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REVIEW ARTICLE

Common bile duct stones – their presentation, diagnosis and management

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Abstract Common bile duct (CBD) stones continue to pose a significant problem both to the patient and the surgeon. They increase the morbidity of a patient undergoing Cholecystectomy from less than 5% to as much as 20% and almost zero mortality to as high as 30%. Recent times have thrown up a fair share of controversy in the management of this condition both due to technological innovations and costreduction-pressures. The aim in CBD stone disease, as in any benign disease is to discover a therapeutic algorithm with minimal morbidity, no mortality and at reasonable cost. This can be achieved only by a thorough understanding of the disease and also the available diagnostic and treatment modalities.This article dicusses the diagnosis, investigation and therapy of CBD stones and gives a therapeutic algorithm.

Keywords Common bile duct stones · Gall stones · Laparoscopic · MRCP · ERCP

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Introduction

Common bile duct (CBD) stones continue to pose a significant problem both to the patient and the surgeon. They increase the morbidity of a patient undergoing cholecystectomy from less than 5% to as much as 20% and almost zero mortality to as high as 30% [1–53]. Recent times have thrown up a fair share of controversy in the management of this condition both due to technological innovations and cost-reduction-pressures. The aim in CBD stone disease, as in any benign disease is to discover a therapeutic algorithm with minimal morbidity, no mortality and at reasonable cost. This can be achieved only by a thorough understanding of the disease and also the available diagnostic and treatment modalities.

Presentation

CBD are often asymptomatic and are detected incidentally during workup in up to 7–20% of patients with gallbladder stones awaiting cholecystectomy [1–8, 49]. From studies of biliary acute pancreatitis it is clear that up to 90% of stones pass through the CBD and into the faeces [10]. Stones less than 3 mm if they do not cause pancreatitis pass unnoticed into the stools [10].

Incidence of bile duct stones in patients with cholelithiasis increases with age and duration of the disease. In patients below 60 years CBD stones occur in 8–15% while in those above 60 they are seen in 15–60% [9]. In patients with acute cholecystitis they are seen in 18% of patients [9].

Stones may present with any combination of the following: biliary colic, obstructive jaundice, cholangitis, acute pancreatitis, biliary fibrosis, or as a choledochoduodenal fistula. Primary ductal stones are stones that are brown;

powdery; usually oval shaped; crumble easily and are found either in the absence of the gall bladder or 2 years after cholecystectomy [11]. They are more common in patients with duodenal diverticula. Stones may also be found in the CBD in the absence of gallbladder stones in patients with recurrent pyogenic cholangitis, infection with clonorchis sinensis or fasciola hepatica and may occur in patients secondary to sphincter of oddi dysfunction, papillary stenosis, proximal to CBD strictures etc. They behave differently from secondary stones and require some form of drainage of the biliary tree after choledochotomy and evacuation of the stones [11].

Investigation of CBD stones [12–50]

One of the main reasons of investigating a patient with gallstones prior to cholecystectomy is to exclude the presence of associated CBD stones. All investigations are aimed at evolving a minimally invasive approach with the least number of complications achieved in a cost effective manner to achieve a low overall morbidity of treatment. The most controversial aspect has been the relative timing of MRCP, ERCP and surgery. Reporting on 88 patients with gallbladder stones, Bose et al. found that of 53 patients with one or more risk factors, 26 harbored CBD calculi; none of 35 patients without risk factors had CBD stones. Jaundice correlated best, with a sensitivity of 69%; and pancreatitis had the lowest sensitivity (12%) [7]. Elevated serum bilirubin and alkaline phosphatase levels correlated better than liver enzymes and serum amylase [7]. The sensitivity and negative predictive value of cholescintigraphy scanning for diagnosing CBD calculi were better than those of ultrasonography, the sensitivity being 84% versus 50% and the negative predictive value 95% versus 82% [7]. Endoscopic retrograde cholangiopancreaticography was successful in 94% of the patients, and CBD calculi were diagnosed in 74% [7]. Moreover, peroperative cholangiography was 100% sensitive with no false-positive results [7]. Ultimately, a palpable stone at surgery was the best predictor. When all the criteria were analysed, it was found that as the number of criteria increased so did the percentage of patients harboring CBD calculi [7]. There is considerable variation among individual surgeon's practice in this area. We will present in the following sections an overview of the different diagnostic modalities available. It is for individual surgeons to evolve a dignostic flow chart based on each patients clinical presentation, availability of the investigative modality and economic feasability given the population that they treat.

