gall bladder removal. Underlying abnormalities in gall bladder function and in the constituents of the bile again lead to high stone recurrence rates, so these techniques are usually reserved for patients medically unsuitable for surgery or unwilling to submit to surgery.

CHOLECYSTECTOMY

Aim of treatment

For those symptomatic patients with gall stone related problems confined to the gall bladder the aim of treatment should be elimination of the stones and of the risk of recurrent stones. Cholecystectomy is the most cost effective and the only reliable method of achieving this. It remains the treatment of choice and the standard by which other remedies are now measured (box 1).

Throughout the Western world and increasingly in the developing world cholecystectomy is now available either as an open operation, requiring upper abdominal laparotomy, or as a laparoscopic ("closed" or "minimally invasive") operation. Both methods require a general anaesthetic. But however the operation is done the surgical objectives are the same—namely, to eliminate the gall bladder and contained stones along with stones in the rest of the biliary tree if necessary, without injuring the biliary tree or surrounding organs and allowing the rest of the patient's life to be lived free of biliary stone disease.

Cholecystectomy and asymptomatic gall stones

In general, elective cholecystectomy for asymptomatic gall stones has not been cost effective and is uncommonly indicated.[43,44] Even for gall stones discovered during surgery for non-biliary reasons there has been no good evidence of benefit from cholecystectomy for asymptomatic gall stones. Diabetes was seen as a relative indication for cholecystectomy in the

presence of asymptomatic gall stones but doubt has also been cast on this.[45] Though as a general rule asymptomatic gall stones should be left in situ, special consideration may be indicated for certain high risk patients—for example, those with haemolytic diseases, those undergoing non-hepatic transplantation, and very young patients.[45 46] We can intuitively identify these as high risk groups deserving individual consideration, but there is little scientific evidence of benefit from prophylactic cholecystectomy.

Box 2—Gall stone related risk factors for gall bladder carcinoma

Gall bladder wall
- Non-function
- Scarring/contracture
- Calcification
- Thickening

Gall bladder epithelium
- Adenomyosis
- Papillomatosis

History
- Chronic disease

Gall bladder cancer risk

The risk of gall bladder cancer is increased by stones but remains very low and cannot usually be taken as justification for prophylactic cholecystectomy in asymptomatic patients. Gall stone induced bile stasis and recurrent infection seem to be responsible for the increased gall bladder cancer risk rather than the size or number of stones.[24] This link seems strongest when the gall bladder is affected by chronic cholecystitis over many years and is calcified or heavily scarred and contracted or when mucosal changes such as adenomyosis or papillomatosis are present (box 2). These mucosal changes may be identified with good quality ultrasound scans and histologically are associated with epithelial metaplasia and dysplasia.[24 47–50] Stones may also be seen in patients with anomalous union of the pancreatic and biliary ducts as seen in choledochal cysts, a condition also associated with dysplasia and eventual malignant change in biliary epithelium.[51]

Open cholecystectomy

The mortality associated with open cholecystectomy has decreased over the past five decades. In 1934 Heuer found a mortality of 6·6% in a review of collected reports covering over 36 000 patents.[51] At that time advanced biliary disease, hepatic disease, inadequacies in surgical management, and anaesthetic complications were common causes of death. Fifty years later McSherry reported mortality ranging from 0·3% for elective open cholecystectomy to 8·0% for elderly patients with acute cholecystitis.[52] Comorbidity[54] and age[53 54] had become the major mortality predictors, with cardiovascular disease, cerebrovascular disease, and pulmonary embolism in decreasing frequency accounting for the great majority of postcholecystectomy deaths. Less common causes include respiratory failure in patients with pre-existing lung disease, mesenteric arterial occlusion in those with vascular disease, and bleeding in those affected by cirrhosis and portal hypertension. Deaths related to technical factors in the procedure itself are now rare but have included loss of arterial ties, gut perforation, and sepsis due to bile leakage.

