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Review Article

Management of Common Bile Duct Stones: A Comprehensive Review

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Abstract: Bile duct stones (BDS) are usually secondary to gallstones but may be found primarily in biliary system, although the percentage is minimal. They are usually suspected on history and clinical examination alone but symptoms may be variable ranging from asymptomatic to complications such as biliary colic, pancreatitis, jaundice or cholangitis, the latter can be life-threatening in some patients. Abnormalities in the liver function tests especially the elevated direct bilirubin and alkaline phosphatase indirectly raise the suspicion. The majority of BDS can be diagnosed by Transabdominal Ultrasound, but in some cases further imaging such as, Computed Tomography, Endoscopic Ultrasound or Magnetic Resonance Cholangiography are employed prior to endoscopic or laparoscopic removal. Approximately 90% of BDS can be removed following Endoscopic Retrograde Cholangiography (ERC) + sphincterotomy. Most of the remaining stones can be removed using mechanical lithotripsy. Patients with uncorrected coagulopathies may be treated with ERC + pneumatic dilatation of the sphincter of Oddi. Shockwave lithotripsy (intraductal and extracorporeal) and laser lithotripsy have also been used to fragment large bile duct stones prior to endoscopic removal. Despite all the minimally invasive procedures the role of open surgery for the removal of difficult or impacted stones cannot be completely forgotten. The role of medical therapy in treatment of BDS is currently uncertain. This review focuses on the clinical presentation, investigation and current management of BDS.

Keywords: Bile Duct Stones (BDS), Endoscopic Retrograde Cholangiopancreatography (ERCP), Common Bile Duct (CBD), Intra-operative Cholangiography (IOC)

1. Introduction

Stones present in the common bile duct (CBDs) are termed choledocholithiasis. The incidence of choledocholithiasis is not known in gallbladder disease [1] but CBD stone develops in about 10-20% of patients with gallstones. CBD stones are found in almost 3-10% of routine cholecystectomy. They can present with high bilirubin and raised liver enzymes especially alkaline phosphatase but may be asymptomatic. Diagnostic modalities to assess the patients are liver function tests (LFTs), whereas imaging like ultrasound (US) abdomen, Computed Tomography scans (CT), and more often Magnetic Resonance Cholangiopancreatography (MRCP) are helpful. Intraoperative cholangiography (IOC) during surgery can be utilised to diagnose CBD stones [2].

Modalities to treat these stones include endoscopic retrograde cholangiopancreatography (ERCP) either before or after the surgery, laparoscopic removal or open surgery [3]. Other less commonly employed options are dissolving solutions, laser lithotripsy, electrohydraulic lithotripsy (EHL),

and extracorporeal shockwave lithotripsy (ESWL). CBD stone may be extracted by percutaneous transhepatic stone removal and CBD exploration can be performed during laparoscopic or open surgery. Clinical situation dictates the type and time of any intervention [4].

One modality cannot be suitable for all clinical situations in different institutions. Certain factors can influence the clinical practice including status of the disease like patient demographics, most importantly availability of expertise in endoscopic, radiological and surgical procedures, as well as healthcare finances [2].

2. Pathogenesis and Clinical Manifestation

CBDs can be categorized as primary, arising de novo or secondary slipping through cystic duct from the gallbladder [5]. Bilirubin is the main component of primary stones following biliary stasis and infection whereas secondary stones are mainly composed of cholesterol. Table 1 Cholecystectomy and choledocholithotomy can deal efficiently with secondary stones, but with primary stones more complex methods are needed to avoid recurrence. [6].