1. Biochemical investigations

Liver function tests are commonly performed to evaluate a patient with jaundice. A raised alkaline phosphatase along with a raised gamma glutamyl transpeptidase (GGT) confirms obstruction to the biliary tree. SGOT and SGPT are not usually markedly elevated unless the patient has post cholangitic liver abscesses. If they are increased associated conditions such as cirrhosis and viral hepatitis should be considered. Single tests such as bilirubin, alkaline phosphatase, or GGT are predictive of CBD stones to the extent of 25–40% [7]. When all biochemical tests are normal, the incidence of CBD stones is just 7% [7]. Yang et al. report on 1,002 patients undergoing laparoscopic cholecystectomy [46]. They found that at least one abnormal elevation among the five biochemical parameters had the highest sensitivity (87.5%). Total bilirubin had the highest specificity (87.5%), highest probability ratio (3.9), highest accuracy (84.1%), and highest positive predictive value (27.4%). All five biochemical predictors had high negative predictive values; gamma glutamyl transferase was highest (97.9%), while the lowest was total bilirubin (94.7%) [46]. Multivariate analysis showed only gamma glutamyl transferase, alkaline phosphatase, and total bilirubin to be independent predictors; gamma glutamyl transferase appeared to be the most powerful predictor (odds ratio 3.20) [46].

2. Cholangiography

Berggren et al. reporting on 782 of the 1,000 patients who had successful preoperative intravenous cholangiography, demonstrated detection of 30 CBD stones and information about anatomical variation in CBD anatomy [15]. Patients with inconclusive i.v.c. studies, or those with a history of contrast allergy, had intraoperative cholangiography, which demonstrated a further 19 CBD stones [15]. There were no contrast reactions and no damage to the biliary system which might have been obviated by intraoperative cholangiography. In the 724 patients who did not require complimentary intraoperative cholangiography, there has been no clinical evidence of missed CBD stones [15]. It has disadvantages of reactions to iodinated contrast, difficulty in sufficiently opacifying the CBD and inability to perform any therapeutic procedure. It is now not popular for diagnosing CBD stones having been replaced by MRCP and ERCP.

3. Ultrasound abdomen

This test is a screening procedure for CBD stones. In the diagnosis of CBD stones, US exhibits poor test performance at detecting CBD stones with sensitivities in the range of 25–58% and specificities of 68–91% [48]. A normal US result in conjunction with normal total bilirubin and alkaline phosphatase levels has been shown to have an excellent negative predictive value for choledocholithiasis, approaching 95% [7–10]. When used in tandem with 5 biochemical parameters (bilirubin, SGOT, SGPT, alkaline phosphatase, GGT, it achieves a predictive accuracy as high as 95%, if, any two biochemical parameters are positive [7–10]. Interpreting this data if there is a high suspicion of stone based

on clinical and biochemical parameters, ultrasound would be capable of confirming a CBD stone at a statistically satisfactory level [1–42].

The disadvantages of US are:

(i) It cannot detect stones in the retro duodenal, pancreatic, intraduodenal portion of CBD due to the echogenicity of duodenal gas. An impacted stone can be diagnosed by indirect evidence of biliary dilatation.
(ii) No therapy is possible.