Morbidity for open cholecystectomy varies between 5% and 15% and is also heavily influenced by patterns of comorbidity and by the presence of gall stone complications such as cholecystitis and choledocholithiasis.[54] Wound infection rates are generally less than 5% for elective cases, rising to 10-15% for urgent, acute cases.

Cholecystitis is associated with very low mortality. However, cholecystectomy in the presence of acute cholecystitis doubles perioperative mortality and increases morbidity, particularly from bleeding, sepsis, and duct injury. It also amplifies the effect of any comorbidity. None the less, early cholecystectomy during an attack of cholecystitis is an effective treatment, obviating the risks of perforation and recurrent attacks and allowing treatment to be condensed into one hospital admission instead of two. The same reasoning applies to gall stone pancreatitis, except that the pancreatitis should be allowed to settle and the serum amylase activity to return to normal before cholecystectomy. In gall stone pancreatitis which is severe, which fails to settle, or which becomes complicated by cholangitis urgent common bile duct drainage by endoscopic sphincterotomy should be considered and may be life saving.[55 56]

Morbidity specific to cholecystectomy centres on injuries to the biliary tract. The most feared and most difficult of these is accidental excision of all or part of the extrahepatic biliary tree. Careful adherence to operative technique, particularly to careful exposure of the structures in Calot's triangle, coupled with a knowledge of the anatomical variability which characterises the region and a high index of suspicion that any particular case harbours a potentially dangerous anatomical variant has led to injury rates of between 0·05% and 1%.[57–60]

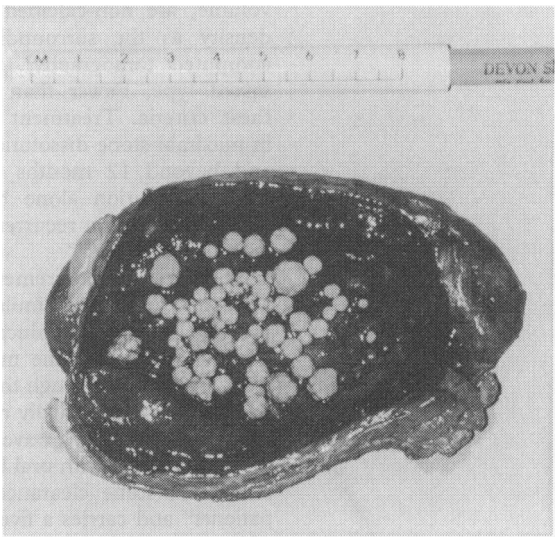
All facilities in which this surgery is performed should have the capacity to carry out intraoperative cholangiography at any time. Though there is disagreement over its routine use, all surgeons performing cholecystectomy should be skilled in cholangiography and interpreting the result. The yield of unexpected common bile duct stones on routine operative cholangiography is 5-10%. Operative cholangiography is also a valuable adjunct for clarifying biliary anatomy and for checking the integrity of the axial biliary tree during cholecystectomy. If an operative injury to the biliary tract occurs, early detection may be facilitated by intraoperative cholangiography.

The current technology costs of open cholecystectomy are comparatively low, as instrumentation is well standardised and largely reusable. The major variable influencing cost is the length of hospital stay. With the advent of minilaparotomy and improvements in analgesia and home postoperative care, hospital stays for open surgery have declined—particularly in the United States, where stays of two to four days after open cholecystectomy are common. In the United Kingdom and Australia stays of four or five days are usual after open cholecystectomy.

