"STUDY OF CLINICAL PROFILE AND MANAGEMENT OF CHOLEDOCHOLITHIAISIS"

By

DR. NAVEEN KUMAR

Dissertation Submitted to
Sumandeep Vidyapeeth,
Pipariya, Vadodara.

In Partial Fulfilment
Of the Requirements for the Degree of
M.S.

In

GENERAL SURGERY

Under the guidance of
Dr Vijoy Singh (M.S.)
Professor Department

DEPT. OF GENERAL SURGERY

S.B.K.S MEDICAL INSTITUTE & RESEARCH CENTRE,

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2015-2018

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Dr. Naveen Kumar

ABSTRACT:

INTRODUCTION:

Choledocholithiasis is the most common cause of obstructive jaundice and occurs in about 10% of patients with symptomatic gallstone. The need for subsequent cholecystectomy in patients with gall bladder in situ after endoscopic removal of stones from the common bile duct is controversial. Performing cholecystectomy after endoscopic retrieval of stones is to prevent further biliary complications. Management strategies need to be individualized and guided by risk factors for surgery and further biliary complication.

MATRIALS AND METHODS:

SOURCE OF DATA

Location: SKBS MEDICAL INSTITUTE & RESEARCH CENTER

Study period: August 2016 – August 2017

METHODS OF STUDY

An Observational study starting from August 2016 – August 2017 will be carried out in SKBS medical college hospital.

RESULTS:

Total 31 patients were included in our study. There were 16 male and 15 female with slight male predominance. 12 patients underwent open surgery and 19 patient underwent ERCP.

CONCLUSION:

ERCP is better in terms of post-operative pain, hospital stay and complication than open surgery with slight cost factor.

KEYWORDS: Choledochoduodenostomy, common bile duct, T-tube, ERCP

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Biliary obstruction, which is the interruption of bile flow from the liver to the small intestine, can occur at any level within the biliary system. Choledocholithiasis is most commonly a complication of gallbladder stones; only in a minority of the patients they arise de novo in the bile ducts. Its incidence in the developing nations is continuously rising.[1,2] Though they are seen in all age groups, it is the 'fat, fertile, flatulent, female of fifty' that is most commonly affected. The incidence increases with age.[3] The incidence has also been rising in this part of the country; possible reasons are the changing dietary habits, increasing awareness of health in people and improvements in the imaging technology. A patient with ductal stones was at the mercy of the natural course of the disease until the late nineteenth century; fortunate, if there was spontaneous passage of the stone, or eventually succumb to the complications.

Langenbuch performed the first cholecystectomy in 1882. It was not until several years later, that Robert Abbe performed the first choledochotomy. Soon enough, choledochotomy became the gold standard notwithstanding the fact that addition of the ductal exploration to cholecystectomy raises the morbidity and mortality significantly.[3,4]

With the gaining experience, these rates started falling; nevertheless there was a definite risk. This is related to the degree of obstructive jaundice and the presence of medical risk factors.

The introduction of endoscopic sphincterotomy in 1974 opened the non-surgical options. Instantly it became popular. But many studies have proven that pre-operative endoscopic sphincterotomy and surgery offers no advantage over surgery alone.[5]

However, endoscopy is a safe option in elderly patients and in those with medical risk factors. It relieves obstruction, improves the general condition in the settling of acute cholangitis with a much lower mortality. Newer endoscopic techniques have claimed a good clearance rate for the large stones too.

Laparoscopic cholecystectomy has been extensively accepted since Mouret first successfully finished the procedure in 1997.[6] The advent of laparoscopy dramatically changed the scenario. Management of Choledocholithiasis has become even more controversial. Though some centres have specialized in laparoscopic common bile duct exploration, many resort to preoperative sphincterotomy for ductal stones.

The liver and biliary system, throughout the history of mankind, has always held a distinctive place. For many historical and contemporary civilizations the liver has presented a mysterious organ with complex anatomy, an overwhelming number of functions and an extraordinary ability to regenerate. ***The Babylons (2000-3000 BC)*** regarded this organ as the '*seat of the soul'*.[7] The respect this organ commanded is evident from the clay model of sheep's liver, in which the gallbladder, the portal vein, falciform ligament, caudate and quadrate lobes have been well represented. The portal vein had a special significance, its enlargement being associated with military defeat.

There was some understanding of the physiology too, the common bile duct was known as the 'outlet'; porta hepatis as the '*gate*' and the ligamentum teres as the '*door to the palace*'.[7]

Erasistratus, a Greek physician of 4th century BC, recognized that some of the cases of jaundice were due to obstruction of the duct that leads from gallbladder to the bowel. His contemporary Diocles agreed with him and demonstrated this in cadavers.[7]

In 2nd century AD***, Galen*** emphasized that the impaired passage of the '*yellow bile*' can be caused by inflammation, induration, obstruction or by external pressure by surrounding structures, causing closure of the common duct.[8,9,10,11].

Thirteen centuries later, in 1543***, Andreas Vesalius*** of Padua, in his most detailed anatomical treatise, '*De humani corporis fabrica'*, depicted the anatomy of the common bile duct as we may know of it today. Later***, Francis Glisson*** (1640***), Abraham Vater*** (1720) and ***Ruggero Oddi*** (1887) refined it further with the descriptions of the sphincteric mechanism.[8,11]

One of the first reports of the common bile duct pathology was the report of cholangitis by ***Jean Martin Charcot*** (1877), a French physician. He described the symptoms associated with the passage of common duct stones - right upper quadrant pain, fever with chills and jaundice, known to us as *Charcot's triad*. Later a hepatologist from Los Angeles, ***Telfer Reynolds***, added hypotension and altered mental status to it (*Reynold's pentad*) related to sepsis in cholangitis.[10]

Robert Abbe of New York, in 1889 performed the first choledochotomy on a 36 yr old woman with dark jaundice, removed a single stone lodged midway in the duct and sewed it up with fine silk. Simultaneously, ***Ludwig Courvoisier, Lawson Tait, A. W. Mayo Robson, Percy Bland Sutton, W. W. Keen*** performed choledocholithotomy.[9]

William Stewart Halstead, in 1899, performed a choledochoduodenal anastomosis for an ampullary carcinoma. He also advocated post-cholecystectomy drainage through open cystic duct. He operated upon his mother for cholelithiasis and choledocholithiasis. Ironically, he succumbed to the complications following the second surgery for his recurrent choledocholithiasis in 1922.[10]

Emil Theodor Kocher's name is eponymically linked to biliary surgery with the Kocher incision and Kocher manoeuvre. He also devised transduodenal sphincteroplasty.

Charles McBurney in 1898, reported about transduodenal choledochotomy. This can be considered essentially as the precursor of the modern day endoscopic sphincterotomy.

John B. Murphy of Chicago, advocated cholecystoenterostomy avoiding choledochotomy.

Hans Kehr of Germany invented the T-tube. In one of his two treatises on biliary surgery he quotes "*I do not shy at introducing my finger into the hepatic and common ducts to guard against leaving the stones behind".* He recognized the dangers of acute cholangitis and advocated drainage of the ducts.

Imaging of the ducts

In 1925, Graham and Cole introduced oral Cholecystography.[9] Mirizzi of Argentina, in 1931, described the method of intra-operative injection of lipiodol for cholangiography.[8,9] Although percutaneous transhepatic cholangiography was described initially in 1937 and later again in 1952, it was not until in 1973, with the introduction of the Chiba needle by ***Okuda***, that it gained widespread acceptance.[9]

Endoscopy

The first attempt at the visualization of the ducts was by ***Bakes*** of Czechoslovakia, in 1923, using a speculum-like 'funnel'. In 1941, ***McIver*** of United States introduced a rigid, right angled endoscope utilizing optical lenses and an irrigating system. ***Wildegans*** of Germany, in 1953, devised the precursor of the modern choledochoscope, using a sophisticated lens system. ***Berci***, of Los Angeles, introduced the modern rigid right angled choledochoscope using the Hopkins rod-lens system with an instruments channel.[9]

In 1965, ***Shore*** and ***Shore*** introduced the first flexible choledochoscope in US, but it never came into general usage as the images were of poor quality. Yamakawa, in 1975, successfully extracted a retained stone through a T-tube tract. Percutaneous transhepatic cholangioscopy was reported by ***Nimura*** and ***Chen***.[9]

The technique of endoscopic retrograde cholangiopancreatography evolved with the pioneering work of ***McCune*** in 1968 and ***Oi*** in 1970. ***Kawai*** et al of Japan and ***Classen*** et al of Germany, in 1974, introduced endoscopic papillotomy. Soon it became enormously popular and with it the gastroenterologists invaded the hitherto surgical territory. The availability of small sized cameras in the 1980s and later endoscopic tip mounted tiny computer chip, revolutionized this further.[9]

The Laparoscopic era

The late 1980s witnessed another revolution, the emergence of the laparoscopic era. This was embraced by the surgeons instantly. The first laparoscopic bile duct exploration was undertaken by ***Phillips, Sackier*** et al and ***Petelin***. In 1994, Berci and Morgenstern reported 226 cases of laparoscopic bile duct exploration.[9]

EMBRYOGENESIS OF THE BILIARY TRACT

The liver primordium appears in the middle of the 3rd week as an outgrowth (hepatic diverticulum) of the endodermal epithelium at the distal end of the foregut.[12] The connection between the hepatic diverticulum and the foregut (duodenum) narrows, forming the bile duct. A small ventral outgrowth is formed by the bile duct at the end of the 4th week, and this outgrowth gives rise to the gallbladder and the cystic duct. The common bile duct and the hepatic ducts may be seen at the beginning of the 5th week at which stage they are in the solid state.

Slow ductal recanalization occurs approximately from the 6^{th} through 12^{th} weeks. At approximately the 12^{th} week, bile is formed by hepatic cells. The positional changes of the duodenum causes the entrance of the bile duct gradually shifts from its initial anterior position to a posterior one, and consequently, the bile duct passes behind the duodenum.

Human fetal gallbladder contractility in the second half of pregnancy has been reported, although its physiological role is unknown.[13]

SURGICAL ANATOMY OF THE COMMON BILE DUCT

Extrahepatic Biliary Tract

The right and left lobes of the liver are drained by ducts originating as bile canaliculi in the lobules. The canaliculi empty into the canals of Hering in the interlobular triads. The canals of Hering are collected into ducts draining the hepatic areas, the four hepatic segment ducts.

The right hepatic duct is formed by the union of the anterior and posterior segment ducts at the porta hepatis. This pattern was present in 72% of specimens examined by Healey and Schroy[14]. The average length of the right hepatic duct is 0.9 cm. The left hepatic duct is usually (67%)[14] formed by the union of the medial and lateral segment ducts (Fig. 2). The average length of the left hepatic duct is 1.7 cm[14].

Usually the right and left hepatic ducts are of equal size. In patients with chronic obstructive biliary disease, the left duct, for unknown reasons, is larger than the right duct.[15]

The common hepatic duct is formed by the union of the right and left hepatic ducts in the porta with the lower end being at its junction with the cystic duct. Its length varies from 1.0 cm to 7.5 cm. The diameter of the duct is about 0.4 cm. Cystic duct contains 5 to 12 crescent-shaped folds of mucosa similar to those seen in the neck of the gallbladder (spiral valve of Heister). The length and the manner in which the cystic duct joins with the common hepatic duct vary. It joins the hepatic duct at an angle of about 40° in 64-75% of individuals. In 17-23%, the cystic duct parallels the hepatic

duct for a longer or shorter distance and may even enter the duodenum separately (absence of CBD). In 8-13%, the cystic duct may pass inferior to or superior to the common hepatic duct to enter the latter on the left side[16,17,18]. Less frequently, the gallbladder is sessile with little or no cystic duct.

Common Bile Duct (Ductus Choledochus)

The CBD begins at the union of the cystic and common hepatic ducts and ends at the papilla of Vater in the 2nd part of the duodenum. It varies in length from 5 cm to 15 cm. The average diameter is about 6 mm. The CBD can be divided into 4 portions or segments

a. **Supraduodenal:** Lies between the layers of the hepatoduodenal ligament in front of the epiploic foramen of Winslow, to the right or left of the hepatic artery, and anterior to the portal vein. Its length is 2-5 cm.[19] The distal part of this portion is related to the posterior superior pancreaticoduodenal artery and is easily injured while exploring the common duct[20].

b. **Retroduodenal**: It is between the superior margin of the first portion of the duodenum and the superior margin of the head of the pancreas. It is 1-3.5 cm long.

c. **Pancreatic**: It extends from the upper margin of the head of the pancreas to the point of entrance into the duodenum and passes downward to the right, posterior to the pancreas or within the pancreatic parenchyma. The duct may be in intimate contact with the duodenum for 0.8-2.2 cm before entering the wall.[21]

d. **Intramural**: It takes an oblique path averaging 1.5 cm through the duodenal wall where it receives the main pancreatic duct inferiorly. The two ducts usually lie side-by-side with a common adventitia for several millimetres. The diameter of both ducts decreases within the duodenal wall.[22] The septum between the ducts is reduced to a thin mucosal membrane before the ducts become confluent.

Arterial Supply

The extrahepatic bile ducts are supplied from the cystic artery above and from the posterior superior pancreaticoduodenal artery below with several variations[23] .The supply from the cystic artery is relatively constant; however the lower supply may be from the hepatic, gastroduodenal, or supraduodenal arteries.

The cystic artery usually arises from the right hepatic artery Reaching the gallbladder behind the common hepatic duct, the cystic artery usually branches into an anterior superficial branch and a posterior deep branch. The cystic artery may arise from the left hepatic artery or the gastroduodenal artery.

In approximately 25% of subjects, the superficial and deep branches arise separately .The superficial branch may spring from the right hepatic, left hepatic, gastroduodenal, or retroduodenal artery.[24]

Michels[20] described 12 types of double cystic arteries. Less common than duplications is a recurrence of the superficial branch. The artery first supplies the fundus, then turns downward to branch over the body of the gallbladder[25].

Balija et al[26] presented a laparoscopic visualization and classification of the cystic artery . Chen et al[27] reported autopsy findings on the origin and course of the cystic

artery: The cystic artery arises from many possible origins; the right hepatic artery is the most common origin (76.6%). The Calot triangle (hepatocystic triangle), which is an important imaginary referent area for biliary surgery, is bounded by the common hepatic duct (CHD), the cystic duct, and the cystic artery. Appleby[28] emphasized that the surface of the common bile duct should be protected to prevent iatrogenic ischemia as well as to avoid venous bleeding.

The epicholedochal arterial plexus of the CBD is derived from the retroduodenal or posterior superior pancreaticoduodenal arteries[29]. The collateral circulation is enhanced by two intramural plexuses. These may be compressed between the oedematous mucosa and the external tough fibrous coat in pathologic conditions such as cholangitis or CBD obstruction secondary to choledocholithiasis.

Veins

Venous blood from the cystic duct and hepatic ducts enter the liver through small veins along with ascending veins from the CBD[30] .

Lymphatics of the Biliary Tract

Lymph from the gall bladder and the extra hepatic biliary ducts drain into the celiac and superior mesenteric nodes via the cystic node, hiatal node and pancreaticoduodenal nodes.

Innervation of the Gallbladder and Biliary Tract

Parasympathetic (vagal) and general visceral sensory fibers from the hepatic division of the anterior vagal trunk and the celiac division of the posterior vagal trunk follow the hepatic artery and its branches to the extrahepatic bile ducts and the gallbladder.

Preganglionic sympathetics and visceral afferent fibers for pain reach the celiac plexus by way of the greater thoracic splanchnic nerves. The autonomic fibers synapse in the celiac ganglia, and postganglionic and sensory fibers pass into the hepatic plexuses to reach the liver.

Fibers from the right phrenic nerve travel by way of the phrenic, celiac, and hepatic plexuses to reach the gallbladder. Many of these fibers are afferent and may account for the pain referred to the right hypochondrium and radiating to the back between the shoulder blades in some patients with gallbladder diseases.

Burnett and associates[31] demonstrated 3 nerve plexuses: subserous, muscular, and mucosal. The ganglion cells in each nerve plexus decrease in number from subserous to mucosal levels. In comparison with the myenteric plexus of the gut, the subserous plexus ganglia are larger and spaced farther apart. In spite of this well-developed nerve supply, there are relatively few smooth muscle cells in the ducts.[32]

Histology

The bile ducts are composed of an external fibrous layer of connective tissue, a few thin smooth muscle layers (longitudinal, oblique, and circular), and an internal layer of mucosa of columnar epithelium

PHYSIOLOGY OF BILE SECRETION[33]

Bile is made up of the bile acids, bile pigments, and other substances dissolved in an alkaline electrolyte solution. It is secreted normally between 600 and 1000 ml/day. The maximum volume that the gallbladder can hold is only 30 to 60 milliliters.

Bile Formation

Bile contains substances that are actively secreted into it across the canalicular membrane, such as bile acids, phosphatidylcholine, conjugated bilirubin, cholesterol, and xenobiotics. Because they are osmotically active, the canalicular bile is transiently hypertonic. However, the tight junctions that join adjacent hepatocytes are relatively permeable and water, glucose, calcium, glutathione, amino acids, and urea passively enter the bile from the plasma by diffusion.

About 1 to 2 grams of cholesterol are removed from the blood plasma and secreted into the bile each day. Phosphatidylcholine that enters the bile forms mixed micelles with the bile acids and cholesterol. The ratio of bile acids: phosphatidylcholine: cholesterol in canalicular bile is approximately 10:3:1.

Deviations from this ratio may cause cholesterol to precipitate, leading to one type of gallstones.

People on a high-fat diet over a period of years are prone to the development of gallstones. Inflammation of the gallbladder epithelium may also change the absorptive characteristics of the gallbladder mucosa, sometimes allowing excessive absorption of water and bile salts but leaving behind the cholesterol in the bladder in progressively greater concentrations.

The bile undergoes modification in the bile ductules by cholangiocytes, whose tight junctions although less permeable than those of the hepatocytes, remain freely permeable to water and thus bile remains isotonic.

Glutathione is hydrolyzed to its constituent amino acids by an enzyme, gamma glutamyltranspeptidase (GGT), expressed on the apical membrane of the cholangiocytes.

In the gallbladder, the bile is concentrated by absorption of water. Liver bile is 97% water, whereas the average water content of gallbladder bile is 89%. Bile becomes slightly acidic as sodium ions are exchanged for protons.

About 94 percent of the bile salts are reabsorbed (enterohepatic circulation), one half of this by diffusion through the early small intestine mucosa and the remainder by an active transport process through the mucosa in the distal ileum. On the average these salts make the entire circuit some 17 times before being carried out in the feces. The glucuronides of the bile pigments, bilirubin and biliverdin, are responsible for the golden yellow colour of bile.

Blood levels of cholesterol and alkaline phosphatase usually rise in patients with jaundice due to intra-or extrahepatic obstruction of the bile duct as they are excreted in the bile.

Regulation of Biliary Secretion

When food enters the mouth, the resistance of the sphincter of Oddi decreases under both neural and hormonal influences. The production of bile is increased by stimulation of the vagus nerves and by the hormone secretin, which increases the water and HCO_3^- content of bile. Fatty acids and amino acids in the duodenum release CCK, which causes gallbladder contraction.

Substances that increase the secretion of bile are known as **choleretics.** Bile acids themselves are among the most important physiologic choleretics.

Effects of Cholecystectomy

Cholecystectomized patients maintain good health and nutrition with a constant slow discharge of bile into the duodenum, although eventually the bile duct becomes somewhat dilated, and more bile tends to enter the duodenum after meals than at other times.

Cholecystectomized patients can even tolerate fried foods, although they generally must avoid foods that are particularly high in fat content.

ETIOPATHOGENESIS AND NATURAL HISTORY

Common bile duct calculi may be classified by their chemical composition, their origin and also by the time they are discovered relative to cholecystectomy. With respect to their chemical composition they can be classified into cholesterol stones and pigment stones with the majority of the stones being cholesterol stones. Cholesterol stones are primarily the product of crystallization of the insoluble cholesterol in supersaturated bile.