Mostly asymptomatic but they may lead to symptoms of biliary colic, obstructive jaundice, and complications like ascending cholangitis or pancreatitis [7]. Biliary colic associated with nausea and vomiting is the most common presentation with a frequency of 5.2% and 12% [7]. Other symptoms include dark-colored urine and pale stools whereas most serious complications are cholangitis and gallstone pancreatitis with a mortality rate of 10–20%. [8]. Biliary obstruction and secondary infection can lead to acute obstructive cholangitis (AOC) a life-threatening condition [9]. Classically, patients present with upper abdominal pain, along with jaundice and spiking fever for more than 24 h (Charcot's triad or hepatic fever). As the disease progress, patient can develop hypotension and confusion (Reynold's pentad). The sensitivity of Charcot's triad is (26.4%) but high specificity (95.9%). Although, highly indicative of acute cholangitis, it does not confirm as it is present in 26.4% to 72% of patients [10]. Mortality may range from 10–20% in AOC [11], however, overall mortality falls below 10% after biliary drainage [12]. Almost 50% of the mortality was reported due to severe acute cholangitis in the era prior to ERCP [13] as well as the emergency surgery which may reach to 30% [14].

Gallstones smaller than 5 mm, invariably known as microlithiasis or biliary sludge, are risk factors for pancreatitis. Microlithiasis can lead to functional obstruction at lower end of CBD ie the sphincter of Oddi, leading to bile and/or biliary-pancreatic fluid reflux resulting in the injury of the pancreas [15]. Most of the times it is a self-limiting mild form, but there may be about 10% mortality [16] whereas in severe cases it may reach to 10-30% [17].

Table 1. *Characteristics of different types of gallstones.*

	Cholesterol stones	Brown pigment stone	Black pigment stone
Prevalence	80–90%	5–10%	<5%
Main composition	50–90% cholesterol	~50% bilirubin	>50% bilirubin
Colour	Yellow - grey	Brown	Dark brown - black
Aetiology	Cholesterol supersaturation	Increased deconjugation of bilirubin glucuronides	Increased biliary bilirubin load

3. Assessment and Diagnosis

3.1. Laboratory Test

Double the normal values of direct bilirubin, alkaline phosphatase (ALP), and diameter ≥ 10 mm on ultrasound is presumed to predict the stones in CBD [18]. However, the most specific and sensitive test is high levels of GGT [19]. In cases of complete CBD obstruction the bilirubin levels will be markedly elevated [7].

3.2. Radiological Imaging

3.2.1. Transabdominal Ultrasonography (TUS)

Ultrasound is the investigation of first preference for the diagnosis of gallstones and the intra- and extrahepatic biliary tree status especially in the patient with jaundice, but its role in delineating choledocholithiasis is less optimum [20]. Although, it can measure the size of common bile duct, size and number of stones in it and gallstones [8] its sensitivity for detecting CBDs ranges between 25-63% [21]. However, its specificity for choledocholithiasis reaches up to 83–95% [22] depending on dilation of the CBD and experience of radiologist. In a recent study, diagnostic accuracy for detecting choledocholithiasis was 76.9% with sensitivity of 76.2% and specificity of 81.3% [23].

3.2.2. Endoscopic Ultrasound (EUS)

An ultrasound probe is inserted through an endoscope to reach the duodenum to take images of the common bile duct (CBD). It is an effective diagnostic aid for CBD stones as the bile duct is closely related to duodenum [24]. In a meta-analysis assessing 2673 patients, EUS showed overall sensitivity of 94% and specificity of 95% for discovering choledocholithiasis [25].

3.2.3. Magnetic Resonance Cholangiopancreatography (MRCP)

It is replacing endoscopic retrograde cholangiopancreatography (ERCP) for assessing CBD stones leading to biliary obstruction [26]. MRCP is non-invasive, rapidly performed, and avoids ionizing radiation and contrast materials [27]. Pre-operative MRCP significantly decreases incidence of post-operative complications as it provides the anatomical details and decrease the incidence of residual stone.

It reduces the risk of CBD injuries by detecting congenital anomalies [26]. Morbid obesity, claustrophobia and pace-makers are the contra indications [28]. A meta-analysis has shown a sensitivity and specificity of >90% for MRCP and EUS for CBD stones [29].