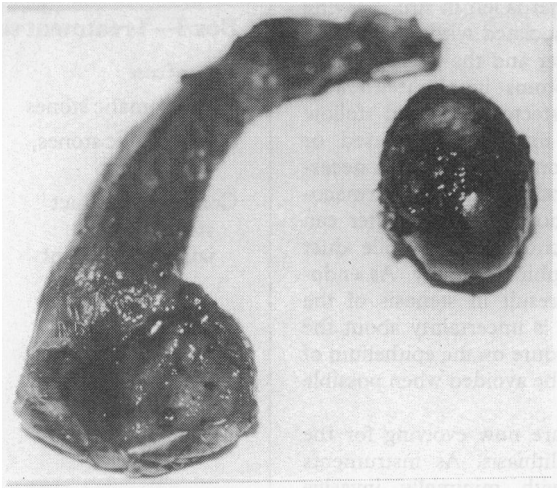
LAPAROSCOPIC CHOLECYSTECTOMY

The principles of laparoscopic cholecystectomy are identical with those of open cholecystectomy, with the exception of the access route and the capacity to convert to an open procedure should the laparoscopic technique fail. Laparoscopic cholecystectomy is now well established and has spread rapidly such that it has become the most common form of cholecystectomy in most of the Western world.

Early reports indicated that the laparoscopic bile duct injury rate could be substantially higher than that seen with open cholecystectomy.[60] Later reports, how-



Multiple gall stones in acute on chronic cholecystitis



Stone removed from gall bladder showing thinning of gall bladder wall and loss of mucosa

ever, recorded improvements, most bile duct injury rates now being comparable to that expected with open cholecystectomy.[61] Vascular and bowel injury can occur during placement of gas insufflation needles or access ports. Death or severe morbidity may result from the subsequent blood loss, gas embolism, or sepsis. The incidence of vascular and bowel injuries and gas embolisation can be minimised by techniques avoiding needle placement in the direction of major vascular structures and by the use of open port introduction techniques such as Hasson's cannula.

Early experience suggested that the loss of gall stones into the peritoneal cavity was a benign event. Later reports highlighted the potential for stones lost in the peritoneal cavity to produce delayed complications such as abscesses or obstructing adhesions.[62-64] It is now advised that care should be taken to ensure as complete a removal of all stones from the peritoneal cavity as possible at laparoscopic surgery.

At present the cystic duct is usually secured with a metal clip. Provided that care is taken to exclude the bile duct and hepatic vessels from the clip, this is safe in the short term. However, bile duct obstruction and cholangitis due to migration of metal clips through the duct wall into the lumen of the common bile duct may occur.[65]

The possibility that gall bladder malignancy could be spread during laparoscopic cholecystectomy should be borne in mind, particularly when there is longstanding disease and gall bladder wall thickening or gall bladder polyps have been detected on ultrasonography. The risk of port site implantation may be reduced by removing the gall bladder from the abdomen in a protective bag. Changing to an open procedure should be considered if handling by laparoscopic instruments is likely to lead to gall bladder leakage.[66,67]

The reduced pain, scarring, stay in hospital, and postoperative recuperation times achieved with laparoscopic surgery have led to a high degree of patient acceptance. However, the technology and training costs are high and exacerbated by the increasing trend to use of disposable instruments. Social and cultural factors, high costs, and the steep learning curves required will limit the pace of acceptance of this procedure into the health systems of poorer countries.[68]

GALL STONES IN PREGNANCY

The incidence of gall stones rises during pregnancy, a trend particularly noticed in developing societies where there have been changes towards Western style diets.[69] Screening ultrasound scans detected biliary sludge or gall stones in up to 40% of pregnant women in one Italian study.[70] This is thought to be related to enhanced lithogenicity resulting from increased cholesterol saturation and decreased chenodeoxycholic acid in bile during periods of sustained high oestrogen concentrations and exacerbated by reduced gall bladder emptying during pregnancy.[71]

Only a small proportion of stones formed during pregnancy will be symptomatic. Pre-existing, asymptomatic gall stones may also become symptomatic.[72] When possible, surgery for gall stones should be avoided during pregnancy and symptoms treated medically until after delivery, when cholecystectomy can safely be performed, usually without loss of lactation. If severe symptoms or complications mandate surgery it is most safely carried out during the second trimester. Cholecystectomy carries a small risk of radiation or drug induced teratogenesis in the first trimester, of abortion in the first and second trimesters, of premature labour in the third trimester, and of fetal death in utero at any stage. These risks must be balanced against the severity of symptoms and the risk that uncontrolled gall stone disease may pose to the mother.