They have their origin in the gallbladder. Pigment stones are those that consist of bilirubinate salts of calcium and are formed within the bile ducts. Chemical composition of the stones varies geographically.[34] In the western countries they are predominately of the cholesterol type[35], while in the oriental countries they are the pigment variety.[36]

Kumar et al reported that most CBD stones occurring in the northern part of India are of the cholesterol variety.[37]

Stones that are formed de nova in the bile ducts are termed primary stones and those that originate from the gall bladder as secondary. Majority of the stones are secondary stones. This classification, based on their origin has more clinical value, as the management strategies differ considerably in the subsets. Primary stones have to be dealt with by a drainage procedure and the secondary stones, by clearing the duct of stones coupled with a cholecystectomy.

Stones can be called retained if the patient presents within 2 years and recurrent if more than 2 years after choledocholithotomy.

Primary common duct stones are associated with biliary stasis and infection.

Primary stones are usually of the brown pigment type, which are soft, non-faceted, yellowish–brown and friable. The cause of biliary stasis may include biliary stricture, papillary stenosis or sphincter of Oddi dysfunction. The biliary stasis promotes growth of bacteria, which produce phospholipase A1, thus releasing fatty acids from biliary phospholipids. The duct epithelium and/or bacteria (e.g.: Escherichia coli) produce beta- glucuronidase in amounts sufficient to deconjugate bilirubin diglucuronide. The presence of free fatty acids, deconjugated bilirubin and bile acids leads to the formation of insoluble calcium bilirubinate particles. With the loss of bile acids, cholesterol becomes insoluble, resulting in the formation of biliary sludge. The sludge also contains mucin and bacterial cytoskeletons, which further aid in stone formation.

Infection with tropical parasites such as Clonorchis sinensis and Ascaris lumbricoides can lead to the formation of these stones, commonly in the Asian population.[38] These parasites may promote stasis by either blocking the biliary ducts or by damaging the duct walls, resulting on stricture formation.[39]

Secondary stones need cholesterol supersaturation, stasis and accelerated nucleation as pre-requisites for their formation. The sex of the patient, parity, obesity, weight loss, and genetics are risk factors for the development of cholesterol stones. In hemolytic disorders where the pigment excretion in bile is increased, black pigment stones may be formed in the gallbladder.

Small gallstones migrate through the cystic duct into common duct. Factors those are favorable for the further growth of the stone are present in the ducts also. Some of these stones obstruct at the lower end and lead to increase in the biliary pressure with the consequent dilatation of ducts. This allows for the passage of the larger stones from the gallbladder.[40]

The CBD stones if left untreated have the following outcomes. They can pass into duodenum spontaneously, this is usually the case of the small stones, or give rise to complications such as obstructive jaundice, if the stones obstruct the duct, cholangitis, if the obstructed system gets infected, and pancreatitis, if the stone obstructs at the ampulla.

In long standing cases of obstructive jaundice, biliary cirrhosis supervenes.

CLINICAL EVALUATION

Biliary calculous disease increases with age, being rare in children and has an increased incidence between the ages 35 and 55. The incidence shows a gradual increase after 55 years of age. This disease is more common in females.

Patients with choledocholithiasis usually present with intermittent obstruction but asymptomatic stones are not uncommon. In an autopsy series by Crump 24% of the patients with cholelithiasis also had stones in the bile duct. Also the prevalence of the ductal stones increased with age.[41]

In another series reported by Hermann, only 9% of the young patients undergoing cholecystectomy had CBD stones while upto 96% of the patients above 80 had them.[42]

Stones may pass spontaneously into the duodenum uneventfully or after a transient attack of pancreatitis. In a study reported by Kelly,gallstones were found in the feces of patients with cholelithiasis, diameters varying from1 to 12 mm. This was mostly seen in the patients with pancreatitis, but 12% of the controlpatients also had them.[43]

The common symptoms in patients with CBD calculi are jaundice, biliary colic, with or without fever, cholangitis, pancreatitis, clay-colored stools, pruritis and dark urine.

Jaundice requires some time to develop and is of obstructive type, intermittent with fluctuations. The biliary stasis consequent to the ductal obstruction gives rise to the jaundice. The extent of icterus depends on the severity and duration of CBD obstruction.

With the dilatation of the ducts, the stones float up in the bile duct, allowing for the passage of bile; the jaundice then resolves. But in untreated patients, the chronic cholestasis resulting from long-standing partial obstruction, leads to secondary biliary cirrhosis, hepatic failure and the development of portal hypertension. Rubin et al reported that 50% of the patients with common ductal stones had jaundice.[44] Cranley's findings are in agreement with this, with only 9.6% of the patients with jaundice as the sole criterion harboring CBD stones.[45] In Bose's series, jaundice had a sensitivity of 69% and specificity of 89%.[46] Jaundice has been a classical indication for choledochotomy, but its reliability varies from 20 to 75%.[47,48,49,50]

Biliary 'colic', is more of a constant nature with only minor fluctuations in intensity. It is characteristically felt in the epigastrium and radiates to the right hypochondrium and to the right subscapular region.[51] Rarely may it be felt in the chest, left hypochondrium or lower abdomen.[52] The distension of the biliary tract, which occurs when a stone impacts in the distal CBD; gives rise to the pain. Sometimes the direct irritation of the sphincter of Oddi may be the reason. The pain of biliary colic typically lasts 2 to 4 hours, then often suddenly resolves.

Right upper quadrant pain, jaundice and fever with rigors which constitute the classical Charcot's triad, seen in cholangitis is almost always indicative of the common ductal stones. A study on patients with cholangitis showed fever in 92% of patients, jaundice in 65%, pain in 42%, and all 3 in 19%.[53] In the series by Rubin et al, though fever and pain individually were not of much significance, 15 out of the 16 patients exhibiting the triad had CBD stones.[54] The finding of Way and associates were also in agreement with this (97%).[50] In acute suppurative cholangitis, added to these are hypotension and mental confusion (Reynold's pentad). Cholangitis has a varied presentation, from a mild self-limiting illness to septic shock, observed in 5% of patients.

Four to eight percent of patients with gallstones develop pancreatitis.[54] It is a complication arising out of obstruction at the common channel with a stone or due to the edema of the ampulla of Vater secondary to stone migration. This may be transient as mentioned earlier or persistent. Small biliary stones[55] or even microlithiasis (sludge) may precipitate an attack.[56] Patients may be classified as having mild or severe attacks. Pancreatic pain is different from biliary pain. The pain is located in the epigastric and mid-abdominal areas and is sharp, severe, continuous,

and radiates to the back. Nausea and vomiting are frequently present, and a similar previous episode is reported by approximately 15% patients.

Jenson et al, in a study to evaluate the predictive ability of the indicators of the CBD stones in 319 patients undergoing cholecystectomy, found that out of 35 patients with jaundice only 10 (28.6%) had ductal stones (a sensitivity of 26.3%), 8 (36.4%) out of 22 patients with fever (sensitivity 21%), 17 (43.6%) of the 39 patients with pale stools (sensitivity 44.7%) and 2 (8.3%) of the 24 patients with pancreatitis (sensitivity 5.3%) had common ductal calculi.[57]

On palpation, tenderness is present in the right hypochondrium. Rigidity, guarding and rebound tenderness are characteristically absent. If present, acute cholecystitis or cholangitis must be suspected.

DIAGNOSIS OF COMMON BILE DUCT STONES

Clinical and Laboratory evaluation

Patients presenting with CBD stones should be subjected to a detailed history and physical examination. History of jaundice in the past, prior surgeries, medical risk factors should be noted. Liver function tests show an obstructive picture. Typically bilirubin(conjugated>>unconjugated), alkaline phosphatase and gamma glutamyl-transferase levels are elevated, the transaminase levels are normal or elevated as in late case or in patients with cholangitis. ALP and gamma-glutamyl-transferase (GGT) levels typically rise to several times the normal level after several days of bile duct obstruction. Rise of alkaline phosphatase levels occur earlier and persist for a longer duration than bilirubin. These changes are not specific as they can be normal in asymptomatic patients. Occasionally, despite normal liver function tests,

intraoperative evaluation may reveal ductal stones in about 3-5% of patients.[58] Jensen et al found that of the 41 patients with elevated bilirubin only 17(41.5%) had CBD stones, similarly only 22(37.3%) of the 59 patients had stones.[59] Of the patients with abnormal liver function tests Cranley et al showed that only 34% had stones but 67% of the patients with CBD stones had abnormal liver function tests.[60] The prothrombin time is frequently prolonged because of the impaired absorption of vitamin K. White cell counts are elevated in cholangitis. In patients presenting with pancreatitis, serum amylase levels are elevated.

Acute cholangitis presents with fever, jaundice and pain and in severe cases with confusion, and hypotension (Reynold's pentad). Later renal failure and thrombocytopenia may appear as a part of disseminated intravascular coagulation (DIC).[61] These patients have elevated white cell counts, decreased platelet count and prothrombin time, elevated renal parameters and positive blood cultures. Ultrasound may reveal a dilated biliary system.

Ultrasonography

It has become the investigation of first choice in the diagnosis of biliary tract diseases, as it is easy to perform, inexpensive, non-invasive, causes little discomfort to the patient and avoids irradiation and potentially toxic contrast media.

Diagnostic sensitivity of ultrasound for cholelithiasis is 95-99% with a very low false-positive and false-negative rate.[62] If the gall bladder cannot be identified, the presence of an echogenic focus in the gall bladder area is nearly as specific a finding as that of calculi in a distended gall bladder.

Laing et al while evaluating 53 patients with obstructive jaundice got a sensitivity of 29%, specificity of 91% and an accuracy of 55% while evaluating 53 patients with obstructive jaundice.[63] Cronan reported a sensitivity of 58 in detecting stones located in the proximal duct but this fell down to 23% of those in the distal duct.[64] The results of Gross et al showed a sensitivity of 25%, a specificity of 89%, a positive predictive value of 50% and a negative predictive value of 73%.[65] Most of the studies show the sensitivity to be in between 10-33%. Ultrasound is exquisitely sensitive in determining the dilatation of the bile ducts. Dilated bile ducts are seen as tubules lying alongside the portal vein branches. Though this pattern is characteristic and specific, the pitfalls are in those instances where the patient is scanned within a few days of onset of obstructive jaundice, when the system is not yet dilated; or where a ball valve calculus in the lower duct produces a marked dilatation without producing any clinical symptoms. Gross et al demonstrated a sensitivity of 88% and a specificity of 93% in the sonographic evaluation of ductal dilatation.[65] 30% of the patients with CBD stones had no ductal dilatation in the series of Laing et al.[63] Cronan showed a dilated duct in 67% and 77% of these were positive for stones.[64] With the criteria of common duct that measures less than 9 mm in diameter, normal liver function tests with no recent history of jaundice or pancreatitis. Csendes et al got a 99% negative predictive value.[66]

The sonologic criteria for the common ductal stones are:

1. Presence of echogenic material in the CBD with post-acoustic shadowing,

2. Dilatation of the CBD

IV Cholangiography

Biliagram (meglumine-ioglycamate) when injected intravenously; is rapidly secreted into the biliary tree by the liver. Careful radiography with or without tomography can clearly define the ducts and the gallbladder delineating the stones.[67]

However, failure to opacify the ducts arise in 3-10% of the cases.[68] The contrast agent may cause allergic reactions. Its limitation is in patients with complete biliary obstruction, where the contrast is not secreted into the system. Moreover the anatomic delineation obtained is inferior to that of a peroperative cholangiogram. Cranley et al assessed the value of iv cholangiography and got a sensitivity of only 26.32% and a false negative rate of 11.5%.[60] Goodman and co-workers found that the common bile duct was adequately visualized in only 50% of the patients with serum bilirubin levels less than 3 mg.dL-1 and when it was visualized the diagnostic accuracy rate was only 40%.[69] Way and associates reported that 38% of the patients in their series had either misleading results or inadequate study.[70] Johnson et al showed common duct visualization in 60% of the patients, with similar percentage having stones.[71] In a study by Rubin et al, common ducts were visualized in 14 patients out of the 17 patients and stones were found in 7 of them. False-negative were encountered in 6 patients.[72]

Percutaneous Transhepatic Cholangiography

Patients with a dilated biliary tree are good candidates for percutaneous transhepatic cholangiography. This is only undertaken once a bleeding tendency has been excluded and the patient's prothrombin time is normal. Antibiotics should be given prior to the procedure. Under fluoroscopic control, a needle (the Chiba or Okuda needle) 15 cm long and 0.7 mm in diameter is advanced into the liver through the eighth intercostal

space in the midaxillary line to a point about 2 cm short of the right margin of the vertebral column. The stilette is then removed and while injecting contrast (e.g. meglumine iothalamate 60%, w/v) the needle is slowly withdrawn until contrast is seen entering a bile radicle. Addition to this technique enables placement of a catheter into the bile ducts to provide external biliary drainage or the insertion of indwelling stents. The scope of this procedure can be further extended by leaving the drainage catheter in situ for a number of days and then dilating the track sufficiently for a fine flexible choledochoscope to be passed into the intrahepatic biliary tree in order to diagnose structures, take biopsies and remove stones. Despite the use of fine gauge needles, ther is a risk of bile leakage and hemorrhage. Other complications include haemobilia, pancreatitis, hepatovascular fistula and septicemia. These occurred in about 5% of the patients studied by Elias.[73]. The success rate of this procedure varies from 75 to 100%.[61,69,73] Generally, the accuracy is better with malignant obstructions rather than calculus obstruction, but Rubin et al demonstrated CBD stones in ten patients out of the 12 examinations.[72]

ERCP

Recent years have witnessed endoscopic retrograde cholangiopancreatography being used more frequently as a therapeutic technique than as a diagnostic modality in patients with hepatobiliary and pancreatic diseases. Under conscious sedation, with a side viewing duodenoscope, the ampulla of Vater is visualized, the bile duct is selectively cannulated and a water soluble contrast injected under fluoroscopic control. This delineates the biliary tree; stones, strictures or any other lesions can be visualized. Bile collected can be sent for cytological and microbiological studies. Brushings can be sent for cytological evaluation. Complications include cholangitis,

pancreatitis, haemorrhage, allergic reactions to the contrast agent. The success rates reported for ERCP is between 60-90%[61]. In a randomized study, Elias et al compared PTC ERC in patients with extrahepatic biliary stasis. Of the PTC group, 92% were successful and among the patients with ERC, 62% had successful examinations.[74]

MRCP

Magnetic resonance cholangiopancreatography has been used to evaluate a wide range of biliary and pancreatic disorders. MRCP is highly accurate for the assessment of the common bile duct calculi with reported range of sensitivity of 86-100%, specificity of 93-100% positive predictive value 92-100% and negative predictive value of 95-100%.[75,76] ERCP, PTC and intraoperative cholangiography (IOC) are invasive, operator dependent, and associated with risks and complications such as pancreatitis. CT and ultrasound are limited by low sensitivity for choledocholithiasis. Compared to ERCP, MRCP is non invasive and is less operator-dependent, uses no ionizing radiation, requires no exogenous contrast medium or sedation. The technique utilizes heavily T2-weighted imaging sequences that result in selectively high signal intensity of static or slow-moving fluid such as bile and pancreatic secretions contained within the bile ducts and the pancreatic ducts respectively. Current T2-weighted imaging techniques (e.g. Half- fourier acquisition single shot turbo spin-echo (HASTE) or single shot fast spin-echo (SSFSE), can acquire an image in less than one second.[75,76] These ultrafast MRCP techniques can eliminate respiratory artifacts and minimize susceptibility effects from bowel or biliary gas, surgical clips, and biliary stents. There are two complementary methods of acquiring MRCP images. One method acquires a single thick section (30-80 mm) in the coronal plane or coronal-oblique planes. A second technique acquires multiple thin sections (2-5mm)

in the axial, coronal, and/or coronal-oblique plane. From these thin-section source images, maximum intensity projection (MIP) images are reconstructed that appear similar to projection images obtained with ERCP.

Calculi within the common bile duct appear as low signal intensity foci surrounded by high signal intensity bile. MRCP images are able to show ducts proximal to an obstruction and demonstrate duct caliber in the physiologic state without distention from exogenous contrast injection.

Thin section source images are important because high signal intensity of bile anterior and posterior to a calculus may obscure the calculus on thick section projection MRCP images. Although its spatial resolution is lower than that of ERCP, MRCP has been able to depict common bile duct calculus small as 2mm in diameter.

MRCP can give false positive results if choledocholithiasis occurs with strictures or causes of filling defects in the CBD such as pneumobilia, tumor, or blood clot. Pneumobilia is non-dependent, and axial images may show an air-fluid level. Another potential pitfall is the "pseudocalculus effect" caused by transient forceful contraction of the Vaterian sphincter muscle complex that surrounds the distal CBD.[77]

False negative diagnosis may occur when calculus is impacted in the narrower Vaterian portion of the distal CBD or ampulla, or when calculi are small.

ERCP has the advantage over MRCP of being both diagnostic and therapeutic for CBD calculi. Physical examination, liver function tests, and sonographic findings of biliary dilatation are used to stratify patients based on risk of harboring CBD calculi and determine need for ERCP. These markers have high sensitivity but low specificity, with subsequent ERCP revealing choledocholithiasis in only one-third to

two-thirds of patients who were determined to be at increased risk. The precise role of MRCP in the preoperative setting remains controversial. MRCP may also be useful for identifying congenital variants that increase the risk of inadvertent biliary injury during laparoscopic cholecystectomy. These variants include low or medial cystic duct insertion and parallel course of the cystic and hepatic ducts.

MANAGEMENT OPTIONS IN CHOLEDOCHOLITHIASIS

Laparotomy and choledochotomy along with cholecystectomy was the traditional and standard line of management of choledocholithiasis. For the first half of the last century, this was the sole modality of management. The introduction of endoscopic retrograde cholangiography in the mid 70s heralded the endoscopic era and the non-surgical management of the common duct stones. In the early 90s, laparoscopic cholecystectomy gained widespread acceptance, with it the management has become even more controversial. Newer options that have emerged are chemical dissolution, extracorporeal lithotripsy, intracorporeal lithotripsy.

The options available for the management of CBD calculi are summarized in the following box:

Table 1 : Modes of management of CBD calculi.

SURGICAL	-Choledocolithotomy -Biliary enteric drainage procedures(Transduodenal sphincteroplasty, Choledochoduodenostomy , Choledochojejunostomy) -Laproscopic bile duct exploration
NON-SURGICAL	-Endoscopic sphincterotomy and removal of stones with • Basketing/ballon • Mechanical lithotripsy • Electrohydraulic lithotripsy • Laser lithotripsy • Chemical dissolution -Percutaneous transhepatic stone removal -Observation
OTHERS	-Extracorporeal shockwave lithotripsy -Gallstone dissolution

The optimal management of ductal stones depends upon the clinical situation-emergency or elective, the age of the patient, his/her general condition and on the clinical expertise and facilities locally available.

SURGICAL MANAGEMENT

Common bile duct exploration is associated with considerable morbidity and morbidity. Adequate preoperative preparation is required for a patient who is posted for surgery on the bile duct.

Preoperative preparation

This includes correction of underlying metabolic abnormalities, anemia, or coagulopathy. Jaundiced patients should be appropriately hydrated preoperatively.

Glycogen stores may be built up by giving IV 10% dextrose. Coagulation abnormalities are corrected with fresh frozen plasma, platelets & Vit K injections. Antibiotic regimens are best left to the surgeon choice, but a single preoperative dose of antibiotics may be sufficient for routine cases; however, in patients with indwelling biliary stents, broad- spectrum antibiotics may be continued in the postoperative period.

Consultation by a cardiologist of pulmonologist should be sort in patients over the age of 65 years with sufficient risk of cardiopulmonary disease for fitness for surgery.

Glycemic control should be achieved in diabetic patients.