3.2.4. Intraoperative Cholangiography (IOC)

It is still a matter of debate for the routine intra-operative cholangiography in laparoscopic cholecystectomy (LC) for CBDs as shown in a systematic review of 8 RCTs (1715 patients) that could not find good evidence in favor or against, the use of IOC in preventing retained CBDs [30]. One of the meta-analysis showed a pooled sensitivity of 87% and a specificity of 99% of IOC in detecting CBD stones during LC [31]. Technical difficulties like failure to cannulate the cystic duct, contrast leakage during procedure, air bubbles, failure to opacify the bile duct due to quick injection, and transitory spasm of the sphincter of Oddi may all make it less reliable.

3.2.5. Conventional Computed Tomography (CT)

Conventional (nonhelical) CT demonstrates a sensitivity reaching up to 75% for choledocholithiasis if composite diagnostic criteria are used (eg, ductal dilation) [32]. Helical CT shows improved performance with 65-88% sensitivity and 73-97% specificity [33].

3.2.6. Intraductal Ultrasonography (IDUS)

IDUS is performed at ERCP and can visualize small bile duct stones or sludge that a cholangiogram or MRCP fail to detect; therefore, it has been deemed more reliable than ERCP, abdominal CT, and MRI in the detection of CBDs. IDUS can detect remnant CBD stones and sludge, confirm bile duct clearance and, thus, decrease the recurrence or missing rate of CBD stones [34].

3.2.7. Percutaneous Transhepatic Cholangiography (PTC)

Under US and/or fluoroscopic guidance access to biliary system is achieved by a Chiba-22g needle with contrast to opacify the ducts. It is not routinely performed but can be utilised when ERCP is impossible as in the patients of previous biliary-enteric bypass surgery.[36] ERCP is the method of choice in cases of low biliary obstruction, whereas PTC is preferred in cases where obstruction is higher than the common hepatic duct, or in case ERCP has failed [35].

4. Treatment

4.1. Medical

It is usual for non-obstructing CBD stones, after cholecystectomy, to treat conservatively as one third may pass spontaneously within six weeks [36]. If they develop cholangitis or gallstone pancreatitis, aggressive rehydration is required along with bowel rest. Commonly associated bacterial infections include *Escherichia coli*, *Klebsiella* spp., pseudomonas species, *Enterobacter* spp., *Acinetobacter* spp., enterococcus, streptococcus, and staphylococcus [37]. The antibiotics should cover the possible organisms and have effective concentration in bile such as 3rd-generation cephalosporins, ureidopenicillins, carbapenems and fluoroquinolones [38].

4.2. Intervention or Surgery

Two types of interventions are used dealing CBD stones (1) two stage ERCP with endoscopic biliary sphincterotomy (EST), pre- or post-cholecystectomy (2) laparoscopic cholecystectomy along with CBD clearance in one setting. Two review articles [3, 39] have shown that, simultaneous removal of gall bladder and biliary ductal stones by laparoscopic CBD exploration (LCBDE) has comparable rates of stone clearance, morbidity, and mortality, in experienced hands as compared to two-stage management [Figure 1]. Kharbutli et al. reported 7% morbidity and 0.19% mortality in one-stage than two-stage procedures (13.5% and 0.5%) [40].

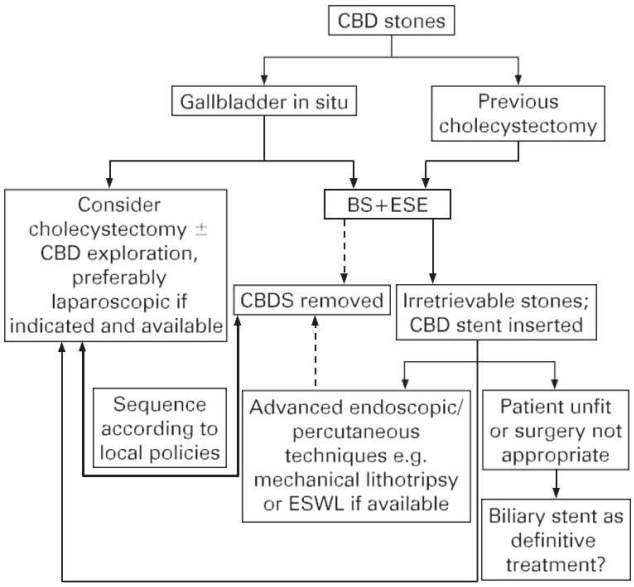

Figure 1. *Step-by-step plan for management of common bile duct stones. BS, biliary sphincterotomy; CBD, common bile duct; CBDs, common bile duct stones; ESE, endoscopic stone extraction; ESWL, extra-corporeal shock wave lithotripsy [41].*