LONG TERM CONSEQUENCES OF CHOLECYSTECTOMY

Removal of the gall bladder and with it of most of our ability to store and then release bile after eating is generally seen as a benign, well tolerated change in physiology. This may not be entirely correct. Even when gall stones were present up to 40% of patients will continue to have symptoms similar to those before operation, though they may be less intense, occur less frequently, and eventually settle in some cases.[73] Duodenogastric reflux may cause postcholecystectomy bile gastritis.[74,75] Patients with pre-existing symptoms of gastro-oesophageal reflux may find them more severe after cholecystectomy owing to an increase in the bile content of the refluxing fluid and perhaps some ill defined changes in the motility of the upper gut postoperatively. These changes and fat malabsorption may also contribute to postcholecystectomy diarrhoea.[76] This is usually transient but occasionally is a persistent problem.

Secondary bile acids are increased in the faeces after cholecystectomy and in bowel cancer, and a role has therefore been postulated for these and hence for cholecystectomy in the pathogenesis of colonic cancer. An increase in the incidence of colonic carcinoma after cholecystectomy has been reported, particularly in the right colon in women. This has not, however, been confirmed and has not been shown in other groups, but the possibility of a weak link between cholecystectomy and colonic carcinoma remains to be firmly excluded.[77]

Treatment of stones in the common bile duct

Symptomatic or asymptomatic choledocholithiasis may be encountered before, during, or after surgery and may necessitate removal of stones from the biliary tree if they are not passed spontaneously. The standard treatment of choledocholithiasis before endoscopic retrograde cholangiopancreatography was open surgical exploration of the common bile duct, usually during cholecystectomy. This requires opening of the common bile duct (choledochotomy), instrumentation of the biliary tree, and removal of the stones by flushing them through to the duodenum or extracting them through the choledochotomy.

Developments in therapeutic fibreoptic endoscopy preceded those of laparoscopic biliary surgery. Consequently, endoscopic retrograde cholangiopancreatography with endoscopic sphincterotomy and extraction of common bile duct stones has taken precedence in the treatment of choledocholithiasis.[78] When carried out before laparoscopic cholecystectomy it reduces the need for open gall bladder surgery in patients with bile duct stones but means that at least two procedures are

required unless the gall bladder is left in situ. Leaving the gall bladder in situ is associated with fibrosis and contraction of the gall bladder and the later development of gall bladder symptoms in about 15% of patients.[75] Elective cholecystectomy should follow endoscopic duct clearance unless it is refused or contraindicated. Sphincterotomy is not always necessary to extract small stones endoscopically. Pharmacological or mechanical dilatation of the sphincter can allow the endoscopic extraction of small bile duct stones without endoscopic sphincterotomy. As endoscopic sphincterotomy can result in stenosis of the sphincter of Oddi and there is uncertainty about the long term effects of the procedure on the epithelium of the distal bile duct, it should be avoided when possible in patients under 45.

Laparoscopic techniques are now evolving for the management of choledocholithiasis. As instruments improve and experience with minimally invasive surgery increases, laparoscopy will increasingly gain a place in the surgical management of choledocholithiasis, similar to that previously occupied by open exploration of the bile duct with open cholecystectomy.

Endoscopic techniques may not always be successful, and open or laparoscopic surgery for bile duct stones may not always be accepted by the patient or be desirable clinically. In these circumstances interventional radiology with transhepatic, percutaneous techniques can be effective for bile duct drainage and removal of bile duct stones. Extracorporeal shock wave lithotripsy, gall stone dissolution, gall stone crushing, and contact fragmentation techniques by means of ultrasound impulses or laser beams also have a place in the treatment of complicated bile duct stones.