The surgical management can be divided broadly into 3 groups depending upon the clinical presentation.

1. Patients presenting with acute cholangitis.

2. Patients with diagnosed/suspicious common duct stones.

3. Patients with asymptomatic ductal stones.

1. Patients presenting with acute cholangitis

General Support

The clinical presentation of this subset of patients varies widely, from mildly ill patients, requiring oral antibiotics, to those with toxic cholangitis requiring intensive care therapy. The initial treatment usually includes stopping oral intake and stating intravenous fluids and antibiotics.

Antibiotic Therapy

Empirical antibiotics have to be administered (usually broad spectrum penicillins such as piperacillin or a cephalosporin or a quinolone along with an aminoglycoside).[78] Antibiotics administered should cover the gram-negative biliary organisms (E. Coli, Klebsiella) and anaerobic species (Bacteroides).[79] The patient is monitored closely for any worsening of symptoms. A study showed that about 17% of the patients require emergency biliary surgery in the first 24 hours and in the remaining two-third will require it in the first 72 hours. In patients who improve clinically by medical treatment alone, surgery may be undertaken electively.[80] Gigot et al have reported seven factors predict death in patients with acute cholangitis. They are:

- Acute renal failure
- Liver abscess
- Cirrhosis
- High malignant strictures
- Percutaneous transhepatic cholangiography
- Female gender
- Advanced age.[81]

Biliary Decompression

Decompressing the obstructed biliary system can be accomplished by non- operative means such as percutaneous biliary drainage or endoscopic sphincterotomy. ERCP and endoscopic sphincterotomy can be sought out as an initial step in most of the cases with small stones. Surgical decompression is indicated in those severely ill patients who cannot be managed by endoscopic or percutaneous means.[82]

Cholecystostomy, in this setting is an expedient and safe procedure, since edema and friability of tissues preclude safe dissection. Once sepsis subsides, definitive procedure may be performed electively.

If the condition permits, choledochotomy and placement of a T-tube can be done. Exploration, if done, should be limited and the stones left in-situ to be dealt with electively, after the condition of the patient improves.

2. Patients with diagnosed/suspicious common duct stones

The surgical options for managing patients with suspicious or proven common bile duct stones include:

- Choledochotomy, exploration of CBD and T-tube drainage,
- Biliary-enteric drainage procedures.

Common bile duct exploration

Technique: Stones in the common bile duct are confirmed either by palpation or cholangiography and choledochotomy is done. Kocher's maneuver facilitates the palpation of the retropancreatic CBD. Packs are placed suitably, the liver retracted

upward, stomach to the left and the duodenum downward. Peritoneum over the anterolateral surface of the common bile duct divided and the duct cleared off the overlying fatty tissue.

Before choledochotomy, bile is aspirated from the duct for conformation and for bacterial culture. Two 3-0 stay sutures are placed on the anterior surface of the duct approximately 1.0-2.0 cm above the superior border of the duodenum, the duct then opened longitudinally (1.5 to 2.5 cm) between them with a scalpel . Escaping bile is aspirated. If stones are exposed they are removed immediately. Gentle milking of the duct is done, proximal to the incision, from above downwards, towards the incision.

Stones and sludge can thus be milked out. Dejardin's forceps introduced and any remaining stones extracted. Alternatively a Fogarty type biliary balloon catheter may be used for the same; it is much less traumatic than the forceps.[83]

After exploration of the proximal ducts, the lower system is similarly explored, including the sphincter. When the stones are being extracted, it is wise to keep a pledget in the proximal duct, which has to be removed at the end of the procedure.

Once the duct is deemed clear of stones the duct system may be flushed with saline. A T-tube is then inserted into the via the choledochotomy incision. The choledochotomy incision is then closed above the T-tube with a single layer of interrupted 3.0 absorbable sutures . A completion cholangiogram may then be performed. A subhepatic drain is placed since bile leaks are inevitable in first few days of surgery.

Operative cholangiogram

Operative cholangiography should be performed meticulously; if not it may yield frequent false-negative and false-positive results. False-positive cholangiograms are

more frequent than false negatives. They may be due to air bubbles introduced into the system, which must be avoided; nevertheless they can be differentiated from stones. The concentrated dye may obscure small stone producing false-negatives.[84]

A 25-35% urograffin is injected slowly and two exposures are made, first one, after 5-7 ml of injection and the second, after 10-15ml. The first exposure coats the ducts and avoids obscuring small stones, especially in an enlarged duct. The second exposure visualizes the distal & proximal ducts and verifies the passage of the dye into the duodenum.[85]

Intraductal filling defects are the most accurate cholangiographic indication of exploration of the common bile duct. Marks et al have reported an accuracy of 98%.[82]

The debate of whether cholangiogram has to be performed routinely or selectively has not reached a consensus. It has been argued that, despite palpable stones it has to be performed as it verifies that the stones are still present, their number, size and location; visualization of the untraumatized ampullary region; and a clear visualization of the often anomalous biliary anatomy. But the advocates of the selective cholangiography[86] fixed to the fact that it entails unnecessary risks and expenses to the patient, also prolonging the operating time. Bose has justified selective cholangiography. Probably, it is necessary to strike a balance between the two.

Biliary -Enteric Drainage procedures

An ambiguity about the need for a drainage procedure often arises during the surgery for choledocholithiasis. Decision to go ahead with these procedures depends on a number of factors pertaining to the individual patient. The increased risk of the

procedure must be weighed against the risk due to recurrent stones. For examples, in an elderly patient with comorbid factors such as pulmonary disease, cardiovascular disease, or diabetes where reoperation is risky, a biliary enteric drainage can be done. Other indications are in recurrent stones, stones associated with strictures and primary bile duct stones.

The three basic types of biliary-enteric drainage procedures are:

1. Transduodenal sphincteroplasty,
2. Choledochoduodenostomy
3. Choledochojejunostomy.

1. Transduodenal sphincteroplasty[87]

This procedure is appropriate for patients with an impacted stone at the terminal portion associated with a short stricture or narrowing. The advantages of this procedure include the ability to examine the papilla of Vater directly and biopsy the area of the stricture to rule out occult neoplastic changes.

The disadvantages include the necessity of making a duodenotomy with the associated risk of duodenal leaks, post operative pancreatitis and the placement of biliary- enteric anastomosis at the farthest extremity of the biliary tree. Problems with strictures and cholangitis may follow the procedure.

Technique: If cholecystectomy or choledochotomy has already been done, passing of small catheter into the duodenum is helpful to locate the ampulla. If not, after an extensive Kocher's manoeuvre, the ampulla can easily be felt between the fingers, in the groove between the second portion of the duodenum and the pancreas. The

duodenum is opened transversely opposite the papilla. Silk sutures are pre-placed at the either end of the incision, to elevate the duodenum and to limit the duodenotomy.

The orifice of the major papilla is cannulated. The secretions that fill the catheter may be used to determine whether it is in the bile or the pancreatic duct, If it cannot be passed, it is safer to pass it from above, An incision can be made over a bulging impacted stone, on the antero-superior aspect, so as not to damage the pancreatic duct, The duct has to be laid open until the diameter of the stoma is equal to the largest diameter of the common duct[10] thereby destroying the entire sphincter mechanism. Sphincteroplasty is carried out with sequential clamping and division and suture approximation of the duodenal mucosa with the bile duct mucosa.

2. Choledochoduodenostomy

This procedure is selected in patients with lower biliary tract strictures associated with stones and chronic inflammatory changes. It has the advantage of being technically easier than sphincteroplasty and of being able to utilize the already existing choledochotomy. Its disadvantages are the necessity of having to make a duodenal incision, with all attendant risk.

The anastomosis can be done in two ways:

- **Side-to-side choledochoduodenostomy**: This is technically easier than the end-to-side variety. This technique utilizes the vertical choledochotomy and a longitudinal duodenotomy. The anastomosis is done in such a way that the vertical choledochotomy is converted to transverse incision to widen the opening. One of the long term sequel reported with this procedure is the 'sump syndrome', in which sepsis occurs as a result of obstruction of the anastomosis.

- **End-to-side choledochoduodenostomy**: This requires complete division of the bile duct with oversewing of the distal end and implantation of the proximal cut end into the duodenum. In procedure the risk of sump syndrome is eliminated.

3. Choledochojejunostomy

This again has 2 types:

- **In-continuity choledochojejunostomy**: This is a less favored procedure because of the potential risks of intestinal leak and fistula; moreover it is technically more difficult.

- **Roux-en-Y Choledochojejunostomy/Hepaticojejunostomy**: This is the procedure of choice for many patients who require definitive biliary drainage; it is indicated in patients with stones associated with high strictures.

In his study comparing choledochoduodenostomy vs. T-tube drainage, Lygidakis reported that patients who underwent the former procedure had a low early morbidity, no mortality, and no re-operations due to recurrent choledocholithiasis when compared to the latter.[88]

- Allen et al have recommended that a drainage procedure be included, if any following are present:
- Many stones in the duct
- History of previous choledochotomy
- Marked dilatation (>2 cm) of the duct
- Inability to remove all the stones from the duct
- Ductal stricture.[89]

4. Patients with asymptomatic ductal stones

Ten to twenty percent of patients undergoing cholecystectomy have asymptomatic common bile duct stones. These patients pose a different problem altogether . In patients undergoing an open cholecystectomy, the options available are the same as above. But in patients undergoing laparoscopic cholecystectomy, the ideal management is debated.

The options available are:

1. Leaving the stones alone, with observation
2. Preoperative endoscopic sphincterotomy
3. Laparoscopic common bile duct exploration
4. Post-operative endoscopic sphincterotomy
5. Conversion to open surgery with a formal CBD exploration.

If facilities and the expertise for laparoscopy are available, then a laparoscopic transcystic common bile duct exploration may be carried out.

Laparoscopic Management of Common Bile Duct Stones

The introduction of therapeutic laparoscopy altered the surgical approach to patients undergoing cholecystectomy. In an effort to treat patients with common duct stones in one session and avoid the potential complications of ES (especially in younger patients with small-diameter CBDs), several laparoscopic techniques of transcystic CBD exploration (LTCBDE) evolved. As skill in laparoscopic suturing was acquired, laparoscopic choledochotomy was increasingly performed. Various techniques of

LTCBDE developed, including lavage; trolling with wire baskets or biliary balloon catheters; the technique of cystic duct dilation; biliary endoscopy; stone retrieval with wire baskets under direct vision; and antegrade sphincterotomy, lithotripsy, and catheter placement.

LTCBDE or Choledochotomy

Indications for LTCBDE or choledochotomy include filling or equivocal defects on cholangiography, stone size less than 9 mm for LTCBDE, fewer than eight stones for LTCBDE, possible tumor, and favorable cystic duct. Contraindications to LTCBDE include stones larger than 1 cm; stones proximal to the cystic duct entrance into the CBD; small, friable cystic duct; and 10 or more stones. Indications for choledochotomy include filling defects in a bile duct larger than 6 mm in diameter but are also based on the expertise of the surgeon.

Choledochoscopy

Choledochoscopic transcystic CBDE requires dilation of the cystic duct in nearly all cases. A new incision in the cystic duct should be made approximately 1.5 cm from the common duct. A hydrophilic guide wire should be placed inside a balloon-dilating catheter and inserted into the bile duct. If there is any resistance or question regarding its location, radiographic or fluoroscopic confirmation must be obtained. A dilating balloon catheter with an outer diameter the size of the largest stone but smaller than the inner diameter of the common duct is chosen to dilate the cystic duct .

After careful dilation of the cystic duct, a bidirectional flexible choledochoscope is introduced into the cystic duct and manipulated down the CBD while warm irrigation is employed. When the first stone is identified, a straight 4-wire 2.4-French Segura

basket is inserted down the working channel, passed just beyond the stone, opened, withdrawn, and closed, capturing the stone. The stone and basket assemblage are then pulled up to the tip of the scope and withdrawn in unison. Choledochoscopy is continued until no stones are identified and the ampulla can be seen, not necessarily transgressed.

An effort is made to pass the scope up into intrahepatic bile ducts, though this can be performed only about 10% of the time.

NON-OPERATIVE MANAGEMENT

Endoscopic Retrograde Cholangiopancreatography

Since its introduction in 1970, ERCP has been extensively used in the diagnosis and management of choledocholithiasis. Following procedures are possible with endoscopy:[90,91]

• Sphincterotomy

• Stone extraction

• Lithotripsy

✓ Mechanical

✓ Shock wave (electrohydraulic, laser)

✓ Chemical dissolution

• Stent drainage

• Balloon dilatation

• Sphincter of Oddi manometry

• Photodynamic therapy

• Papillectomy

Technique

A single dose of intravenous antibiotic is given before the start of the procedure after a six hour fasting period. A diagnostic ERCP is performed to determine the feasibility and the advisability of endoscopic sphincterotomy. The sphincterotome is passed deeply and selectively into the common bile duct. The Ehrlangen model consists of an electrosurgical wire enclosed in a Teflon catheter, an adjustable handle, and a side port for injecting contrast medium.[92] The exposed distal 1 to 3 cm of the wire is the cutting edge and is flexed by tensing the proximal adjustable handle attached to the diathermy unit.

After fluoroscopic confirmation of the proper placement of the sphincterotome within the bile duct, the sphincterotome is withdrawn so that approximately one half to two-thirds of the wire is visible in the duodenum outside the papillary orifice. The length of the intramural segment of the bile duct to be cut usually can be judged accurately by seeing the bulge of the papillary apparatus and common bile duct superior to the papillary orifice. The sphincterotome is oriented in an 11-12 O' clock position by gentle flexion of the cutting wire and fine manipulation of the directional tip of the endoscope. Short bursts of blended diathermy current are then applied so that a measured cut is made through the sphincter muscle to allow the passage of all stones.

All stones should be removed at the time of sphincterotomy to prevent re-impaction and subsequent cholangitis. A balloon-tip catheter is passed into the proximal duct under fluoroscopic guidance, inflated, and then pulled down the bile duct, sweeping the stone before it. Alternatively, a Dormia basket may be used to attempt stone capture and extraction. Should this not succeed, a naso-biliary drain or double pigtail stent should be left in the bile duct to keep the stone dis-impacted while giving thought to alternate modalities.

In patients where a free deep cannulation cannot be obtained, passing a flexible 0.035 inch catheter can be accomplished[94] a guide wire can then be passed through it.

Once the guide wire is in-situ, a two-channel sphincterotome can easily be passed over it. If this is unsuccessful, a pre-cut sphincterotomy may be tried.[95]

In this technique, a needle knife in which the cutting wire protrudes 2 to 3 mm beyond the distal tip is placed in the papillary orifice, and a free hand cut is made in the direction of the bile duct for approximately 5 mm. The opening can then be probed with a standard sphincterotome and enlarged to an appropriate size. Fistulotomy may be tried by piercing the prominent intraduodenal bulge of the bile duct, proximal to the papillary orifice, and letting an impacted stone to be retrieved.[92]

Complications

The experience of the endoscopist is one of the most significant factors related to the development of ERCP complications.[93] Statistics on complication rates vary accordingly. Acute pancreatitis following ERCP occurs in < 7% of the patients.

Necrotising pancreatitis, a very serious complication, is observed in about 0.1% of post-procedure cholangitis. This occurs when there is significant & high grade bile duct obstruction. The most frequent bacterial pathogens are Enterobacteriaceae spp. And pseudomonas. If obstructed bile is identified on endoscopic cholangiogram, it is important to rapidly treat obstruction by either surgical means. Other complications include haemorrhage, perforation and sepsis.

Approximately 85-90% of the CBD stones can be extracted using a Dormia basket.[91] But in the rest they cannot be removed either because they are large or there is a disproportion between the size of the stone and the diameter of the distal CBD.

Anatomical variation (juxtapapillary diverticulum) or patients with prior gastrectomy, gastroenterostomy can occasionally pose problems. To overcome this various methods have been used.

Mechanical Lithotripsy

Large stone may be broken down by mechanical lithotripsy. Two types are available: through-the-scope lithotripter and the emergency lithotripter (Soehendra lithotripter, Wilson lithotripter).

Electrohydraulic lithotripsy

The principle of this procedure is that sparks discharged underwater generates high frequency hydraulic pressure waves. Since these can destroy the normal tissues, they have to be placed in close proximity of the stones.[96]. The procedure is therefore preformed through a cholangioscope, either per-orally with a mother-baby scope or via a percutaneous transhepatic approach. The success rates reported are 99%.[91]

Laser lithotripsy

Shock waves can be produced under water by means of a pulsed laser. Laser-induced shock-wave lithotripsy is again performed with a mother-baby scope. The types used are Q-switched Nd/YAG, flash lamp pulsed dye laser.[19]

Chemical dissolution

Mono-octanoin and methyl-tert-butyl ether have been used to dissolve CBD stones via a nasobiliary catheter and T-tubes. But it has lost popularity because of its cumbersome nature and time consuming technique.

Surgery Vs Endoscopy

Historically, the standard treatment of gall bladder and bile duct stone has been surgical. Per-oral endoscopic techniques provide an effective alternative for removing bile duct stones by endoscopic sphincterotomy and stone extraction and may be safer than surgery in elderly people and other high risk groups as the associated morbidity and unchanged regardless of age.[93] As endoscopic management of bile duct stones and leaving the gall bladder in situ could be definitive treatment in these patients. There is a tendency to adopt a wait and see strategy even in those who may be fit for surgery.[97]

Several recent series have suggested that mortality after surgical bile duct exploration have decreased[98], and two recent prospective randomized studies have questioned the rationale for leaving the gall bladder in situ after endoscopic sphincterotomy.[99,100] Indeed, the published evidence suggests an individualized approach to the management and outcomes of bile duct and gallbladder stones in elderly and high risk patients. Prospective randomized studies comparing bile duct clearance rates with endoscopic sphincterotomy and with open surgery showed rate of 88% versus 94%[100] and 90%.[99] The frequency of retained bile duct stones after open surgery is about 1-5%.[101] In 12 recent of open surgery published from 1988 to1992 mortality in patients aged over 70 ranged from 0 to 9%. And in eight series it was less than 4%.[98] In comparison, complications from endoscopic sphincterotomy occur in 5-10% of cases, with a mortality of 0.5-1% unrelated to age.[93]

Recent prospective randomized trials comparing surgery (open and laparoscopic) with sphincterotomy for bile duct stones have found that morbidity and mortality were similar in the modes of treatment, presumably in non-emergency situations.[99,100,102]

In elderly or high risk patients morbidity was 23% after sphincterotomy versus 16% after surgery, with mortality 4% versus 6% respectively.[100] In patients presenting as emergencies with acute cholangitis a prospective randomized trial found that sphincterotomy was associated with fewer complications and lower mortality than surgery.[103] Thus in elderly or high risk patients, elective surgery may be as safe as spincterotomy. But this requires further evaluation. In cholangitis urgent sphincterotomy appears to be the preferred option. Retrospective studies of patients who have undergone endoscopic sphincterotomy for bile duct stone with gallbladder left in situ suggest that only about 10% of patients develop recurrent biliary problems over 10 years.[104] However, two prospective studies suggest that a higher proportion of patients develop recurrent biliary symptoms after a shorter period.[99,100] Targarona et al randomized elderly and other high risk patients to either endoscopic sphincterotomy with the gallbladder left in situ or open surgery and found that after a mean follow up of 17 months biliary symptoms recurred in 10 of 50 (20%) in the sphincterotomy group (7 of whom required surgery) versus 3 of 48 (6%) in the surgery group.[100] Hammarstrom et al randomized middle aged and elderly patients with definite bile duct stone to endoscopic sphincterotomy with the gall bladder left in situ or open. Surgery and found that after a follow up of more than 5 years. 13 of 35 (37%) in the sphincterotomy group required surgery (though only 7 of these (20%) had recurrent biliary symptoms) compared with 2 of 41 (5%) in the surgery group.[99] In another prospective randomized study of 206 patients early surgery was required in 19% in the endoscopic group and 1.8% in the surgery group.[102] The risk of acute cholecystitis after sphincterotomy without a cholecystectomy ranges from 1 to 16%; most of these cases tend to occur soon after the sphincterotomy in those with gall bladder stones.[100,101] Thus, although 20-40% of patients may require subsequent

cholecystectomy for recurrent symptoms after 17 months to 5 years, the converse is also true; that is, most (60-80%) will not require cholecystectomy. Even if cholecystectomy is delayed, the outcome may be no worse than after early cholecystectomy.[98] The advantage of laparoscopic cholecystectomy in elderly patients is fewer complications, lower mortality and a shorter length of stay than after open cholecystectomy.[105] Elderly patients have higher morbidity and length of stay after laparoscopic cholecystectomy than younger ones because elderly patients are more likely to present with acute complications of gallstones.[82]. In high risk patients laparoscopic cholecystectomy has less morbidity and mortality than open cholecystectomy.[105] Based on current evidence we therefore suggest the following approach for managing bile duct stones with an intact gall bladder in elderly people. Sphincterotomy should be the initial procedure in acute cholangitis or severe gall stone pancreatitis.[101] In an elective clinical setting, if the patient is otherwise fit, the options include,

- Endoscopic retrograde cholangiopancreatography following by laparoscopic cholecystectomy
- Open or laparoscopic cholecystectomy and bile duct exploration
- Endoscopic retrograde cholangiopancreatography and cholecystectomy only for recurrent symptoms (wait and see strategy). The choice should be made according to local availability and expertise. If the patient is unfit with co-morbid disease then leaving the gall bladder in situ is justified.