4.2.1. Endoscopic Management

Endoscopic retrograde cholangiopancreatography (ERCP) is performed by locating and cannulating the ampulla of Vater by a side-viewing duodenoscope, and stones can be removed, after sphincterotomy or sphincteroplasty, by balloon or basket extraction. In cases of larger stones mechanical lithotripsy is employed.

ERCP (either pre- or postoperatively) is usually preferred at most centres for managing suspected/confirmed CBDs. The successful clearance rate in isolated ERCP is up to 87-97%, albeit, two or more treatment sessions are needed in almost 25% of patients [42]. However, it has a complication rate of 5-11% and include pancreatitis, haemorrhage, cholangitis, duodenal perforation along with 1% mortality [43]. Failure rates of 5-10% are described for ERCP and a number of patients may not have stones at all as shown in one study (15-25%) [44].

Endoscopic balloon dilation of the papilla is another easier

procedure to endoscopic sphincterotomy (EST), has lower bleeding rate [45] and less functional abnormality to the sphincter of Oddi [46], although pancreatitis is higher than EST [47]. However, endoscopic balloon dilation is less promising than EST in removing CBDs as shown by a recent meta-analysis [48].

Short-term biliary stents can be used in cases with failed retrieval of the stones followed by endoscopy or surgical procedure. [41] Biliary stenting is considered relatively a reasonable and effective method in dealing difficult CBD stones, especially in old age, weak patients with comorbidities and double-stent is better to a single stent as the patency can be maintained for 3-months [49].

4.2.2. Laparoscopic Common Bile Duct Exploration (LCBDE)

The management of concomitant gall bladder and CBDs has evolved significantly over few decades. Open common bile duct exploration (OCBDE) was carried out if any CBDs were detected at cholangiography. After the advent of ERCP, open CBD exploration was exclusively used for patients in whom ERCP fails. After the improvements in laparoscopic technique, more LCBDE from the trans-cystic duct or via opening the CBD are performed to retrieve CBDs, thus obviating the need for preoperative ERCP [19]. LCBDE offers single stage procedure with identical or occasionally superior CBD clearance, and earlier discharge. The other beneficial effect is preservation of sphincter of Oddi function and thus complications associated with bile reflux are avoided [9, 50]. It is safe procedure even in elderly patients [51].

In cases of small stones in a narrow calibre bile duct, trans-cystic method is adopted while trans-ductal is employed for larger stones obstructing the dilated bile duct, intrahepatic ductal stones, or tortuous cystic duct [52].

4.2.3. Trans-cystic (TC) vs Trans-ductal (TD)

In the trans-cystic method, copious isotonic saline along with 1–2mg glucagon (for sphincter relaxation) is flushed to irrigate the CBD as small stones might pass into the duodenum from the sphincter of Oddi or taken out from the same opening made in the cystic duct for catheter. If it fails, a helical Dormia basket can be pushed gently from the cystic duct and the stones can be removed using fluoroscopic imaging [53]. Today, LCBDE under fluoroscopic guidance is a preferred procedure, which, if unsuccessful, a Choledochoscope (≤10 Fr) can be passed under direct vision [53].

Laparoscopic choledocholithotomy can be carried out with different techniques such as distal CBD dilation, manipulation of balloon catheter, basketing under or without fluoroscope, choledochoscopic removal and IOC. After stone removal, closure of the CBD is mostly done primarily or over a T-tube is kept in the CBD. The T-tube may be left for decompression of the biliary system with persistent distal obstruction, postoperative ductal imaging and residual CBDs can be accessed and removed [54].