4. MRCP (Magnetic resonance cholangiopancreatogram)

This relatively new diagnostic procedure which involves capturing a heavily T2 weighted image (which enhances fluid containing structures) is rapidly gaining acceptance [12–23]. The reasons for this are

(i) It is non-invasive
(ii) It simultaneously gives considerable information regarding adjacent structures such as the pancreas and liver
(iii) Allows for 3 dimensional reconstruction
(iv) Combined with Gadolinium enhanced MR angiography forms a complete single investigation
(v) Can replace intraoperative cholangiogram once experience at interpretation improves
(vi) Shares the same disadvantages as ERCP in that it cannot differentiate between stone, sludge, mucus plugs

The drawbacks of MRCP are its high cost and requirement of an expert interpreter. Pitfalls were caused by flow artifacts, compression by vessels, and low contrast between calculi and surrounding parenchyma [17]. The sensitivity for detecting stones appears to decrease according to the size of the stone: 67–100% for stones >10 mm in size, 89–94% for stones measuring 6–10 mm, and 33–71% for bile duct stones <6 mm in size [47].

Choledocholithiasis can be diagnosed with a sensitivity of 88-92% and specificity of 91–98% (vs. 98% for ERCP) [12–23]. In a blinded study with 110 patients, 30 with choledocholithiasis, 2 observers, one of whom had an experience of 2 years, achieved comparable results with a sensitivity of 90%, specificity of 93%, positive predictive value of 82%, and negative predictive value of 96% and overall accuracy of 92% with inter-observer agreement of 93% [21].

5. ERCP

ERCP can detect 94% of CBD stones [7]. In the diagnosis of choledocholithiasis ERCP has a sensitivity of 90%, a specificity of 98%, and an accuracy of 96% [48]. It has the added advantage of allowing therapeutic interventions in the same sitting. But proper technique is essential to achieve accuracy. ERCP will be dealt with in detail in the section on treatment.

6. CT scan

It is not a commonly done investigation once a clinical diagnosis of CBD stone is made. Usually when the etiology of distal common duct obstruction is not clear an ultrasound followed by a CT scan would be done. Now in modern practice the patient is more likely to undergo an endoscopic ultrasound followed by an ERCP. CT scan however is more accurate than abdominal ultrasound in detecting retroduodenal and intra-pancreatic stones; but requires a dilated common duct. The classical appearance is described as a “Target sign”. For the diagnosis of CBD stones, high resolution computed tomographic cholangiography achieved a sensitivity of 87% (95% CI (84-90)), a specificity of 97% (95% CI (95-98)), and an overall accuracy of 95% (95% CI (94-97)) for the diagnosis of CBD stones compared to direct imaging such as ERCP or IOC [47].

In an occasional patient CT cholangiography is a useful alternative to ERCP for example in a patient with a gastric outlet obstruction or duodenal diverticulum or a patient unwilling to have an ERCP. In this procedure the CBD is opacified by oral or IV cholangiography and spiral CT with a slice thickness of 2 mm is used for imaging the common duct.

7. Endoscopic ultrasound

This procedure is very efficient in imaging the intrapancreatic and the intraduodenal portion of the CBD. In addition it allows differentiation from a cholangiocarcinoma at the lower end and also FNABC from any suspected non-calculous lesion. Its imaging of the upper biliary tract including the intrahepatic branches is, however, less accurate. Sensitivity is 93–97% and specificity is 97–100% [29]. Dilatation of the CBD as a marker of choledocholithiasis has a specificity of 94% [29]. EUS is very accurate in determining the cause of extrahepatic obstruction with a sensitivity of 97% and a specificity of 88% compared with the combined gold standard of ERCP, intraoperative cholangiography (IOC), and clinical follow-up [47]. In particular, EUS is very accurate in diagnosing CBD stones, with a sensitivity of 95%, specificity of 98%, and an accuracy of 96%. EUS is especially more accurate in detecting small stones or stones within small caliber CBDs [47].

8. Intraoperative cholangiogram (IOC)

Many groups believe in routine intraoperative cholangiogram [54]. Groups that believe in routine intraoperative cholangiogram argue that it increases the operative time

just by a few more minutes. It is also less morbid and has no mortality as compared to ERCP, while being more cost effective. However, this requires surgical units to invest in a C arm device/portable X-ray device with radiolucent tables which is outside the reach of many centres performing laparoscopic cholecystectomies.