Percutaneous Transhepatic stone removal

This technique is used only if the endoscopic means fail. This can also be used in conjunction with ERCP (the randez-vous procedure). This method was first described by Perez et al in 1979.[106] Stokes et al have reported a success rate for stone removal of 93% in the patients with contraindications to surgery and with a failure of endoscopic extraction.[107]

Extracorporeal Shock Wave Lithotripsy (ESWL)

Bile duct stones can also be fragmented by ESWL. The later generation machines do not need a water bath or general anesthesia. Fluoroscopic localization of the CBD stone is usually preferred to ultrasonography. ERCP and papillotomy are performed initially.[96] The fragments must be extracted by ERCP or percutaneously.

BACKGROUND

Choledocholithiasis is the most common cause of obstructive jaundice and occurs in about 10% of patients with symptomatic gallstone. Fifteen to 20% of patients have silent choledocholithiasis.[108,109,110] The need for subsequent cholecystectomy in patients with gall bladder in situ after endoscopic removal of stones from the common bile duct is controversial. Performing cholecystectomy after endoscopic retrieval of stones is to prevent further biliary complications. Management strategies need to be individualized and guided by risk factors for surgery and further biliary complication.

Endoscopic retrieval of the stones by ERCP with endoscopic sphincterotomy (ES) is a safe and effective treatment for bile duct calculi.[111,112]

At present, ES is advocated in most patients with bile duct stones and in patients with gallbladder in situ, regardless of age[113,114].

The incidence of symptomatic cholecystectomy for the conditions of acute cholecystitis, acute pancreatitis and abdominal pain after ES varies from 2.5% to 22%.[115,116] The predictive factors for the development of biliary symptoms after ES in patients with intact gallbladders have not yet been defined. Some authors recommend elective cholecystectomy after ES in cases of GB calculi, pre-existing cholangitis, acute biliary pancreatitis, complete opacification of the GB during ERCP and non-visualization of the GB after ES, but others do not.[117,118,119,120]. Therefore, clinical outcomes at follow- up and identification of factors subsequent symptoms from the biliary tract are needed.

In the present study, we have attempted to enumerate the demographic characteristics, various modes of clinical presentation, diagnostic tests, management and complications of the patients with Choledocholithiasis.

To evaluate age, sex, incidence, most common etiopathological factors for biliary calculi in our institution.

1. To study varying clinical presentations in patients with CBD stones.
2. To study various modes of management adopted in our institution.

- **SOURCE OF DATA**

Location: SKBS MEDICAL INSTITUTE & RESEARCH CENTER

Study period: August 2016 – August 2017

- **METHODS OF STUDY**

An Observational study starting from August 2016 – August 2017 will be carried out in SKBS medical college hospital.

All the patients presenting with features of Choledocholithiasis will undergo work up for the diagnosis. Admitted Patients will go for all the routine investigations and reviewed. The outcome will be evaluated as per the predesigned Performa of study.

- **Inclusion Criteria:**

1. All patients diagnosed as Biliary stone disease by clinical examination and radiological investigations.
2. All patients operated for Choledocholithiasis.

- **Exclusion Criteria**

1. Patients with multiple co morbidity.
2. Patient not willing for study.
3. Asymptomatic Gall bladder stones found accidentally either at laparotomy or during sonography done for some other problem.
4. Patients with hepatobiliary malignancy.

Investigations or interventions to be conducted on patients:

The following blood and radiological investigations would be carried out in addition to routine investigations for patients -

I. Routine blood investigations (i.e. complete blood count, platelet count, reticulocyte count etc.)

II. Urine & stool examination (routine & microscopy)

III. Renal profile

IV. Serum Electrolytes

V. Serum amylase & serum lipase.

VI. Liver function tests

- Total & Direct bilirubin
- SGPT
- SGOT
- ALP
- PT/INR

VII. Plain x-ray abdomen- erect posture

VIII. Chest x-ray: PA view

IX. HBsAg & HIV

X. USG- Abdomen & pelvis

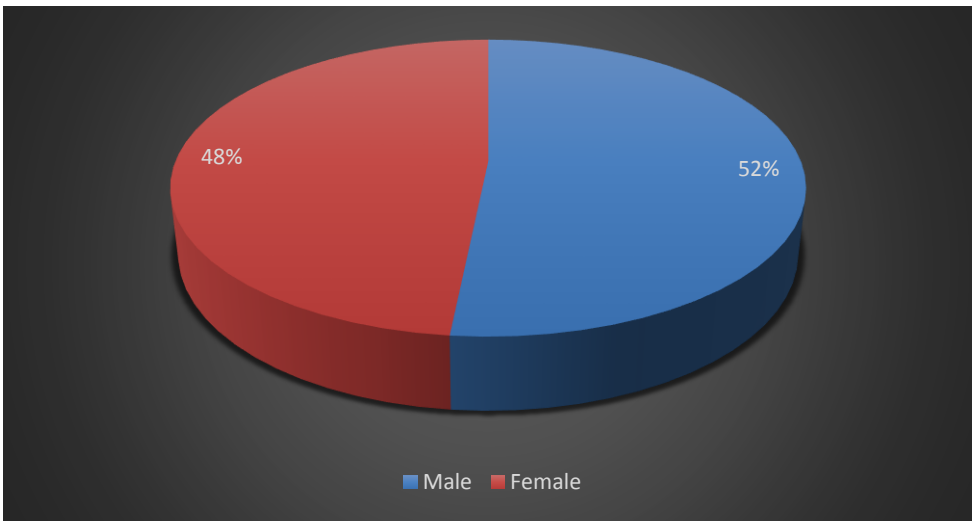
XI. ERCP, MRCP, CT abdomen & pelvis in selected cases

1. GENDER DISTRIBUTION

Table 2 : Gender Distribution of all the patients:

Age in years	ERCP+		Open surgery		All patients	
	No.	**%**	**No.**	**%**	**No.**	**%**
30-40	3	15.8	2	16.7	5	16.1
41-50	6	31.6	2	16.7	8	25.8
51-60	4	21.1	2	16.7	6	19.4
61-70	5	26.3	4	33.3	9	29.0
>70	1	5.3	2	16.7	3	9.7
Total	19	100.0	12	100.0	31	100.0

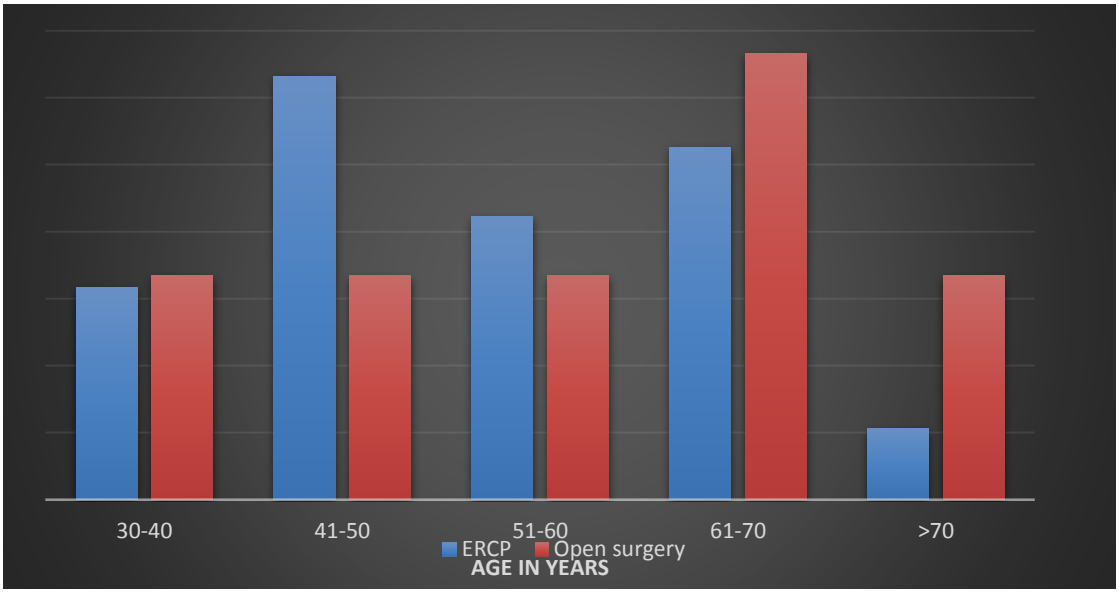
Graph 1 : Gender Distribution of all the patients:



There were 16 male and 15 female patient included in our study with slight male predominance.

2. AGE DISTRIBUTION:

Graph 2 : Age Distribution of all the patients:



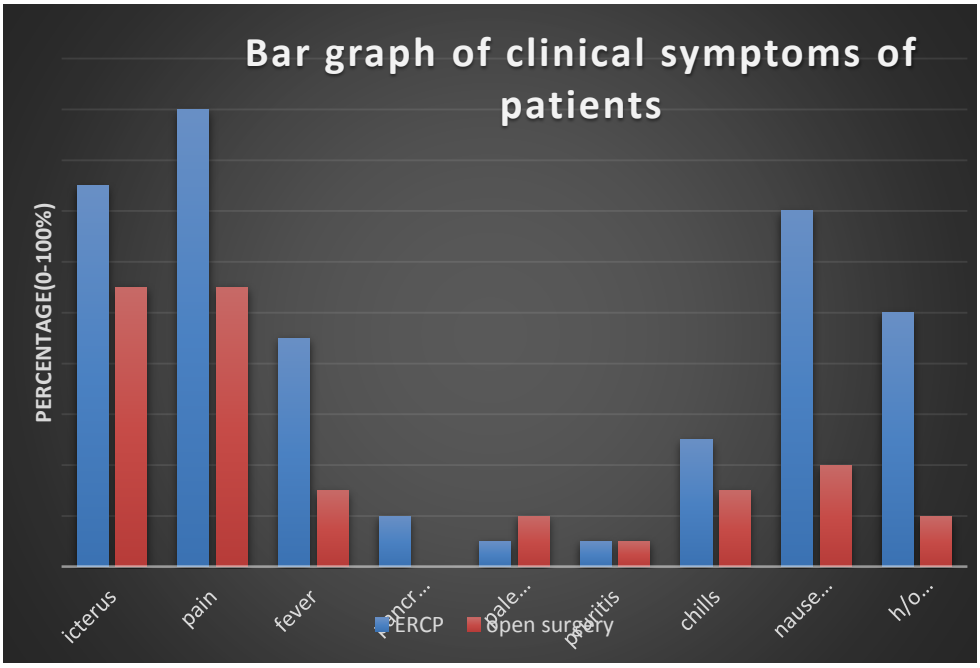
The age at presentation in females ranged from 31 to 85 years, with a mean age of 56.80 years(SD 15.28) .Similarly in males it ranged from 30-75 years with a mean age of 55.13 years(SD 13.42) . Overall the mean age of presentation was 55.94 years(SD14.14) . Thus most of the females presented at a late age than males.

3. CLINICAL PRESENTATION:

Table 3: Clinical symptoms in patients:

Clinical symptoms	ERCP+ (n=19)	Open surgery (n=12)	All patients (n=31)
Icterus	15(78.94%)	11(91.66%)	26(83.87%)
Pain	18(94.7%)	11(91.7%)	29(93.5%)
Fever	9(47.4%)	3(25%)	12(38.7%)
Pancreatitis	2(10.5%)	0(0%)	2(6.5%)
Pale stools	1(5.3%)	2(16.7%)	3(9.7%)
Pruritis	1(5.3%)	1(8.3%)	2(6.5%)
Chills	5(26.3%)	3(25%)	8(25.8%)
Nausea/vomiting	14(73.7%)	4(33.3%)	18(58.1%)
h/o jaundice	10(52.6%)	2(16.7%)	12(38.7%)

Graph 3 : Clinical symptoms in patients:



Jaundice was present in 26 of the 31 patients (83.87%). Pain was complaint in 29 patients(93.54%) . Twelve patients had fever (38.70%) , of these 7 had the classical traid of cholangitis . Eighteen patients had nausea with or without vomiting (58.06%). Pale stools and pruritis was present in only 3 (9.67%) and 2 (6.45%) respectively . Two patients presented with the pain of pancreatitis (6.45%).

Jaundice in the past was elicited in 12 (38.70%) of the patients , of these 4(33.33%) were those without clinically apparent jaundice at presentation . Six patients had history of intervention for biliary tract pathology , 4 (12.90%) of whom had underwent cholecystectomy and 2 (6.45%) had undergone ERCP . All cholecystectomies were done more than 2 years before current admission .

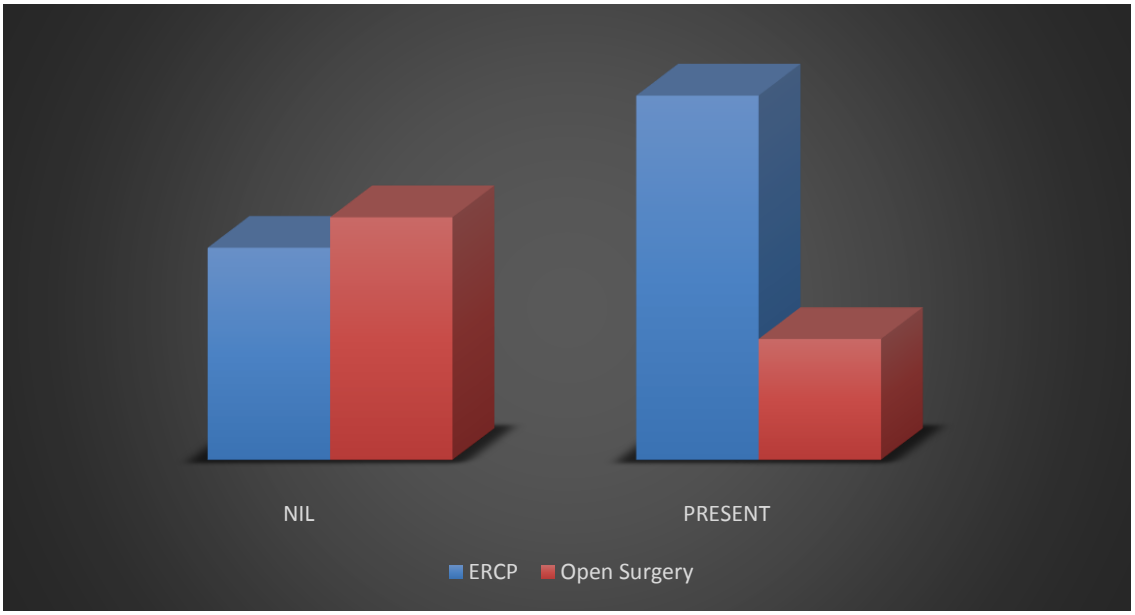
4. MEDICAL RISK FACTORS:

Table 4: Medical risk factors:

Medical risk factors	ERCP+ (n=19)	Open surgery (n=12)	All patients (n=31)
Nil	7(36.8%)	8(66.7%)	15(48.4%)
Present	12(63.2%)	4(33.3%)	16(51.6%)

Inference	**ERCP is associated with more incidence of medical risk factors**

Graph 4 : Medical risk factors:



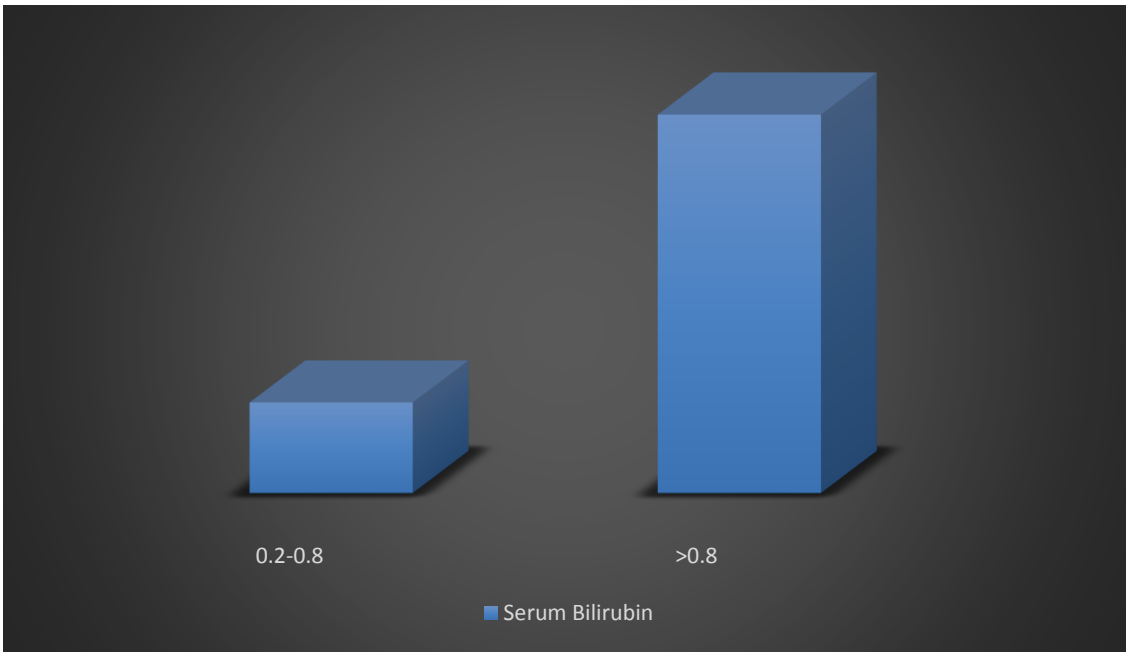
Seven patients (22.58%) had hypertension and 10 (32.25%) were diabetics. Three patients(9.67%) had both hypertension and diabetes . Two patients were suffering from ischaemic heart disease.