Navaratne et al reported that two groups had equal stone removal rates, conversion to open surgery and morbidity. However, transductal group had higher morbidity and post-operative complications. The bile leak was (5.8% vs 1.1%, p=0.0181) and rate of was pancreatitis (7.4% vs 0.6%, p=0.0005) [55]. Hajibandeh, S. et al in their study reported that laparoscopic trans-cystic exploration of CBD is relatively safe and has low biliary complications and morbidity in contrast to the trans-ductal access. Moreover, the hospital stay and procedure time is also reduced [56]. Wang et al concluded, in elderly population, TC-LCBDE is safe, effective and rate of success reaches up to 95.15% [51]. Reinders et al included eight randomized trials in a systematic review with 965 patients, compared the bile duct stone clearance in TC and TD groups was 80.4-100% in former and 58.3-100% in the latter respectively.[60] Bile leaks were less in TC (1.7%) than TD stone removal (11%). They also concluded that TC stone retrieval is more accessible technique with lower complication rates [57]. Another study, by Chander et al, showed TD approach is better in Asian population who have dilated CBD and multiple, large stones [58].

4.2.4. IOC vs Choledochoscopy

Intraoperative cholangiography (IOC) use has been a debate for many years, some advocating its routine use while others in selective cases only. However, it is valuable in detecting choledocholithiasis (removal of stones can be accomplished during or after surgery), for the avoidance or diagnosis of bile duct injury (BDI) and to ascertain the anatomy of biliary tract. Early identification and subsequent repair of CBD injury can be done using IOC and thus it reduces morbidity. In addition, it identifies occult CBDs which can be removed instantly resulting in cost effectiveness for the patient and the hospital [59].

Limited data is available for the use of Choledochoscopy in the CBDs treatment. No clear guidelines are available on LCBDE regarding when to employ flexible Choledochoscopy (FCD) or intraoperative cholangiography (IOC). Flexible Choledochoscope can be passed through midaxillary port and the CBD visualized directly. Continuous irrigation of normal saline keeps the CBD open and intraluminal stones can be retrieved using Dormia basket. Topal et al, compared IOC and Choledochoscopy and found similar results, though in former longer operative time was reported [60]. Vindal et al in a prospective randomized study showed choledochoscopy is superior than IOC for ductal stone removal and clearance after LCBDE, easy and quicker [61].

4.2.5. Primary Closure vs T-tube vs Biliary Stent

There are many options after LCBDE including primary closure, placement of T-tube, or primary closure plus biliary stent placement. Track infection and bile leakage are the long term and uncomfortable complications of T-tube [62]. Recurrent cholangitis and stenosis may follow the primary closure [63]. These complications are, however, avoided in a biliary stent that is removed spontaneously in the course of time, without any intervention [64].

In a systematic review Podda M. et al analysed sixteen studies that compared primary closure and T-tube placement. Operating time, hospital stay was significantly better and cost effective after primary duct closure. The hospital stay was

significantly further reduced where internal biliary drainage was accompanied by primary closure (primary duct closure + BD) in comparison to T-tube drainage. This meta-analysis shows that primary duct closure after LCBDE has lower complications than T-tube drainage [65]. Grubnik, V. et al compared stent with T-tube drainage and reported shorter hospital stay and overall, less morbidity in the former. In addition, biliary stent reduces costs and patients report increase satisfaction [66].

Yi et al [67] studied long term comparison between primary closure with T-tube drainage after LCBDE. In primary closure patients significantly shorter mean operating time and hospital stay were observed, however no evidence of biliary stricture or other complications were observed in either group during follow up. Both T-tube drainage and primary closure after LCBDE with choledochoscopy were found safe and effective in long term results. Leida et al showed early return to work in primary closure patients, a shorter hospital stay, cost effective and lesser complications postoperatively than T-tube (15% vs 27.5%) [68].