Mir et al. [45] report on 1,267 patients (976 females/ 291 males) where laparoscopic cholecystectomy without routine IOC was performed. Twenty-three cases were converted to open procedures; 12 patients developed port site infection, and there was no procedure related mortality. One patient had CBD injury and 4 patients had biliary leak. One cholecystohepatic duct was detected and managed intraoperatively, 1 patient had retained CBD stones, while 1 patient had retained cystic duct stones. Incidental gallbladder malignancy was detected in 2 cases [45].

Reporting on 343 patients undergoing laparoscopic cholecystectomy over a one year period, Korman et al. [55] advocate preoperative ERCP in patients with biochemical or ultrasound abnormalities. They discourage IOC in individuals where ERCP is normal citing increased incidence of false positives resulting in additional procedures and advocate postoperative ERCP with stone clearance for those stones that become symptomatic. Following this policy they had a 1% incidence of post-cholecystectomy stone disease and a 3% false positive rate when IOC was done. They also report no bile duct injury in both groups.

Echoing this advice in a series of 997 patients [56] in whom IOC was accomplished in 962 patients (96%), 46 patients (4.6%) had at least one filling defect. Twelve of these had a normal cholangiogram at 48 hours (26% possible false positive operative cholangiogram) and a further 12 at 6 weeks (26% spontaneous passage of calculi) [56]. Spontaneous passage was not determined by either the number or size of calculi or by the diameter of the bile duct. Only 22 patients (2.2% of total population) had persistent CBD calculi at 6 weeks after laparoscopic cholecystectomy and retrieved by endoscopic retrograde cholangiopancreatography [56]. Treatment decisions based on assessment by operative cholangiography alone would result in unnecessary interventions in 50% of patients who had either false positive studies or subsequently passed the stone [56].

IOC should be therefore probably be done in units where experience to perform laparoscopic CBD exploration exists since in the absence of this and with the availability of ERCP a minimally invasive approach will not be possible. Again it makes sense to perform this procedure if access to ERCP is not available or if the patient comes from a remote location since this will allow the cholecystectomy and CBD clearance to be performed in one single setting. Intraoperative cholangiography should also be performed either in all or in those with high risk of residual CBD stones when an open cholecystectomy is being performed.

9. Laparoscopic ultrasound

Recently some surgical units have advocated the use of laparoscopic ultrasound as an alternative to Intraoperative cholangiogram but many reports show that this procedure is inadequate to examine the intrapancreatic CBD. Since most CBD stones are situated in this portion, this procedure appears to be inferior to IOC [9].

Treatment of CBD stones

The treatment of CBD stones has shown considerable evolution over the last 4 decades (Fig. 1). The cause for this evolution has been constant upgradation of technological capability, which allows treating clinicians to offer cure with minimal discomfort and morbidity. At times, these technological innovations have been adopted without clear-cut guidelines from randomised trials. It is difficult for many non-surgical clinicians to accept the fact that for a "Good risk" patient surgical CBD clearance offers the best chance of a complete cure with minimal morbidity. This argument may become moot in a few years if laparoscopic CBD clearance is standardised in which circumstance, a treatment option with minimal patient discomfort can be offered [24, 25–27, 50, 53].

The factors that decide treatment are:

1 Size of the stone
2 Size of the duct
3 Post cholecystectomy status of the patient
4 Drainage tube in CBD
5 Location of the stone,
6 multiple intrahepatic stones,
7 presence of stricture
8 Risk assessment of the patient-age, cholecystitis, pancreatitis, associated systemic diseases such as cirrhosis of the liver

Surgical therapy of CBD stones [24–27, 50–55]

Open choledocholithotomy (with or without a drainage procedure)

Indications

(i) Dilated CBD with or without inflammation with a positive intraoperative cholangiogram or diagnostic choledochoscopy
(ii) Previous history of cholangitis or jaundice
(iii) Previous history of gall stone pancreatitis with a positive Intraoperative cholangiogram
(iv) Palpable stones in the CBD

This is the standard surgical procedure and the reader is advised to consult standard operative manuals for the technical details. Certain details, however, need to be highlighted.