5. BIOCHEMICAL INVESTIGATIONS

Table 5 : Total bilirubin

Total bilirubin	All patients (n=31)
0.2-0.8	6(19.4%)
>0.8	25(80.6%)

Graph 5 : Total bilirubin

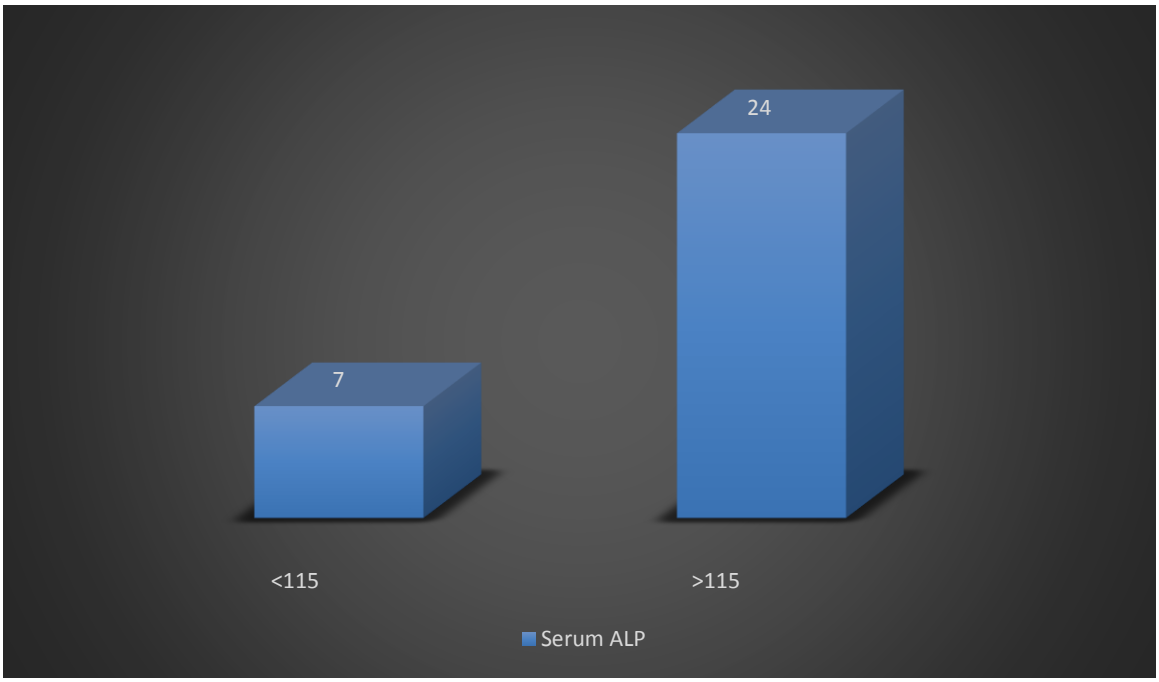


26 patients (83.64%) showed raised serum bilirubin with a maximum of 15.2mg/dl.

Table 6 : Alkaline phosphatase

ALP	All patients (n=31)
<115	7(22.6%)
>115	24(77.4%)

Graph 6 : Serum ALP:



Serum alkaline phosphatase was raised (>115 IU/L) in twenty four patients (77.41%).

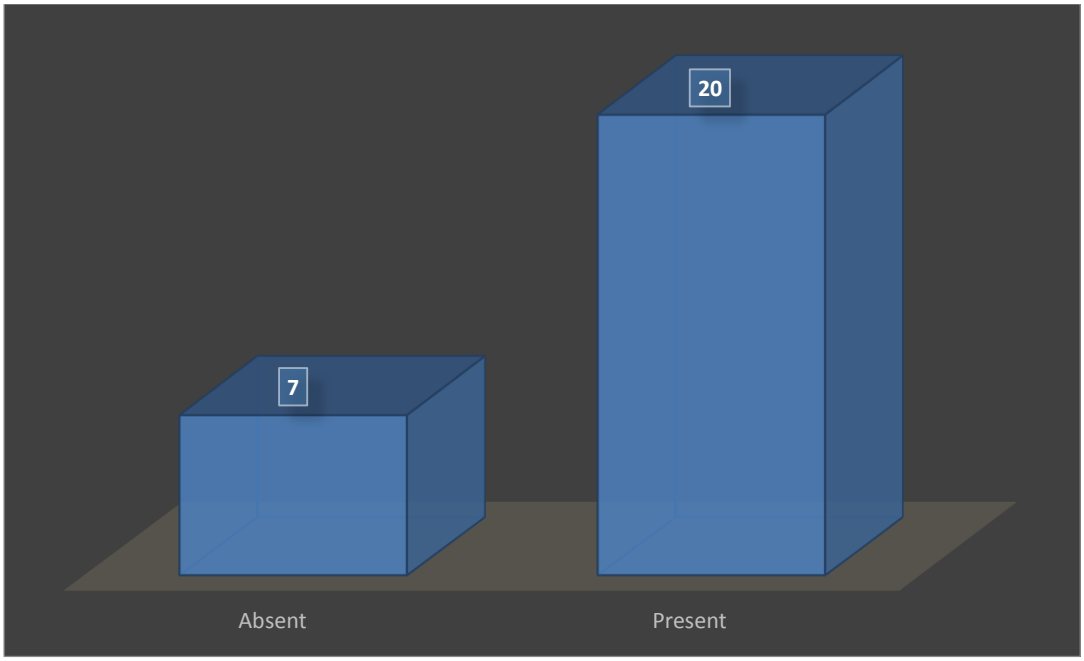
6. ULTRASONOGRAPHY:

- **GB STONE ON ULTRASONOGRAPHY:**

Table 7: GB stone on ultrasonography:

GB stone on USG	All patients (n=27)
Absent	7(25.93%)
Present	20(74.07%)

Graph 7 : Ultrasonography Sensitivity



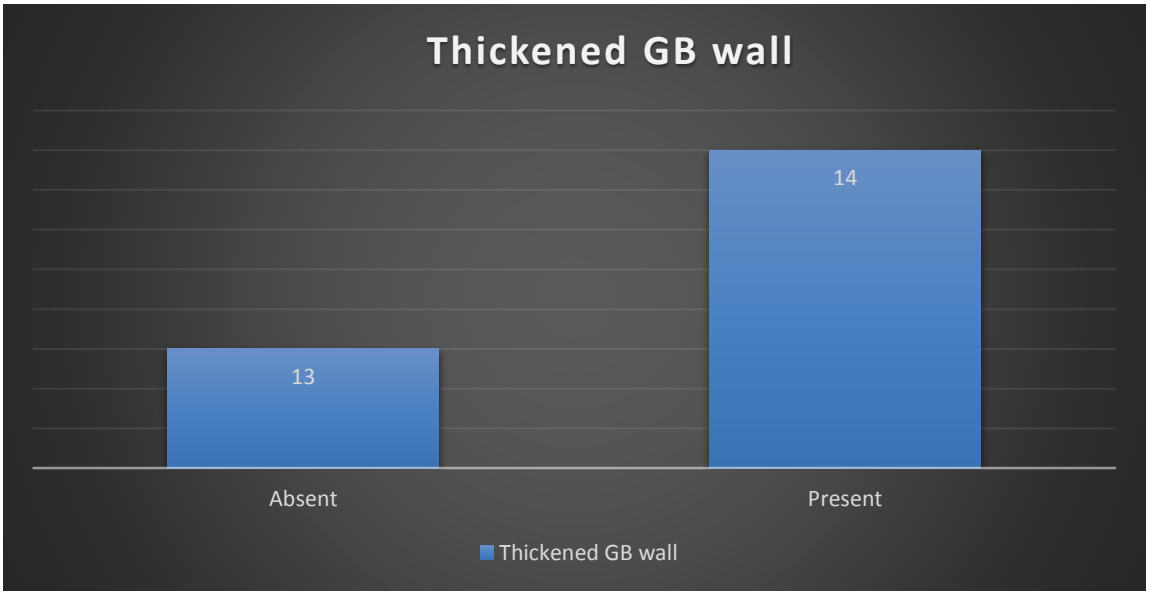
GB stone was present in 20 patients out of 27 patients and was absent in 7 patients. 4 patients had prior history of cholecystectomy out of the total 31 patients .

- **THICKENED GB WALL ON ULTRASONOGRAPHY:**

Table 8 : Thickened GB wall on ultrasonography

GB wall thickness on USG	All patients (n=27)
Absent	13(48.2%)
Present	14(51.8%)

Graph 8 : Thickened GB wall on ultrasonography:



GB wall thickening was present in 14 (51.8%) and absent in 13 (48.2%).

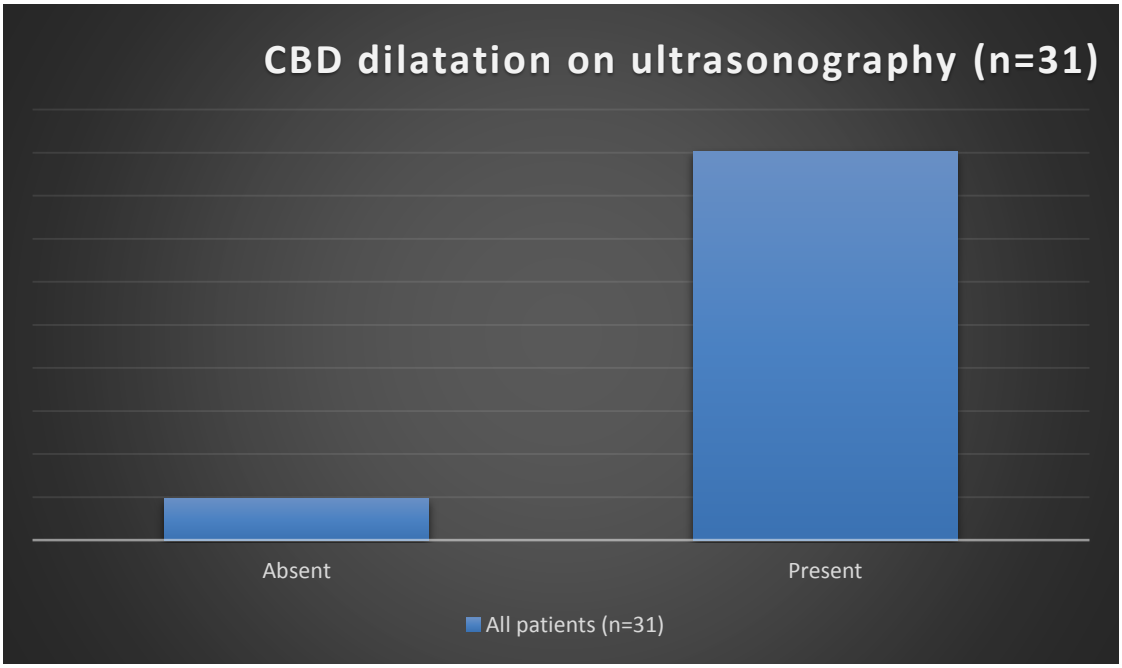
- **CBD dilatation on ultrasonography:**

Table 9 : CBD dilatation on ultrasonography

CBD dilatation on ultrasonography	All patients (n=31)
Absent	3(9.7%)
Present	28(90.3%)

CBD dilatation was detected in 28 (90.3%) and absent in 3 (9.7%).

Graph 9: CBD dilatation on ultrasonography

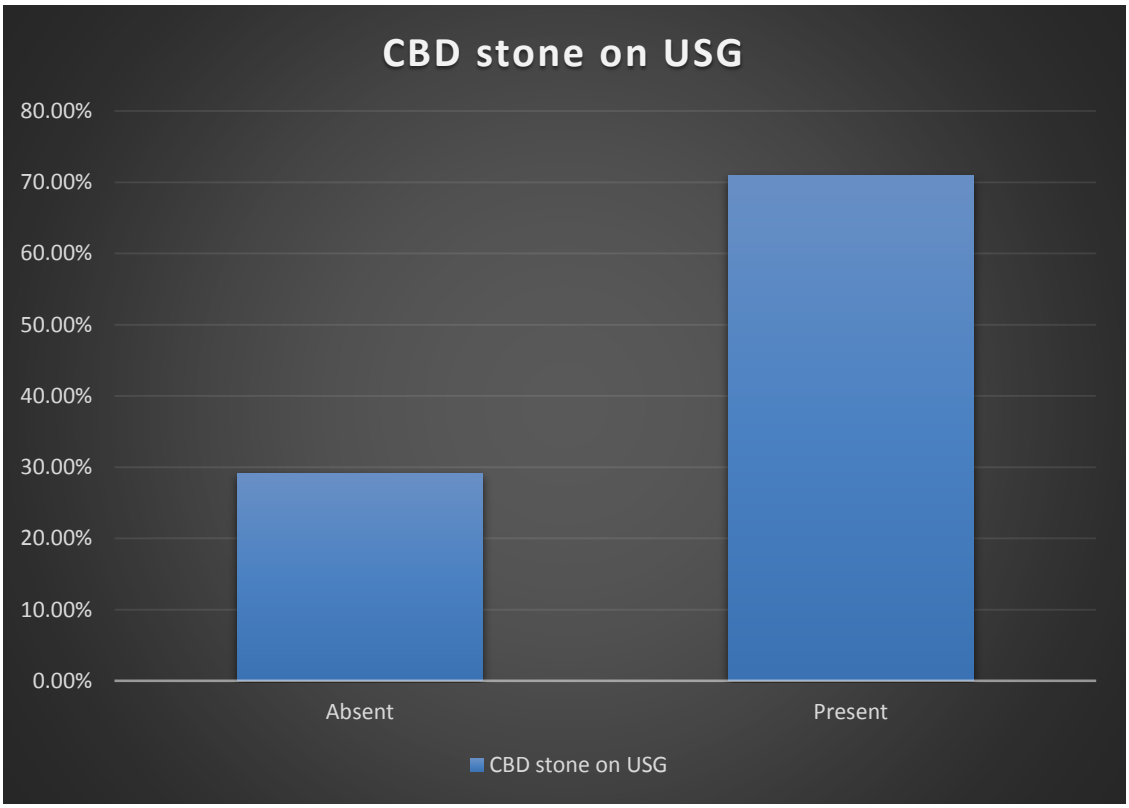


➢ CBD STONE ON ULTRASONOGRAPHY

Table 10: CBD stone on ultrasonography

CBD stone on ultrasonography	All patients (n=31)
Absent	9(29.1%)
Present	22(70.9%)

Graph 10: CBD stone on USG



Stone in CBD was detected in 22 patients (70.9%) and was not detected in 9 (29.1%).

Out of 31 patients 4 patients had h/o prior cholecystectomy. 20 patients had gall bladder stones and gall bladder thickening was present in 14. CBD dilatation was present in 28 patients and CBD stone was seen in 22 patients.

7. CT AND MRCP

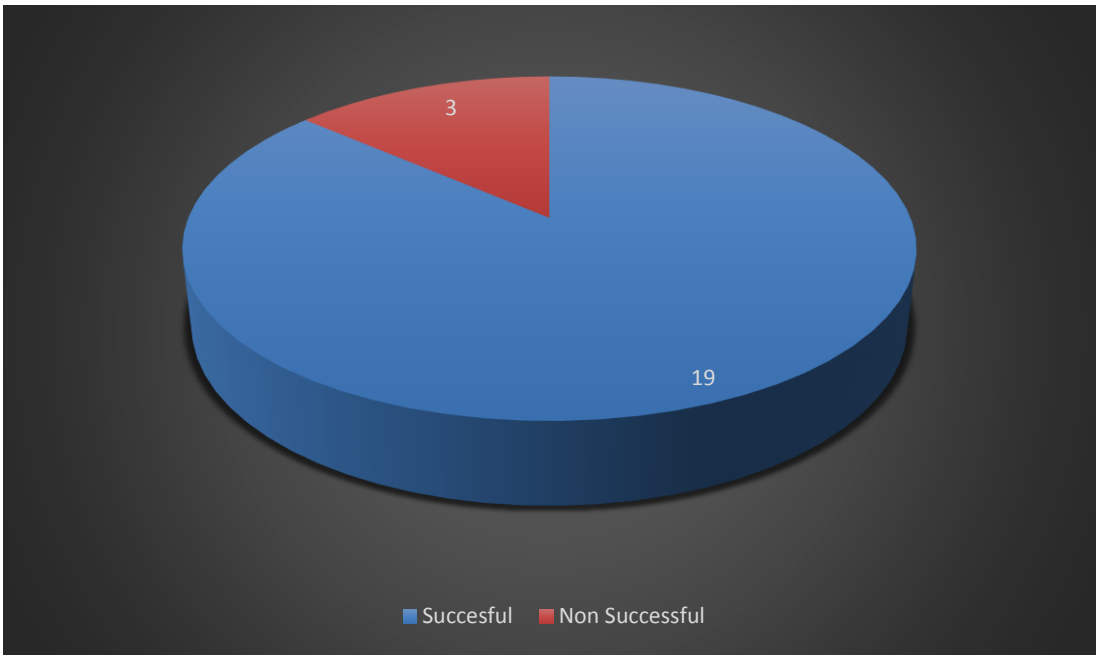
Nine patients, in whom ultrasonography did not show signs of stone, underwent a CT scan of the abdomen with MRCP. CT and MRCP picked up stones in the common bile duct in all (100%) patients.

8. ERCP/ES:

Table 11 : Percentage of patients in which ERCP was successful:

PROCEDURE [ERCP]	NO OF PATIENTS (n=22)
Successful	19 (86.36%)
Not successful	3 (13.63%)

Graph 11: Percentage of patients in which ERCP was successful:

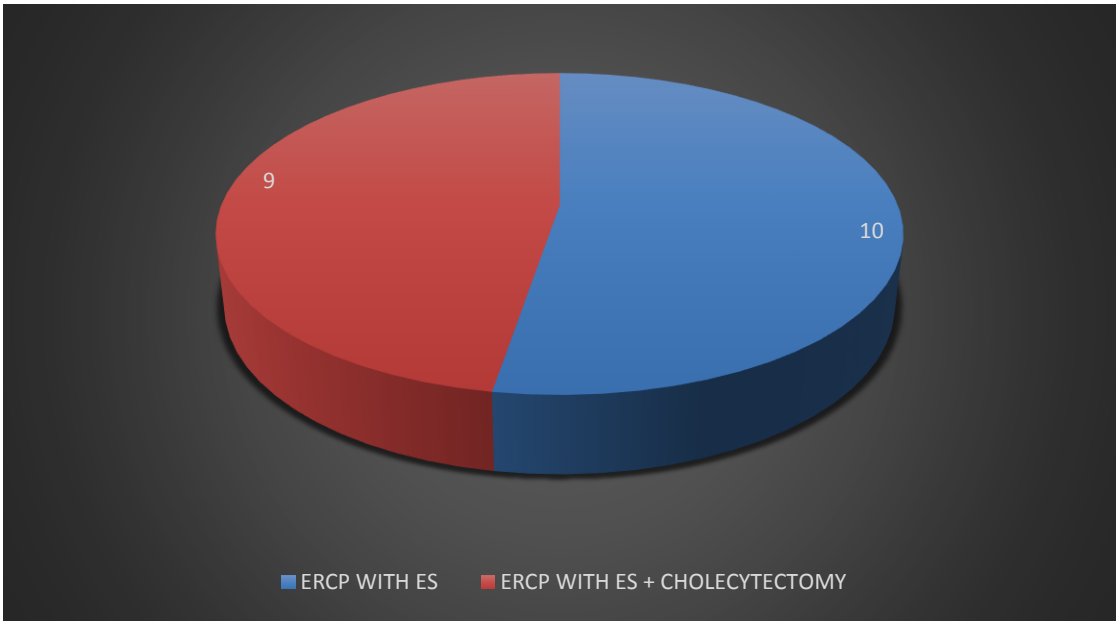


ERCP with ES was used primarily as a therapeutic modality. Of the 22 patients in whom endoscopic retrieval of stones was attempted it was successful in 19 patients (86.36%). In 3 (13.63%) patients there was failure due to impacted stones. All 3 patients underwent formal CBD exploration and cholecystectomy.

Table 12 : Percentage of patients undergoing cholecystectomy after ERCP:

PROCEDURE	No of patients (n=19)
ERCP with ES	10 (52.63%)
ERCP with ES + Cholecystectomy	9 (47.36%)

Graph 12: Percentage of patients undergoing cholecystectomy after ERCP:



In 10 (52.63%) patients ERCP with ES was the sole procedure performed as these patients neither had gall bladder stones nor thickened gall bladder. Nine (47.36%) patients further underwent cholecystectomy, 6 (66.67%) by laparoscopic method and 3 (33.33%) by open method.