Box 3—Treatment selection guidelines

Type of case	*Action*
Asymptomatic stones	No treatment
Symptomatic stones, well patient	Cholecystectomy
Common bile duct stones, non-jaundiced patient	Laparoscopic cholecystectomy and laparoscopic common bile duct exploration if available Otherwise endoscopic extraction of common bile duct stones before cholecystectomy
Symptomatic stones, medically unfit patient	Consider extracorporeal shock wave lithotripsy or stone dissolution or both
Obstructive jaundice, cholangitis, gall stone pancreatitis, previously fit patient	Establish duct drainage by endoscopic stone extraction or duct intubation. Later cholecystectomy

Conclusions

Asymptomatic gall stones rarely warrant treatment. At present the only truly effective treatments for symptomatic or complicated gall stones are those which fulfill the requirements of immediate treatment (gall stone removal and restoration of unimpeded bile flow) and long term prevention of gall stone recurrence (prevention of bile stasis and stone formation). The safest, most widely available and cost effective method remains cholecystectomy.

When acute gall stone problems such as cholangitis or pancreatitis are present cholecystectomy may have to be preceded by endoscopic retrograde cholangiopancreatography and non-duct surgical drainage. These techniques, often supported by extracorporeal shock wave lithotripsy and gall stone dissolution therapy, are also invaluable in cases in which other medical considerations prevent safe biliary surgery or in which it is refused.

Death rates of less than 1% for elective open cholecystectomy are now commonly achieved throughout the developed world. This along with the low rate (also less than 1%) of common bile duct injury ranks open cholecystectomy as the standard for safe, effective elimination of gall bladder stone disease. However, laparoscopic technology has made biliary surgery less painful and allows a shorter hospital stay and quicker recovery, though at present laparoscopic technology costs more. Though techniques for laparoscopic treatment of choledocholithiasis have lagged behind those of cholecystectomy—leading to fragmentation between surgical and fibreoptic endoscopic treatment of choledocholithiasis—this is now being redressed as laparoscopic technology and techniques evolve.

Early reports suggested that laparoscopic cholecystectomy would not be as safe as open cholecystectomy. Contemporary findings, however, suggest that the learning phase is over and that the laparoscopic technique in skilled hands produces results equal to those of open surgery. There is as yet insufficient evidence to say whether laparoscopic surgery is safer than open surgery. Laparoscopic techniques are as refined as those of open surgery. Training programmes in laparoscopic surgery are now freely available and should be mandatory for laparoscopic surgical accreditation and hospital privileges in biliary surgery.

The early years of the next century will probably see further reductions in hospital stay, possibly with most gall stone surgery done on a day to day basis by means of videolaparoscopic technology. The major breakthroughs to follow are likely to be in prevention.

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A MEMORABLE OUTPATIENT

If sister says so

My outpatient sister in those days was of the old school. Tall, majestic, and Scottish, she ruled the clinic. All of us feared her. As a result outpatients ran like clockwork. Sister ushered the patients into the cubicles, commanded them to get undressed, and I was then ordered into the appropriate cubicle with my students in strict rotation.

One day, in the usual crowded clinic, appeared a foreign man carrying a large parcel. He requested to see the professor. "Go into cubicle three, take off all your clothes, and the professor will be in to see you in a short while," said sister. A few minutes later I in turn was ordered into cubicle three. There was my foreign visitor, stark naked, with the large parcel balanced on his knees. "I am the cousin of your patient, Mr M from Teheran. He has asked me to come and tell you during my visit to your country that he is very well after his great operation. He sends you his best wishes and commanded me to bring you this present of a box of pistachio nuts."

Behind me I could detect my students collapsing with suppressed laughter and I could sense the unease of sister. Calling on all my years of strict surgical discipline and training, I kept a completely straight face. "I am delighted to hear that Mr M is well after his operation. Give him my kindest wishes and thank him for his present of the pistachio nuts. You may get dressed now."

If you visit a mosque they ask you to take off your shoes. If you go to a synagogue you are asked to put on one of those little caps. No one would dream of objecting. Obviously, if you bring a present to a professor of surgery of the University of London you first have to get yourself undressed completely. Especially if the outpatient sister orders you to do so.—HAROLD ELLIS *is emeritus professor of surgery, University of London*