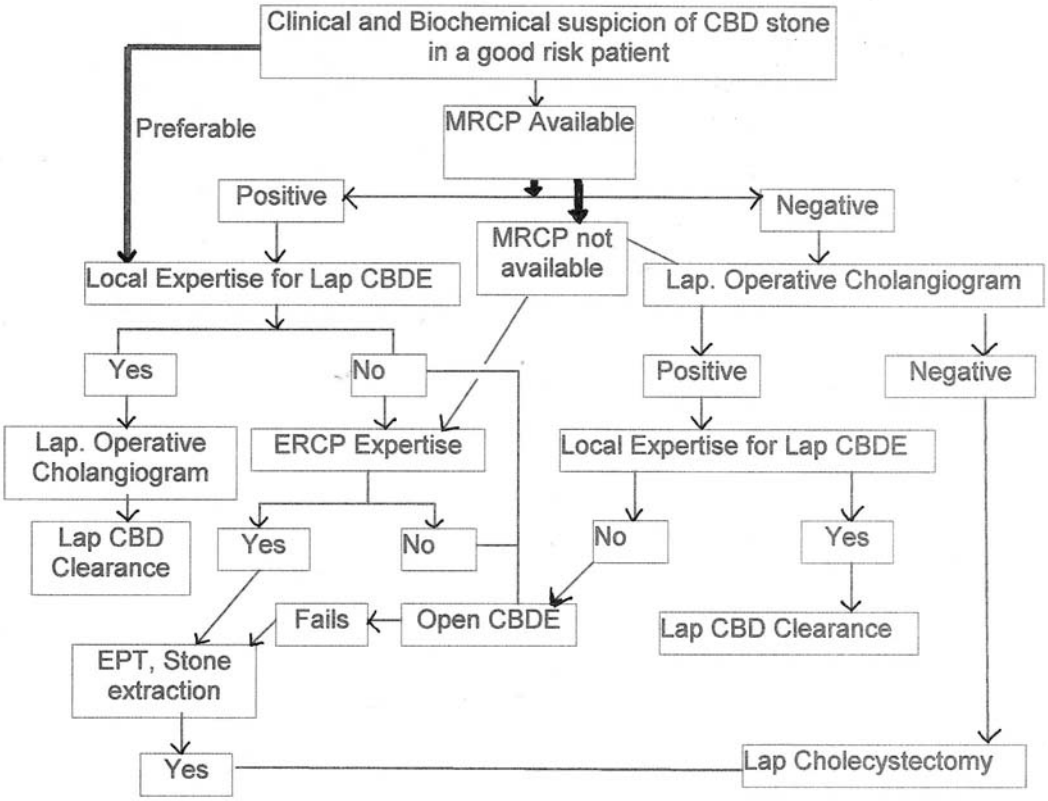

Fig. 1 Algorithm of management of CBD stones in a good risk patient

(i) Kocherization of the duodenum so as to palpate the retroduodenal and intra-pancreatic CBD
(ii) Palpate the ampulla carefully but gently
(iii) Avoid excessive instrumentation of the CBD; Bakes' or any similar rigid dilatation should be avoided
(iv) DO NOT pass the Desjardin's forceps through the ampulla
(v) Do not hesitate to perform a choledochoduodenostomy, sphincteroplasty or choledochojejunostomy provided all required criteria are met.
(vi) Perform choledochoscopy if facilities are available or perform a completion cholangiogram and follow every "minor" technical detail.
(vii) Use the smallest possible diameter T-tube

The residual stone rate of routine CBD exploration with completion cholangiogram is in the range of 7–11% [1–45, 50, 52] and in recent results less than 6% [53]. The reasons for such a high rate are related to missed intrahepatic stones or an improperly done completion cholangiogram.

Completion choledochoscopy has shown better results achieving successful clearance of the CBD in up to 98%. Choledochotomy can on occasion be avoided by cystic duct dilatation and usage of therapeutic choledochoscopy to clear the common duct. An important determinant of whether transcystic CBD exploration will be effective is the size of the stone and the location of the stone. Stones larger than 9 mm cannot be extracted through the cystic duct without fragmentation or in the presence of a friable cystic duct. In addition, stones proximal to the cystic duct-CBD junction can be extracted in only 40% of cases and these cases require either a laparoscopic or open choledochotomy [1–50].