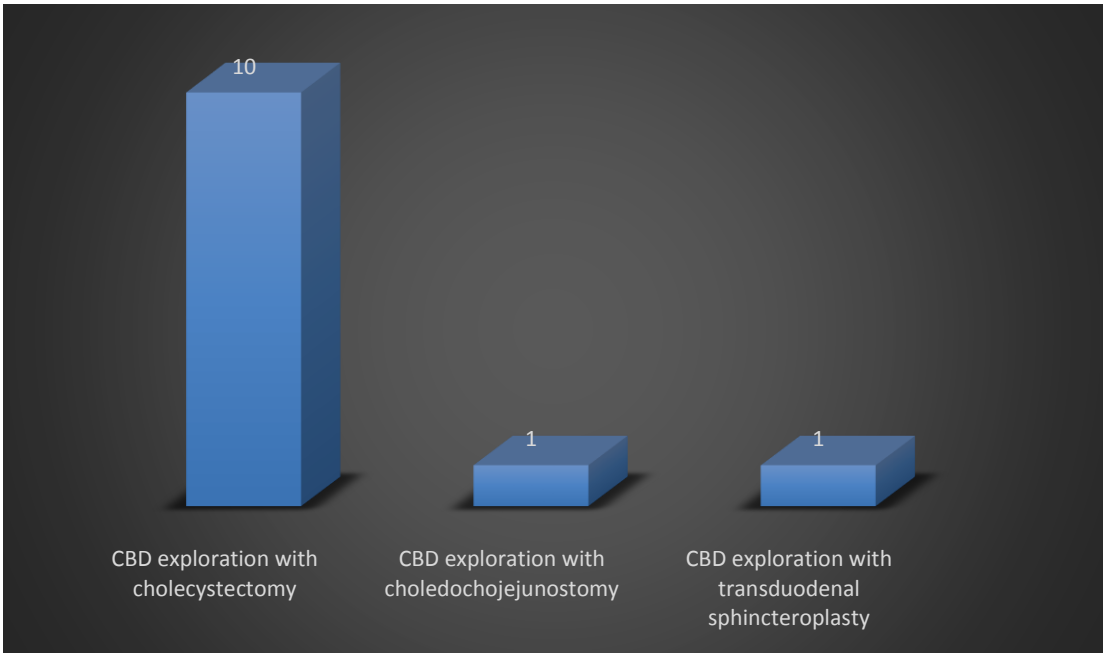
Among the 7 patients with cholangitis, 3 (42.85%) patients had a prior history of cholecystectomy. These 3 patients, in addition to 2 other patients underwent ERCP with ES as the sole procedure. The other two patients underwent CBD exploration and cholecystectomy.

9. SURGERY:

Table 13 : Surgeries performed

Surgery	Number
CBD exploration with cholecystectomy	10
CBD exploration with choledochojejunostomy	1
CBD exploration with transduodenal sphincteroplasty	1

Graph 13: Surgeries performed



Twelve (38.70%) patients underwent open surgical procedures. Ten (83.33%) patients underwent open CBD exploration with cholecystectomy. Nine (90%) of these patients had a T-tube inserted into the CBD.

One (8.33%) patient who was cholecystectomized underwent choldochojejunostomy with jejuno-jejunostomy for a massively dilated proximal CBD (3.5cm) with a narrowed distal CBD which had multiple impacted stones. One (8.33%) patient underwent CBD exploration with transduodenal sphincteroplasty. This was done for an impacted stone at the ampulla of Vater. Four patients (33.33%) in whom there were doubtful clearance of CBD calculi underwent an intraoperative cholangiogram. Stones were palpable intra-operatively in 10 (83.33%) patients.

10. COMPLICATIONS

Table 14 : Complications:

COMPLICATION	SURGERY	ERCP & ES
Wound infection	2	0
Pneumonia	1	1
Acute renal failure	0	1
Bile leak	1	0
Haemorrhage	1	0

Two patients who underwent CBD exploration developed wound infection and 1 developed pneumonia. Persistent bile leak was present in 1 patient which necessitated re-exploration and closure of the leaking CBD rent. In patients who underwent ERCP with ES, 1 patient developed acute renal failure requiring dialysis and 1 developed pneumonia.

Graph 14 : Complications:

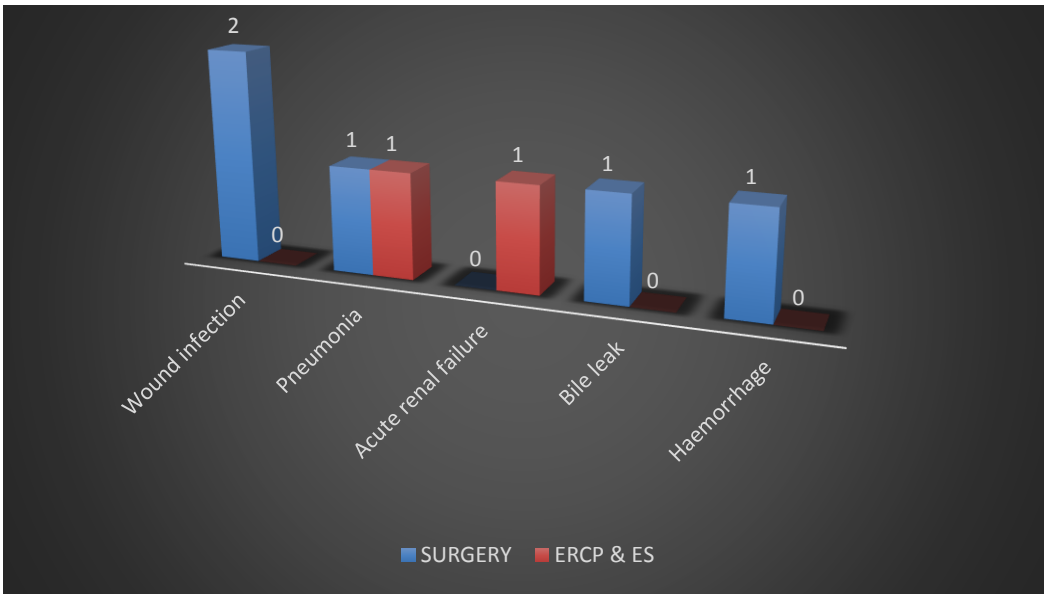
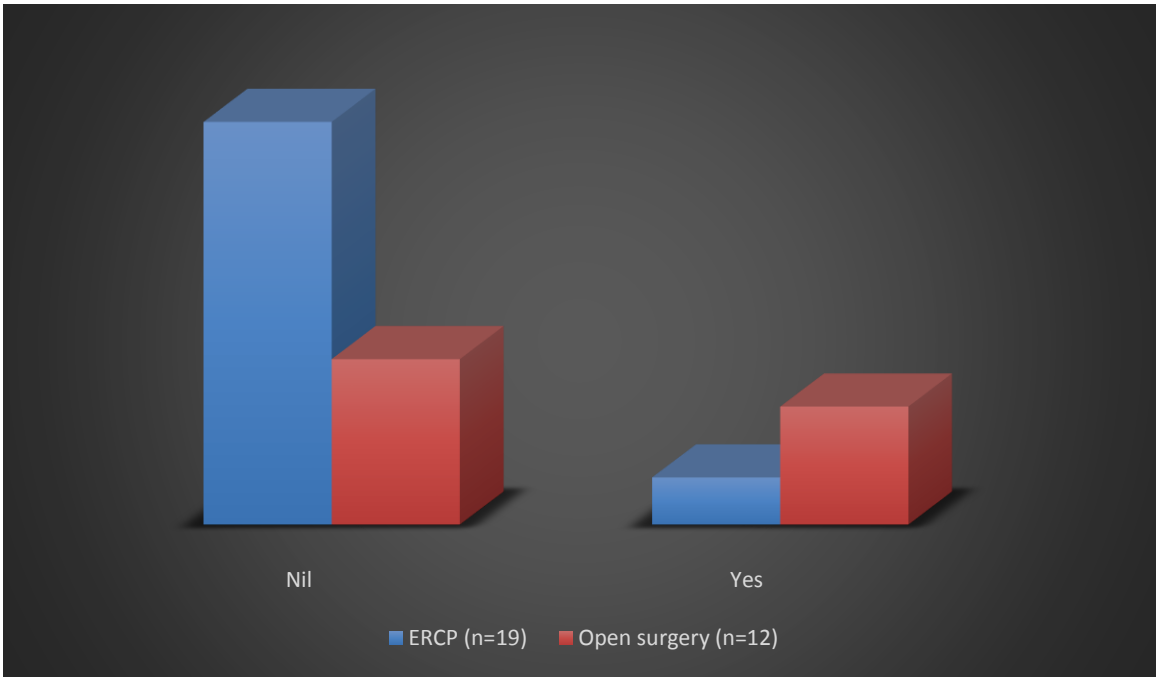


Table 15 : Comparison of Complications:

Complications	ERCP (n=19)	Open surgery (n=12)	All patients (n=31)
Nil	17(89.5%)	7(58.3%)	24(77.4%)
Yes	2(10.5%)	5(41.7%)	7(22.6%)
Inference	Incidence of complications are significantly associated with open surgery.		

Graph 15: Comparison of Complications:

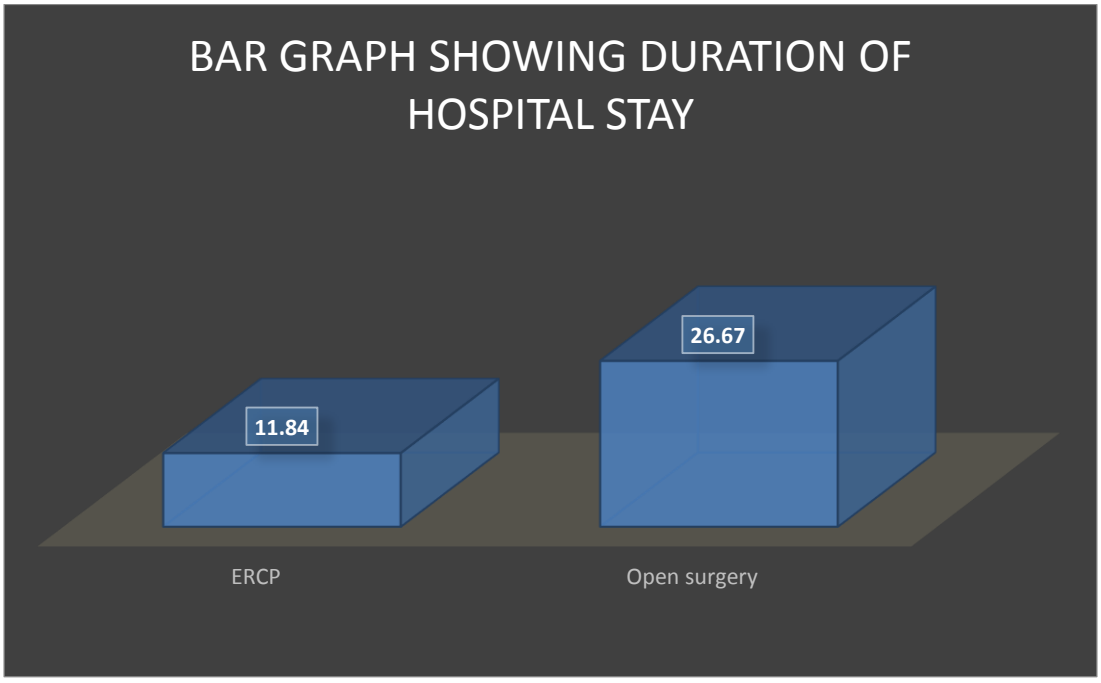


11. HOSPITAL STAY :

Table 16 : Hospital stay (in days)

No of days	ERCP (n=19)	Open surgery (n=12)	All patients (n=31)
Min – Max	3-24	18-42	3-42
Mean ± SD	11.84±6.01	26.67±6.17	17.58±9.46
Inference	Mean duration of hospital stay is Significantly more associated with open surgery.		

Graph 16 : Hospital stay (in days)



In patients who underwent ERCP alone, the mean hospital stay was 8.7 days (SD 4.08), ranging from 4 to 18 days. The patients who underwent cholecystectomy

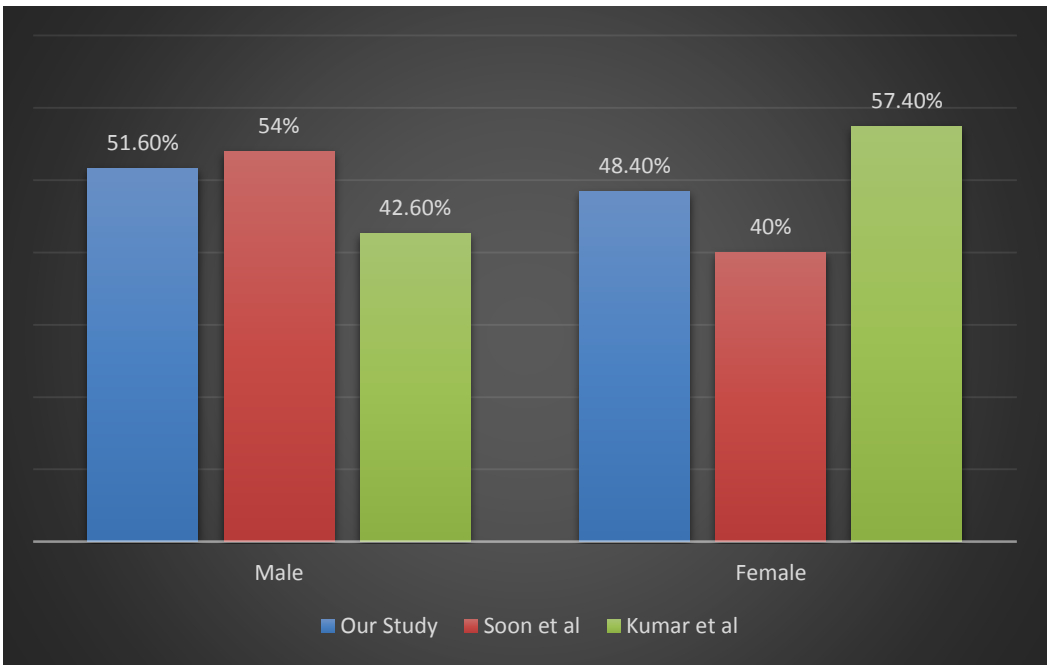
following ERCP had a mean hospital stay of 15.33 days (SD 6.042) ranging from 3 to 24 days. Overall, the patients in the ERCP group had a mean hospital stay of 11.84 days (SD 6.01). Patients who underwent open surgery had more prolonged hospital stay with a mean of 26.67 days (SD 6.17) ranging from 18 to 42 days. Comparing the endoscopy group and the open surgery group, the difference is significant.

1. COMPARISON GENDER DISTRIBUTION:

Table 17 : Comparison of Gender Distribution:

Gender	Our study(%)	Soon et al[121]	Kumar et al[122]
	%	**%**	**%**
Male	51.6	54	42.6%
Female	48.4	40	57.4%
Total	100.0	100.0	100.0

Graph 17: Comparison of Gender Distribution:



- In our studies, males have been found to have higher incidence of choledocholithiasis compared to females (1:0.93).Similar results were found in ratio of 1.3:1 in study conducted by Soon et al.[121]

- However, higher incidence is shown in females in other Study conducted by Kumar et al shows ratio of 0.76: 1 .[122] which may be due to higher incidence of gallstones in females.
- Males show a higher incidence because of larger diameter of cystic duct, which allows the passage of stones very easily.
- Most of the patients in our study came from lower socio-economic class and tribal areas which also influence the incidence rates in males and females.

2. COMPARISON OF AGE DISTRIBUTION:

TABLE 18: COMPARISON OF AGE DISTRIBUTION:

Age in years	Our study		Nathason et al Study[123]	
	No.	**%**	**No.**	**%**
30-40	5	16.1	5	8.4%
41-50	8	25.8	13	21.6%
51-60	6	19.4	17	28.3%
61-70	9	29.0	20	33.3%
>70	3	9.7	5	8.4%
Total	31	100.0	60	100.0

GRAPH 18 : COMPARISON OF AGE DISTRIBUTION:

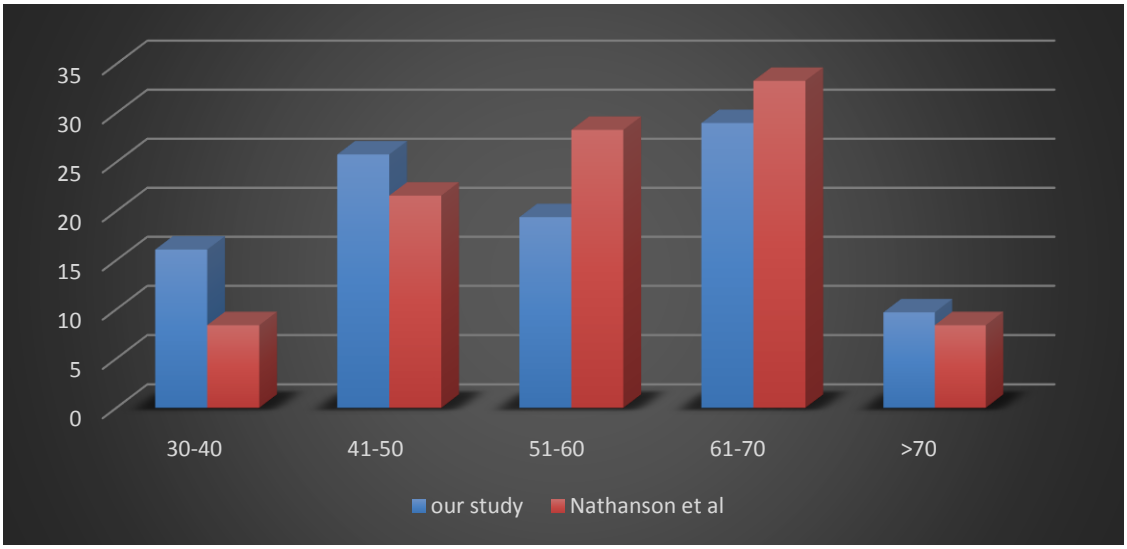
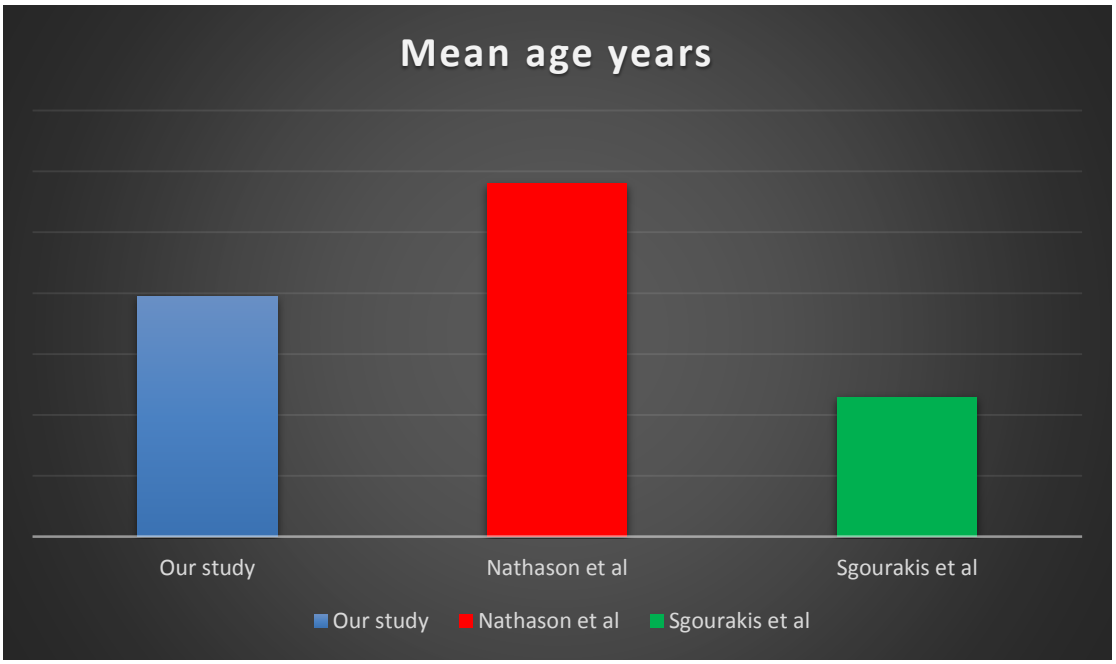


TABLE 19 : COMPARISON OF MEAN AGE:

STUDY	MEAN AGE(in years)
Our study	55.9
Nathason et al[123]	59.6
Sgourakis et al[124]	52.6

GRAPH 19 : COMPARISON OF MEAN AGE:



- The most common age group affected in our studies is between 61 to 70 years age, where the mean age is 55.9 years. There is an increase in incidence and prevalence in choledocholithiasis with increase in age.
- Nathason reported the mean age group to be affected is 59.6 years.[123]
- Sgourakis reported the mean age group to be affected is 52.6 years[124].