TD stone extraction is demanding and require expert intra-corporeal suturing and choledochoscopy technique and may result in increased risk of biliary leaks.[58] TC stone extraction is an accessible procedure and associated with less complications. Number and stone size, cystic duct and CBD diameter can influence what technique will be optimum "(Table 2)" [69]. IOC or choledochoscopy is used to confirm the CBD clearance. Choledochoscopy is better, easier and quicker for confirming the stone clearance after TD-LCBDE. Choledochotomy after LCBDE (TD approach) is usually closed over a T-tube, primary closure is also a safe and effective choice with shorter procedure time and postoperative stay in the hospital. Biliary stent is cost effective and reduces in-hospital stay in contrast to T-tube although there is presently no sufficient evidence in the form of randomized study comparing biliary stent with primary closure.

Table 2. *Effective and important factors in common bile duct stones approach.*

Factor	Trans-cystic approach	Trans-ductal approach
Single or multiple stones	Yes	Yes
Size of Stones < 6 mm diameter	Yes	Yes
Size of Stones > 6 mm diameter	No	Yes
Stones in Intrahepatic tree	No	Yes
Cystic duct diameter < 4 mm	No	Yes
Cystic duct diameter > 4 mm	Yes	Yes
Common bile duct diameter < 6 mm	Yes	No
Common bile duct diameter> 6 mm	Yes	Yes
Poor Suturing ability	Yes	No

4.2.6. Single Stage vs Two Stage Management

Failure of stone clearance after LCBDE or retained stones found after surgery (2.5%) need postoperative ERCP to clear the CBD [70]. Although, single-stage surgical procedure with LCBDE and stone removal with LC has the advantages but alternatively, two-stage CBD stone clearance can be achieved by surgical and endoscopic management on separate dates. Surgical time is shortened significantly, but there is risk of pancreatitis in up to 5% [71, 72] after ERCP, and hospital stay is prolonged due to two procedures [72]. Bansal et al. [72] in a prospective randomized control study looked at short term outcomes, the two-stage procedure was costly ($p < 0.001$) however, there was not much difference was observed between rate of wound infection or other major complications. LCBDE was carried out almost entirely through choledochotomy, and not trans-cystically, resulting in prolonged operative time and increased bile leak [72]. Lu et al. concluded that both single or two-stage management has equivalent results in a large RCT comparing the short-term outcomes, but largely depends on local resources and expertise [39]. Topal et al. concluded if the expertise is available then single stage procedure for concomitant CBD and gallstone disease should be done [73].

4.2.7. Open Common Bile Duct Exploration (OCBDE)

It is an important way for removing CBDs that are not suitable for endoscopic treatment or couldn't be removed at ERCP [41]. Martin et al. reported that ERCP was associated with higher mortality and less success than open surgery [44]. OCBDE is still carried out in resource stricken developing countries, in eastern Europe, and in some Asian countries [74]. Furthermore, it has still its place where all endoscopic measures fail to retrieve the stones especially after the ERCP [75]. However, retained stone rate after open exploration ranges from 1- 8% [76].

4.3. Other Modalities

4.3.1. Electrohydraulic Lithotripsy (EHL)

Despite the fact that conventional methods for stone retrieval are quite successful, but in 5% they may fail with difficult CBDs [77]. Examples include impacted stones, located above strictures, larger ones or located in difficult portions of the biliary tree, not approachable endoscopically. For these patients, shockwave technology can result in the fragmentation of stones. These shockwaves can be produced and applied with intracorporal probes by direct contact with a high voltage discharge [electrohydraulic lithotripsy (EHL)] or a pulsed dye laser (laser lithotripsy), or extracorporeal shockwave lithotripsy (ESWL)

Recent reports have shown promising results with electrohydraulic lithotripsy (EHL) for treatment for bile duct stones [78]. It is not an established standard treatment, as there is paucity of robust data. Furthermore, some cases are difficult to be managed with EHL. Provision of endoscopic and non-invasive stone removal methods are ideal for elderly patients as surgical procedures are avoided in multiple comorbidities.