Primary closure of the CBD may be done if the duct is normal and the surgeon is satisfied of clearance of the CBD. But these conditions are rarely met with in clinical practice.

Indications for choledochoduodenostomy

1. Multiple CBD stones
2. Ampullary stenosis with stones
3. Impacted ampullary stone in the absence of pancreatitis
4. Intrahepatic stones

Contraindications for choledochoduodenostomy are

1. CBD <15 mm
2. Perivaterian diverticulum
3. Sclerosing cholangitis

Indications and prerequisites for sphincteroplasty

1. Multiple CBD stones
2. Recurrent CBD stones
3. Stone impacted at ampulla

4. Papillary stenosis with stones

Contraindications for sphincteroplasty are

1. Long stricture >15 mm
2. Perivaterian diverticulum
3. Duodenal wall or pancreas grossly inflamed

Laparoscopic CBD exploration

CBD exploration may be done after initial confirmation (detection) of a stone by IOC laparoscopic ultrasound. The cystic duct is dilated with graded dilators/balloon dilatation and choledochoscopic stone removal is done. The same limitations to transcystic intervention are applicable in laparoscopy as well. Alternatively the CBD may be approached by a choledochotomy where the CBD is opened with scissors or a harmonic scalpel and the CBD explored using a therapeutic choledochoscope. Alternatively Steerable catheters under fluoroscopic guidance are used. Laparoscopic ante grade sphincterotomy may be added to provide bile duct drainage and to prevent the problem of recurrent ductal stones [12, 25]. At completion, a cholangiogram is done and the CBD may be closed over a T-tube using endosutures. In a report of 300 laparoscopic CBDE procedures [57], 173 (58%) were managed using a transcystic approach and 127 (42%) with choledochotomy. Successful laparoscopic stone clearance was achieved in 271 (90%). Of the 29 (10%) patients not cleared laparoscopically, 10 had an elective postsurgical ERC, 12 were converted to an open procedure early in the series, and 7 had unexpected retained stones. There was one death (mortality rate 0.3%) and major morbidity occurred in 22 patients (7%). The last 100 procedures were performed from July 1995 to February 1997, and stone clearance was unsuccessful in only two patients. There are now reports of series where laparoscopic choledochoduodenostomy has been done for post cholecystectomy CBD stones, for recurrent pyogenic cholangitis with recurrent CBD stones without strictures or as an adjunct to cholecystectomy [58–60].

Advantages

(i) Minimally invasive
(ii) Wound related morbidity is avoided

Disadvantages

(i) Advanced and expensive instrumentation required.
(ii) Technical and laparoscopic skills of a high order are required including endosuturing skills
(iii) No long-term follow up data is available

Non-surgical approaches

ERCP

This particular procedure has wrought the maximum change in the management of CBD stone disease. Successful cannulation of the CBD is seen in up to 98% in expert hands and clearance is achieved in 85 to 92% [1–8, 39–41, 48]. Morbidity is approximately 7% with the highest reported mortality being in the range of approximately 2%. Cholangitis can occur after ERCP in up to 4–5% of individuals and can be prevented by pre-procedure antibiotics at least 30 minutes before the procedure and ensuring that adequate serum levels are maintained during the procedure [1–8, 39–41, 51]. Sphincterotomy with stone extraction is the commonest procedure performed. Balloon catheters are preferred as opposed to Basketing because of the chance of impaction of the basket at the papilla. Sphincterotomy has a bleed rate of 1%, perforation rate less than 1% and can cause pancreatitis in 1–2% [1–8, 39–41, 48]. Most of the patients with these complications can be managed conservatively. Pancreatitis can be prevented by a safely performed papillotomy without using an excessive blend current, prevention of contrast visualisation of acini during pancreatogram, using non-ionic contrast medium and more controversially pre-procedure octreotide. In young individuals a sphincterotomy is not preferred because the long-term effects of sphincterotomy are unknown. It has been demonstrated that the bacterial clearance in the CBD is impaired after sphincterotomy. In response to this criticism of sphincterotomy, some groups have advocated balloon dilation of the sphincter of oddi. Pancreatitis has been seen in up to 7% of patients after balloon dilatation and also there appears to be a limitation to the size of stones that can be extracted though there was no difference as compared to ES [1–8, 39–41, 48]. In patients with stones larger than 15 mm success was seen in 47% of balloon dilatation and 54% in the endoscopic sphincterotomy group [39]. A randomised controlled trial between sphincterotomy and balloon dilatation has shown no benefit for balloon dilatation [1–8, 39–41, 48]. A meta-analysis of trials of endoscopic balloon dilation and sphincterotomy has concluded that balloon dilatation probably useful only in patients with a coagulopathy and even for younger patients it is not advisable to use balloon dilatation [1–8, 39, 40, 41, 48].