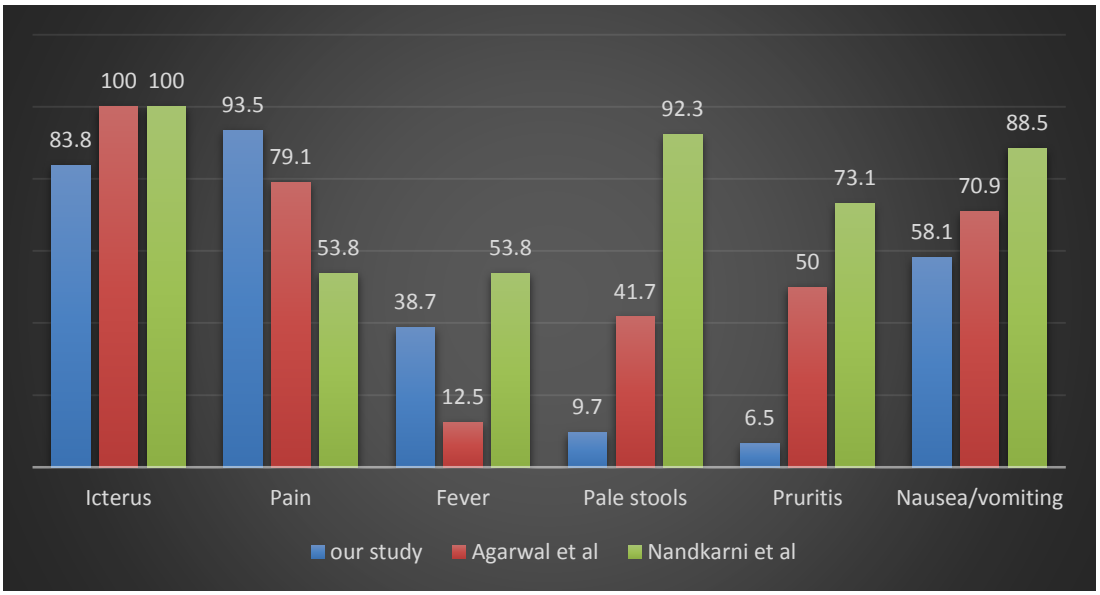
- Hermann, showed that the incidence beginning in childhood is progressive with increase between 35 to 55 years of age, and it continues to gradually increase after the age of 55 years.[125] Hereby, the disease has been found essentially to occur in elderly age group.
- India is developing country where most of the patient are working population and uneducated thus ignorant about their health and initial colicky pain and presents late.
- Our institute is a tertiary institute where patient comes from far and wide for their complaints where most of the patients managed conservatively elsewhere and presents late.

3. COMPARISON OF CLINICAL PRESENTATION:

TABLE 20 : COMPARISON OF CLINICAL PRESENTATION:

Clinical symptoms	Our study	Agarwal et al[125]	Nandkarni et al[126]
Icterus	83.87%	100%	100%
Pain	93.5%	79.1%	53.8%
Fever	38.7%	12.5%	53.8%
Pale stools	9.7%	41.7%	92.3%
Pruritis	6.5%	50%	73.1%
Nausea/vomiting	58.1%	70.9%	88.5%

GRAPH 20 : COMPARISON OF CLINICAL PRESENTATION:



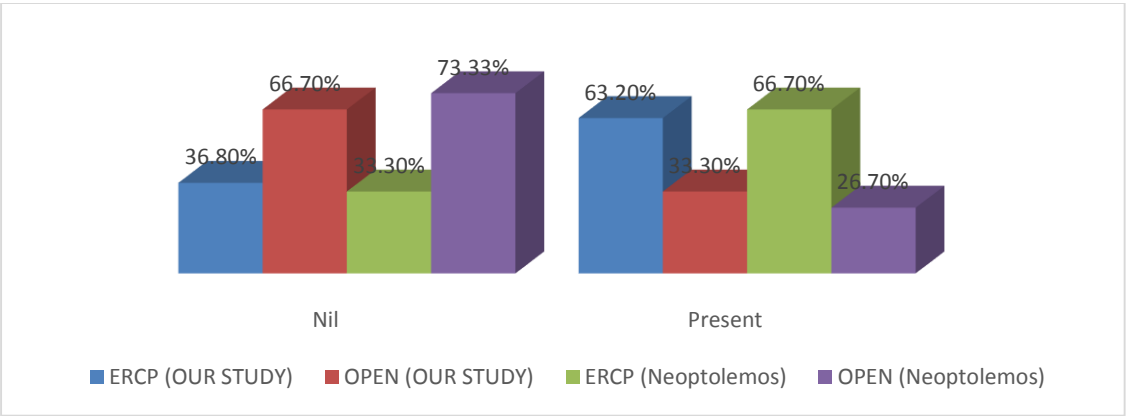
- The most common presenting symptom in our study was pain in right upper abdomen (93.5%), jaundice (84.3%) and fever (38.7%). However, jaundice occurs in absence of stones also and the degree of hyperbilirubinemia correlates with stones.
- As per study conducted by Agarwal et al[125] and Nandkarni et al[126] jaundice was the most common presenting symptom.
- Over seven patients (22.58%) showed a classical triad of cholangitis with mean bilirubin concentration of 7.64mg/dl. The patients could be the ones with long standing cholestasis and consequent infections. The sensitivity of cholangitis is 95 to 100% for CBD stones.
- Small stones in distal CBD sometimes causes intermittent obstruction leading to intermittent jaundice which patient's neglects and presents only with pain.
- By the above discussion, it is evident that the clinical findings are not sufficient to establish the presence of CBD stones but there is requirement, of imaging techniques for accurate assessment.
- Therefore when a patient presents with Pain, fever and jaundice the suspicion of CBD obstruction should be further evaluated by ultrasonography as it is cheap and easily available.

4. COMPARISON OF RISK FACTORS:

TABLE 21: COMPARISON OF RISK FACTORS:

Medical risk factors	Our study			Neoptolemos et al[127]		
	ERCP+ (n=19)	**Open surgery (n=12)**	**All patients (n=31)**	**ERCP+ (n=15)**	**Open surgery (n=15)**	**All patients (n=20)**
Nil	7(36.8%)	8(66.7%)	15(48.4%)	5(33.3%)	11(73.33%)	16(53.3%)
Present	12(63.2%)	4(33.3%)	16(51.6%)	10(66.7%)	4(26.7%)	14(46.7%)

GRAPH 21 : COMPARISON OF RISK FACTORS:



- In our study, presence of medical risk factors and previous history of jaundice were identified as risk factors. In the analysis of risk factors of choledocholithiasis done by Neoptolemos age, jaundice, medical risk factors and bilirubin among

many variables were found as the risk factors for the patients who underwent surgery[127]. Similarly for ES it was acute cholangitis.

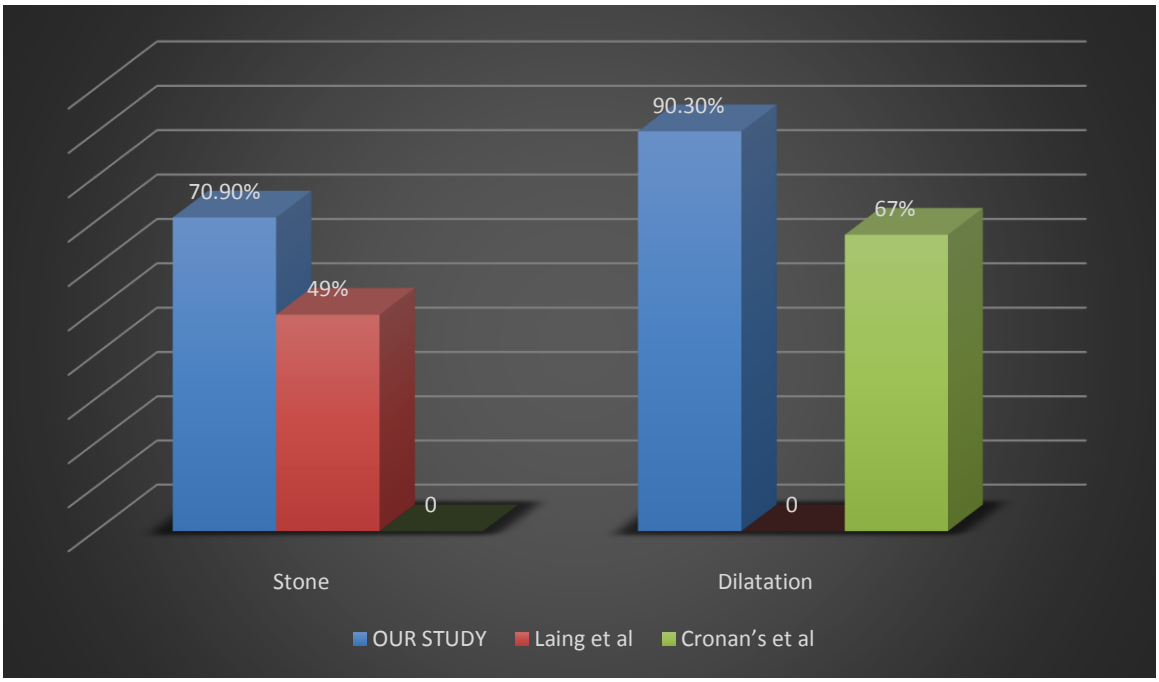
- It is evident that presence of medical risk factors increases morbidity in patients undergoing open surgery as compared to ERCP. So Endoscopic approach was preferred in patients who presented with medical risk factors such as diabetes mellitus, hypertension and ischaemic heart disease.

5. COMPARISON OF ULTRASONOGRAPHY:

TABLE 22 : COMPARISON OF ULTRASONOGRAPHY:

ULTASONOGRAPHY	OUR STUDY	Laing et al[128]	Cronan's et al[129]
Stone	70.9%	49%	-
Dilatation	90.3%	-	67%

GRAPH 22 : COMPARISON OF ULTRASONOGRAPHY:



- Ultrasonography is important and low cost modality in detection of common bile duct stones at periphery.
- Sensitivity of ultrasonography decreases as one goes from proximal to distal duct. It is difficult to differentiate the stone from the periductal structures due to

absence of the surrounding bile. The sensitivity to detect ductal dilatation, which is an indirect evidence of CBD stones is high in ultrasonography.

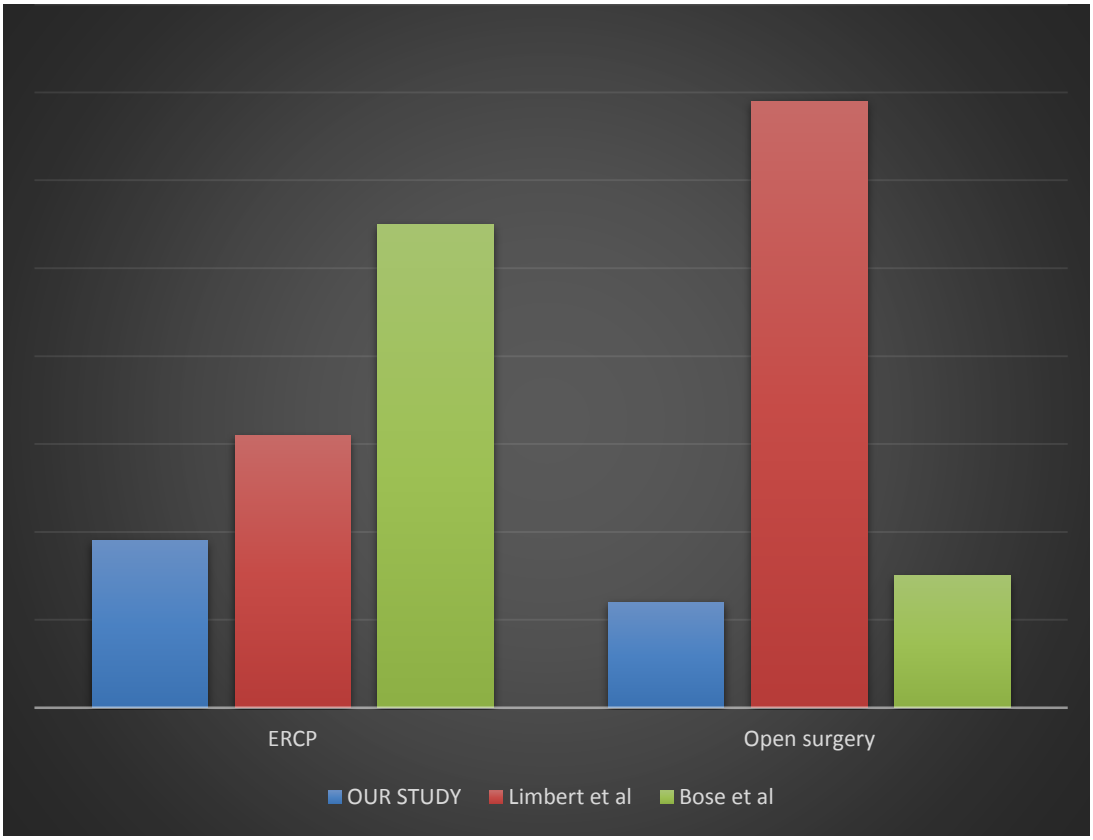
- While evaluating 53 patients with obstructive jaundice, Laing got sensitivity of 49%, specificity of 91% and an accuracy of 55%[128]
- Cronan's study showed sensitivity of 67% for ductal dilatation, however it varied from 58% to 23% in proximal and distal stones.[129] After ultrasonography, further management can be done according to the information provided.
- Our studies show the sensitivity of dilatation as 90.3% and for stones as 70.9%.
- Ultrasonography sensitivity depends upon user and machine generation. This may attribute to above findings of different sensitivity.

6. COMPARISON OF TREATMENT OF CBD STONES:

TABLE 23 : COMPARISON OF TREATMENT:

CBD STONE	OUR STUDY	Limbert et al130	Bose et al131
ERCP	19	31	55
OPEN SURGERY	12	69	15

GRAPH 23 : COMPARISON OF TREATMENT:



- In present era patients opt for minimal invasive surgery rather than open surgery. In the past era, most CBD stones found were managed by open surgery with only few managed by endoscopic retrograde cholangiopancreaticography with or

without endoscopic sphincterectomy (ERCP/ES). Initial, studies suggested, surgical CBD stones extraction for routine cases. However, with more and more surgeons becoming familiar with the techniques of endoscopy, more no of patients are subjected to this procedure. Our study shows that, ERCP/ES was primarily used as treatment and has high success rates of 86.36%.

- In study by Limbert et al[130] in 2002 31 patients underwent ERCP while 69 patients underwent open surgery.
- In Bose et al study[131] in 2012 55 patients underwent ERCP while 15 patients underwent open surgery .
- There is controversy in the need for cholecystectomy following ERCP/ES. Schreurs and colleagues concluded that there is no need for routine prophylactic cholecystectomy, when bile duct stones are treated successfully with endoscopic sphinterectomy and the patients are free of any symptoms[132]. Soon et al was of the opinion that, when the common bile duct stones can be removed by endoscopic sphinterectomy, the opinion of elective cholecystectomy is not warranted.[121] No further complications and symptoms from the retained gall bladder were found in their study.
- We performed a sole procedure of ERCP/ES in 52.6% patients in our study. Out of 7, five patients with cholangitis were treated with endoscopic method. Hence, endoscopic methods are the procedure of choice in patients with cholangitis.
- 01Martin DJ , Vemon DR , Toouli J finally stated that there is no apparent advantage of pre or post operative ERCP for bile duct clearance and also that ERCP necessitates increased number of procedures per patient[133].

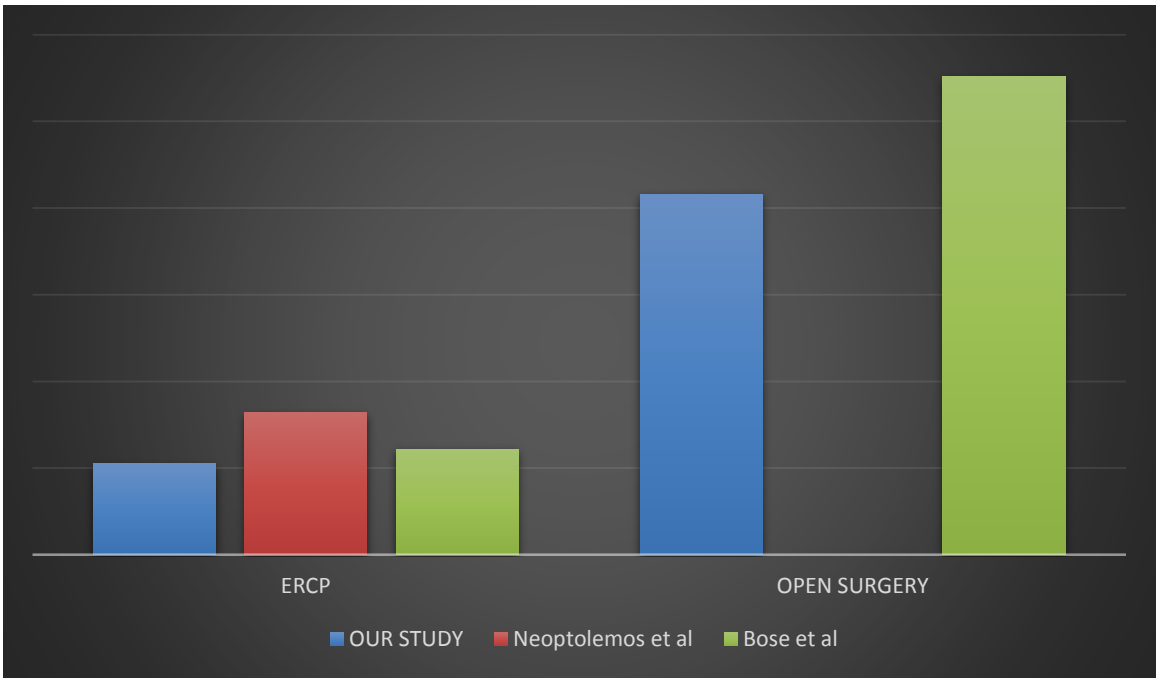
- Open surgery gives excellent results in the era of laparoscopic bile duct exploration by complete clearance of ductal stones in 12 cases (100%) who underwent open bile duct surgery in our study.
- Limbert et al[130] study was conducted in 2002 when availability and cost factors doesn't favoured for ERCP hence more number of patient underwent open surgery. Bose et al study[131] study was conducted in 2012 when advancement of ERCP and its associated less complication favoured ERCP over open surgery.

7. COMPARISON OF COMPLICATIONS:

TABLE 24 : COMPARISON OF COMPLICATIONS:

CBD STONE	OUR STUDY	Neoptolemos et al127	Bose et al131
ERCP	10.5%	16.4%	12.2%
OPEN SURGERY	41.6%	-	55.2%

GRAPH 24 : COMPARISON OF COMPLICATIONS:



- In patients undergoing surgery for CBD stones, mortality rates in relatively fit younger patients and unfit elderly patients is 1% and 28% respectively. But after undergoing surgery for cholangitis,it increases to 12-14% in younger patients. If drainage procedure like is included, the mortality/morbidity is increased.