4.3.2. ESWL

Intrahepatic stones are preferably managed by ESWL and the best way is through Laser lithotripsy. The electrohydraulic lithotripsy is associated with more tissue damage and bleeding and therefore, rarely used [79]. Gallstones were first treated by this method in 1980s preceded by its use in renal calculi [7]. The sound waves are directly applied at the liver and bile ducts usually before ERCP so that larger stones are shattered into

smaller and manageable pieces. It has been utilised over the past three decades, globally for disintegration of biliary and pancreatic stones in patients where routine endotherapy is unsuccessful. The success rates are almost 80-95% [80], although there are no appreciable dissimilarities in CBD clearance in comparison of ESWL with EHL [81].

4.3.3. Laser Lithotripsy

Laser lithotripsy is carried out by cholangioscopy. employing mini scopes or by standard fluoroscopic control [7]. It is a safe and successful in patients, under choloagioscopic view, with difficult CBD stones not treatable by conventional endoscopy. A single beam of amplified light energy at a peculiar wavelength is directed on a stone in the bile duct [7]. The ductal clearance rate after laser lithotripsy ranges from 64 to 97% for retained CBDs, in multiple publications [82-84].

4.3.4. Dissolving Solutions

Ursodeoxycholic acid UDCA inhibit the intestinal reabsorption of cholesterol, reduces its biliary secretion, promote excretion of bile by increasing the flow rate and volume of bile thus reducing the saturation of cholesterol in bile, and therefore, it may be effective in preventing the recurrence of CBDs by causing dissolution of cholesterol stone gradually and improving cholestasis. Only cholesterol-containing stones are dissolved by ursodeoxycholic acid (UDCA) and chenodeoxycholic acid. About 85–95% of Western population have cholesterol stones and use of UDCA may appear to prevent recurrent gallbladder microlithiasis [85]. However, Katsinelos et al. mentioned that UDCA does not reduces the size of stones or causes fragmentation during the endo-prosthetic procedure [86].

Methyl-Tert-butyl-Ether (MTBE) is a strong solvent of cholesterol, work faster but limited by its toxicity to the liver and duodenal mucosa. Several studies have shown better outcomes with the dissolution when combine with endoscopic procedure or lithotripsy

Currently, although no robust data to suggest the role of UDCA in management of CBDs however, owing to lesser untoward effects and better safety profile, gastroenterologists keep on using in difficult to remove CBDs. However more data and randomised trials are needed to elucidate any overall beneficial effect of UDCA on retained CBDs. [7] There is limited place of chemical dissolution therapy in difficult to remove CBDs due to long treatment duration, and a necessary access to the bile duct and many complications.

5. Conclusion

Symptomatic CBDs commonly cause significant morbidity and complications as trivial as biliary colic and jaundice or serious sequelae like ascending cholangitis and pancreatitis. Certain investigations indirectly can help to diagnose the CBDs including serum bilirubin, AST, ALP, CBD diameter and age of the patient. TUS is quite sensitive to pick bile duct dilatation but less so in detecting choledocholithiasis. ERCP, MRCP and EUS are almost equal in their sensitivities, specificities and accuracy rates for diagnosing CBDs. ERCP can remove stone by using a balloon or Dormia basket after EST. EBD can be considered in patients with coagulopathies but there is high incidence of pancreatitis as compared to EST (however bleeding is less).

We recommend for patients with CBDs, single stage laparoscopic cholecystectomy with IOC and CBD exploration should be performed as first step if stone size is not bigger then 5mm, otherwise ERCP should be considered, as well as in the event of failure of LCBDE. Open approach should be reserved as a last resort when all other options remain unsuccessful.

Lithotripsy like laser lithotripsy and EHL are usually performed in specialised units and the evidence in their favour is lacking due to smaller studies. The role of medical therapy is still currently uncertain due to a lack of large randomised control trials particularly in difficult to remove CBDs or in patients with severe co-morbid illness, in whom endoscopic stone retrieval is relatively unsafe or contraindicated.

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