Radiological interventions

These techniques are usually applied in the post-cholecystectomy CBD stone with a T-tube *in situ*. The stone extracted using a Steerable basket after the T-tube tract is dilated. In the absence of a T-tube tract**,** a transhepatic approach using PTC can be used, if ERCP is not possible and surgery is contraindicated. While giving good results, it requires considerable skill on the part of the radiologist and has a success rate from 88–97% and a morbidity rate of 5–10% [9]. Larger stones can be fragmented and then extracted.

T-tube tracts also allow passage of choledochoscopes and extraction of stones under direct vision and radiological guidance. Ultrasonic shock wave lithotripsy has also been used to fragment the stone [9].

Dissolution of common duct stones

This modality of treatment has decreased considerably in popularity due to the technical difficulties, complications and recurrence of stones. Various agents have been used such as ether, chloroform, heparin, clofibrate and bile acids and all have now been abandoned. Methyl tert-butyl ether (MTBE) is an investigational agent. In addition, it causes necrosis when it comes in contact with the duodenal mucosa. It has a very foul odour making patient acceptance difficult. Monooctanoin is the best agent for dissolution of cholesterol gallstones. It is instilled either through a preexisting T-tube/nasobiliary drain or by the transhepatic route after balloon occlusion of the distal bile duct. Though results are good, toxicity resulting in disruption of the biliary epithelium, necrotizing CBD inflammation and gastric mucosal injury is not uncommon. Reporting on an extremely small series of 5 patients, Saraya et al. [42] found only one patient showed complete disappearance of the bile duct stone following MTBE perfusion. Others did not show any appreciable response and had to be treated by endoscopic papillotomy (three patients) or mono-octanoin perfusion (one patient). Side effects of MTBE perfusion included pain in the abdomen in all patients, somnolence and nausea/vertigo in two patients and the smell of ether on the breath in two patients [9, 28, 42].

ESWL

Extra-Corporeal Shock Wave lithotripsy involves focusing the shock wave produced by a spark generator onto a stone resulting in fragmentation and evacuation of these fragments endoscopically through a previous sphincterotomy. To prevent cholangitis and septicemia, pre-procedure antibiotics are used. Mora et al. [43] reported 19 patients with high risk diseases preventing surgery who underwent ESWL for bile duct stones. The procedure was successful in 16 of the 19 patients (84.2%), where combined treatment with ESWL and subsequent instrumental endoscopic extraction achieved complete clearance of the biliary tract. The treatment failed in 3 patients who underwent surgery. No early or late complications were observed, except in one patient who presented a self-limiting febrile syndrome. Reporting on a small series [44] of 16 patients with impacted stones or stones present above biliary strictures White et al. showed that 16 patients received 27 ESWL treatments (mean = 2101 shock at 21 kV) while 4 patients (22%) required multiple treatments. Stone fragmentation was achieved in 94% of patients. All patients had ERCP performed post-ESWL, and only 2 (13%) patients required immediate operations. At discharge, 94% of patients were stone-free. Minor complications (e.g. pain, hematuria) were common. With an average follow-up of 3 years, only 1 patient (6%) required retreatment for recurrence. Hepatic transplantation was required in one patient.

Therefore there appears to be a role for the appplication of ESWL limited to its use as an adjunct to endoscopic therapy in bile duct stones and also in high risk patients unfit for other procedures.

Post cholecystectomy and post choledocholithotomy CBD stones

Post-cholecystectomy CBD stones can be managed by ERCP and stone extraction if no contraindications for ERCP exist. Large stones (>2 cms) in good risk, young patients are probably better managed by open choledocholithotomy or laparoscopic choledochotomy.

Post choledochotomy stones are managed depending on whether any direct access in the form of a T-tube is available. The various options are radiological approaches, choledochoscopic approaches, gallstone dissolution followed by extraction or dissolution alone, ESWL and ERCP [9].

Management of CBD stones in special situations

(i) Associated with portal hypertension or cirrhosis

In a study of 112 patients with cirrhosis of whom 87 underwent surgery and 12 underwent more conservative procedures patients with Child's grade A disease had fewer emergency procedures, operative blood loss and transfusion were less and they had a shorter hospital stay compared with patients with grades B and C. There were 4 deaths after definitive surgery for emergency conditions and these were all in Child's grade C. Of the 83 survivors after definitive procedures 78 patients (93.9%) were still alive 52.8 months later without any biliary tract symptoms. Of the 25 patients undergoing conservative treatment 2 were Child's B and 23 were Child's C grade. The authors suggest that definitive surgery be done in Child's A and B cirrhotic patients, either electively or as an emergency. However, a more conservative approach was advised in Child C patients. Definitive surgery was to be defferred till after liver function had improved [30, 31].

Another situation is portal biliopathy in extrahepatic portal vein thrombosis. In this situation the bile duct is surrounded by large collaterals which bleed profusely if open surgical exploration of the CBD is attempted. In this situation endocopic therapy is safer either by allowing stenting or allowing sphincterotomy and clearance of the CBD. One precaution however is to be aware that dilated varices in the CBD wall may mimick stone disease and EUS must be done to confirm presence of stones before evacuation is attempted. In those patients where open surgery becomes necessary a prior shunt followed by surgery should be attempted. Most authors recommed a 6–8 weeks waiting period after shunt is performed [32].

(ii) Mirizzi syndrome

In this condition there is a stone impacted in the gallbladder neck associated with common bile duct compression with or without cholecysto-choledochal fistula. Mc Sherry has classified Mirizzi syndrome into Mc Sherry type one where there is compression but no fistula and type two where there is a fistula. In a series of 24 patients with Mirizzi syndrome out of 2012 cholecystectomies 14 patients had type 1 and underwent laparoscopic cholecystectomy while the 10 with type 2 underwent an open operation. However, where CBD stones are being dicussed the stone resides within the CBD only in type 2 Mc Sherry when there is complete erosion or 3/4ths erosion of the CBD wall. In these situations an open operation with a hepaticojejunostomy is appropriate [33–36].

(iii) Associated with hepatolithiasis

In a series of 54 patients [37] with hepatolithiasis biliary disease included 27 benign strictures, 7 sclerosing cholangitis, 5 choledochal cysts, 5 parasitic infections, 5 choledocholithiasis, and 5 biliary tumours. Fourteen patients (26%) were treated exclusively with percutaneous techniques. This involved placing transhepatic stents and the track being used for choledochoscopic extraction of stones. 74% (40 patients) had surgery, including 36 Roux-en-Y hepaticoor choledochojejunostomies with large-bore transhepatic stents. Eighteen of these 40 patients (45%) with multiple intrahepatic stones, strictures, or both required additional procedures after operation. There was no inhospital mortality. With a mean follow-up of 60 months, 94% of patients were stone free, 87% of patients were symptom free, and 73% have had their transhepatic stents removed. Catena et al. however advocate hepatic lobectomy where hepatolithiasis is restricted to one lobe [37, 38].

Conflict of interest The authors do not have any disclosable interest

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