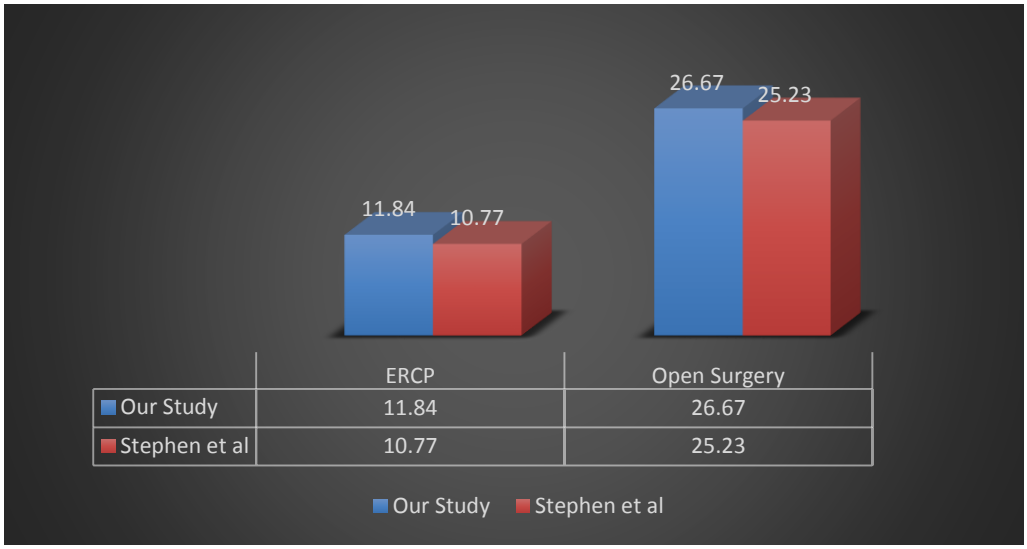
- According to various other reports,mortality/morbidity for ERCP/ES ranges between 0.8 to 1.5% with the complications being haemorrhage, pancreatitis,cholangitis and perforation. In a randomized study, Neoptolemos et al reported complication rate in patients of endoscopic group as 16.4%.[127]
- Our study did not produce any deaths with open surgery or endoscopy. 7 patients developed complications. Five(41.6%) of these had undergone open surgery. This could be because much of the study population was elderly.
- In patients in whom endoscopy was the principal mode of treatment, 2 patients (10.5%) developed complications. Incidence of complications were significantly associated with open surgery (p=0.078).
- Open surgery involves opening of CBD and extraction of stone thus disrupting integrity of CBD lining,damage to adjacent structures during surgery,infection and thus leading to postoperative morbidity.
- ERCP is user based procedure and involves high surgical skill to perform thus range of complication from 10.5% in our study to 16.4% in other study.

8. COMPARISON OF COMPLICATIONS:

TABLE 25 : COMPARISON OF HOSPITAL STAY:

No of days	Our Study	Stephen et al[134]
ERCP	11.84±6.01	10.77±8.21
Open surgery	26.67±6.17	25.23±7.34

GRAPH 25 : COMPARISON OF HOSPITAL STAY:



- The difference in the hospital stay between the patients who underwent treatment by endoscopic methods and those who underwent open surgery was significant in our study ($p<0.001$).
- In a study comparing endoscopic methods and open surgery by Stephen et al the mean hospital stay was 10.77±8.21in the endoscopy group and 25.23±7.34 days in the open surgery group.[134]
- Pain, dressing after open surgery requires more days of hospitalization compared to ERCP which is almost a day care procedure requiring 24-72 hrs. of observation only.

- There were 16 male and 15 female patient included in our study with slight male predominance.
- The age at presentation in females ranged from 31 to 85 years, with a mean age of 56.80 years (SD 15.28) .Similarly in males it ranged from 30-75 years with a mean age of 55.13 years (SD 13.42). Overall the mean age of presentation was 55.94 years (SD14.14). Thus most of the females presented at a late age than males.
- Jaundice was present in 26 of the 31 patients (83.87%). Pain was complaint in 29 patients (93.54%). Twelve patients had fever (38.70%), of these 7 had the classical traid of cholangitis. Eighteen patients had nausea with or without vomiting (58.06%). Pale stools and pruritis was present in only 3 (9.67%) and 2 (6.45%) respectively. Two patients presented with the pain of pancreatitis (6.45%).
- Jaundice in the past was elicited in 12 (38.70%) of the patients , of these 4(33.33%) were those without clinically apparent jaundice at presentation. Six patients had history of intervention for biliary tract pathology , 4 (12.90%) of whom had underwent cholecystectomy and 2 (6.45%) had undergone ERCP . All cholecystectomies were done more than 2 years before current admission.
- Seven patients (22.58%) had hypertension and 10 (32.25%) were diabetics. Three patients (9.67%) had both hypertension and diabetes. Two patients were suffering from ischaemic heart disease.
- 26 patients (83.64%) showed raised serum bilirubin with a maximum of 15.2mg/dl.Serum alkaline phosphatase was raised (>115 IU/L) in twenty four patients (77.41%).

- GB stone was present in 20 patients out of 27 patients and was absent in 7 patients. 4 patients had prior history of cholecystectomy out of the total 31 patients.GB wall thickening was present in 14 (51.8%) and absent in 13 (48.2%).CBD dilatation was detected in 28 (90.3%) and absent in 3 (9.7%).

  Stone in CBD was detected in 22 patients (70.9%) and was not detected in 9 (29.1%).

- Out of 31 patients 4 patients had h/o prior cholecystectomy. 20 patients had gall bladder stones and gall bladder thickening was present in 14. CBD dilatation was present in 28 patients and CBD stone was seen in 22 patients.
- Nine patients, in whom ultrasonography did not show signs of stone, underwent a CT scan of the abdomen with MRCP. CT and MRCP picked up stones in the common bile duct in all (100%) patients.
- ERCP with ES was used primarily as a therapeutic modality. Of the 22 patients in whom endoscopic retrieval of stones was attempted it was successful in 19 patients (86.36%). In 3 (13.63%) patients there was failure due to impacted stones. All 3 patients underwent formal CBD exploration and cholecystectomy.
- In 10 (52.63%) patients ERCP with ES was the sole procedure performed as these patients neither had gall bladder stones nor thickened gall bladder. Nine (47.36%) patients further underwent cholecystectomy, 6 (66.67%) by laparoscopic method and 3 (33.33%) by open method.
- Among the 7 patients with cholangitis, 3 (42.85%) patients had a prior history of cholecystectomy. These 3 patients, in addition to 2 other patients underwent ERCP with ES as the sole procedure. The other two patients underwent CBD exploration and cholecystectomy.

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- Twelve (38.70%) patients underwent open surgical procedures. Ten (83.33%) patients underwent open CBD exploration with cholecystectomy. Nine (90%) of these patients had a T-tube inserted into the CBD.
- One (8.33%) patient who was cholecystectomized underwent choldochojejunostomy with jejuno-jejunostomy for a massively dilated proximal CBD (3.5cm) with a narrowed distal CBD which had multiple impacted stones. One (8.33%) patient underwent CBD exploration with transduodenal sphincteroplasty. This was done for an impacted stone at the ampulla of Vater. Four patients (33.33%) in whom there were doubtful clearance of CBD calculi underwent an intraoperative cholangiogram. Stones were palpable intra-operatively in 10 (83.33%) patients.
- Two patients who underwent CBD exploration developed wound infection and 1 developed pneumonia. Persistent bile leak was present in 1 patient which necessitated re-exploration and closure of the leaking CBD rent. In patients who underwent ERCP with ES, 1 patient developed acute renal failure requiring dialysis and 1 developed pneumonia.
- In patients who underwent ERCP alone, the mean hospital stay was 8.7 days (SD

4.08), ranging from 4 to 18 days. The patients who underwent cholecystectomy following ERCP had a mean hospital stay of 15.33 days (SD 6.042) ranging from 3 to 24 days. Overall, the patients in the ERCP group had a mean hospital stay of 11.84 days (SD 6.01). Patients who underwent open surgery had more prolonged hospital stay with a mean of 26.67 days (SD 6.17) ranging from 18 to 42 days. Comparing the endoscopy group and the open surgery group, the difference is significant.

- In our studies, males have been found to have higher incidence of choledocholithiasis compared to females (1:0.93).Similar results were found in ratio of 1.3:1 in study conducted by Soon et al.[121]
- However, higher incidence is shown in females in other Study conducted by Kumar et al shows ratio of 0.76: 1 .[122] which may be due to higher incidence of gallstones in females.
- Males show a higher incidence because of larger diameter of cystic duct, which allows the passage of stones very easily.
- Most of the patients in our study came from lower socio-economic class and tribal areas which also influence the incidence rates in males and females.
- The most common age group affected in our studies is between 61 to 70 years age, where the mean age is 55.9 years. There is an increase in incidence and prevalence in choledocholithiasis with increase in age.
- Nathason reported the mean age group to be affected is 59.6 years.[123]
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- India is developing country where most of the patient are working population and uneducated thus ignorant about their health and initial colicky pain and presents late.
- Our institute is a tertiary institute where patient comes from far and wide for their complaints where most of the patients managed conservatively elsewhere and presents late.
- The most common presenting symptom in our study was pain in right upper abdomen (93.5%), jaundice (84.3%) and fever (38.7%). However, jaundice occurs in absence of stones also and the degree of hyperbilirubinemia correlates with stones.

- As per study conducted by Agarwal et al[125] and Nandkarni[126] et al jaundice was the most common presenting symptom.
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- Small stones in distal CBD sometimes causes intermittent obstruction leading to intermittent jaundice which patient's neglects and presents only with pain.
- By the above discussion, it is evident that the clinical findings are not sufficient to establish the presence of CBD stones but there is requirement, of imaging techniques for accurate assessment.
- Therefore when a patient presents with Pain, fever and jaundice the suspicion of CBD obstruction should be further evaluated by ultrasonography as it is cheap and easily available.
- In our study, presence of medical risk factors and previous history of jaundice were identified as risk factors. In the analysis of risk factors of choledocholithiasis done by Neoptolemos age, jaundice, medical risk factors and bilirubin among many variables were found as the risk factors for the patients who underwent surgery.[127] Similarly for ES it was acute cholangitis.
- It is evident that presence of medical risk factors increases morbidity in patients undergoing open surgery as compared to ERCP. So Endoscopic approach was preferred in patients who presented with medical risk factors such as diabetes mellitus, hypertension and ischaemic heart disease.
- Ultrasonography is important and low cost modality in detection of common bile duct stones at periphery.

- Sensitivity of ultrasonography decreases as one goes from proximal to distal duct. It is difficult to differentiate the stone from the periductal structures due to absence of the surrounding bile. The sensitivity to detect ductal dilatation, which is an indirect evidence of CBD stones is high in ultrasonography.
- While evaluating 53 patients with obstructive jaundice, Laing got sensitivity of 49%, specificity of 91% and an accuracy of 55%.[128]
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- Our studies show the sensitivity of dilatation as 90.3% and for stones as 70.9%.
- Ultrasonography sensitivity depends upon user and machine generation. This may attribute to above findings of different sensitivity.
- In present era patients opt for minimal invasive surgery rather than open surgery. In the past era, most CBD stones found were managed by open surgery with only few managed by endoscopic retrograde cholangiopancreaticography with or without endoscopic sphincterectomy (ERCP/ES). Initial, studies suggested, surgical CBD stones extraction for routine cases. However, with more and more surgeons becoming familiar with the techniques of endoscopy, more no of patients are subjected to this procedure. Our study shows that, ERCP/ES was primarily used as treatment and has high success rates of 86.36%.
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- In patients in whom endoscopy was the principal mode of treatment, 2 patients (10.5%) developed complications. Incidence of complications were significantly associated with open surgery (p=0.078).
- Open surgery involves opening of CBD and extraction of stone thus disrupting integrity of CBD lining,damage to adjacent structures during surgery,infection and thus leading to postoperative morbidity.
- ERCP is user based procedure and involves high surgical skill to perform thus range of complication from 10.5% in our study to 16.4% in other study.
- The difference in the hospital stay between the patients who underwent treatment by endoscopic methods and those who underwent open surgery was significant in our study ($p<0.001$).
- In a study comparing endoscopic methods and open surgery by Stephen et al the mean hospital stay was 10.77±8.21in the endoscopy group and 25.23±7.34 days in the open surgery group.[134]
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1. Cushieri A. Disorder of the Biliary tract. In: Cushieri A, Steele RJC, Moosa AR, eds. Essential surgical practice, 4th ed. London: Butterworth Heinemann; 2002. P.375-454.

2. Cranley B, Logan H. Exploration of the common bile duct – the relevance of the clinical picture and importance of preoperative cholangiography. Br J Surg 1980; 67:869-72.

3. Bartlett MK, Waddell WR. Indication for common duct exploration; evaluation in 1000 cases. N Eng J Med, 1958; 258: 164-167.

4. DenBesten L, Doty JE. Pathogenesis and management of choledocholithiasis. In: Symposium in biliary tract disease. Surg Clin N Am 1981; 61 (4): 893-907.

5. Neoptolemos JP, Shaw DE et al, A multivariate analysis of preoperative risk factors in patients with Common Bile Duct Stone, Implications for treatment, Ann Surg, 1989; 209; 157-161.

6. Huang ZQ. Present status of biliary surgery in china. World J Gastroenterol 1998; 4 (Suppl 2): 8-9

7. Meyers WC, Jones RS. Development of the liver and biliary tract In: Meyers WC Jones RS (editors). Textbook of liver and biliary surgery. J.B. Lippincott Company 1990; (1): 1-19.

8. Mirizzi PL. Operative Cholangiography. Surg Gynecol Obstet 1937; 65: 702-707 9. Morgenstern L. A History of Choledochotomy In: Berci G, Cushieri A. Bile Ducts and Bile Duct Stones. WB Saunders 1997; 2: 3-8.

10. Mulvihill SJ, Debas HT. History of surgery of gastrointestinal tract. In: Norton JA, Bollinger RR et al (eds). Surgery, Basic Science and Clinical evidence. Springer – Velrag, 2001; 23: 399-412.

11. Wood MD. Presidential address: Eponyms in Biliary Tract Surgery. Am J Surg 1979; 138: 746 – 754.

12. T. W. Sadler, Langman's Medical Embryology 9th Ed, Lippincott Williams & Wilkins 2003; 298-302.

13. Tanaka Y, Senoh D, Hata T. Is there a human fetal gallbladder contractility during pregnancy? Hum Reprod 2000;15:1400-1402. [PubMed: 10831577].

14. Healey JE Jr, Schroy PC. Anatomy of the biliary ducts within the human liver: analysis of the prevailing pattern of branchings and the major variations of the biliary ducts. Arch Surg 1953;66:599. [PubMed: 13039731].

15. Hermann RE. Manual of Surgery of the Gallbladder, Bile Duct and Endocrine Pancreas. New York: Springer-Verlag, 1979.

16. Braasch JW. Congenital anomalies of the gallbladder and bile ducts. Surg Clin North Am 1958;38:627. [PubMed: 13556561]

17. Johnston EV, Anson BJ. Variations in the formation and vascular relationships of the bile ducts. Surg Gynecol Obstet 1952;94:669. [PubMed: 14931175]

18. Newman HF, Northrup JD. Extrahepatic biliary tract anatomy. West J Surg Obstet Gynecol 1963; 71:59. [PubMed: 13938264]

19. Lindner HH, Green RB. Embryology and surgical anatomy of the extrahepatic biliary tract. Surg Clin North Am 1964;44:1273.

20 Michels NA. Blood Supply and Anatomy of the Upper Abdominal Organs. Philadelphia: Lippincott, 1955.

21. Kune GA. Surgical anatomy of the common bile duct. Arch Surg 1964;89:995. [PubMed: 14208474]

22. Dowdy GS Jr. The Biliary Tract. Philadelphia: Lea and Febiger, 1969.

23. Shapiro AL, Robillard GL. The arterial blood supply of the common and hepatic bile ducts with reference to the problems of common duct injury and repair: based on a series of twenty-three dissections. Surgery 1948; 23:1.

24. Dowdy GS Jr, Waldron GW, Brown WG. Surgical anatomy of the pancreatobiliary ductal system. Arch Surg 1962; 84:93.

25. Nikolić V. Artere cystique recurrente. Bull Assoc Anat 1967;136: 739. [PubMed: 16433836].

26. Balija M, Huis M, Nikolić V, Štulhofer M. Laparoscopic visualization of the cystic artery anatomy. World J Surg 1999; 23: 703-707. [PubMed: 10390590].

27. Chen TH, Shyu JF, Chen CH, Ma KH, Wu CW, Lui WY, Liu JC. Variations of the cystic artery in Chinese adults. Surg Laparosc Endosc Percutaneous Tech 2000; 10:154-157. [PubMed: 10872977].

28. Appleby LH. Indwelling common duct tubes. J Int Coll Surg 1959; 31:631. [PubMed: 13665056].

29. Parke WW, Michels NA, Ghosh GM. Blood supply of the common bile duct. Surg Gynecol Obstet 1963:117:47.

30. Petren T. Die extrahepatischen Gallenwegsvenen und ihre pathologisch-anatomische Bedeutung. Verh Dtsch Anat Ges 1932; 41: 139.

31. Burnett W, Cairns FW, Bacsich P. Innervation of the extrahepatic biliary system. Ann Surg 1964; 159:8. [PubMed: 14103280]

32. Mahour GH, Wakim KG, Soule FH, Ferris DO. Structure of the common bile duct in man: presence or absence of smooth muscle. Ann Surg 1967;166:91. [PubMed: 4165872]

33. Kim E Barrett, Susan M Barman, Scott Boitano (editors). Ganong's Review of Medical Physiology, 23 rd Edition. The McGraw-Hill Companies; 2010; (29).

34. Miyake H, Johnston CG, Gallstones : etiological studies. Digestion 1968;1: 219-228.

35. Whiting MJ, Walts JM , Chemical composition of common bile duct stones. Br J Surg 1986; 73:229-232.

36. Yamashita N, Yanagisawa J et al. Composition of intrahepatic calculi. Etiologic significance Dig Dis Sci 1988; 33:449-453.

37. Kumar D, Garg PK, Tandon RK. Clinical and biochemical comparative study of different types of common bile duct stones. Indian J Gastroenterol 2001; 20:187-190.

38. Russell RCG. The Gallstones and the bile ducts In: Russell RCG, Williams NS, Bullstrode CJK (editors). Bailey & Love's Short practice of surgery, 23rd ed,Arnold 2000;54:966-986

39. Dandon IS, Saweid AM. Choledocholithiasis, www.emedicine.com 2002.

40. Taylor Tv, Armstrong CP, Migration of Gallstones. BMJ 1987;294:1320-1322

41. Crump C. The incidence of Gallstones and Gall Bladder disease. Surg Gynaecol Obstet 1931; 53:447-457.

42. Hermann RE. The spectrum of Biliary stone disease. Am J Surg 1989; 158:171-173.

43. Kelly TR, Gallstone Pancreatitis: Pathophysiology. Surgery 1976;80:488-492.

44. Rubin JR, Beal JM. Diagnosis of choledocholithiasis, Surg Gynaecol Obstet1983;156:16-20

45. Cranley B, Logan H. Exploration of the common bile duct- the relevance of the clinical pictur0e and the importance of preoperative cholangiography. Br J Surg, 1980;67:869-872

46. Bose SM. Predictors of choledocholithiasis. Ind J Surg, 2002; 64:335-338.

47. Bartlett MK, Waddell WR. Indication for common bile duct exploration ; evaluation in 1000 cases. N Eng J Med,1958; 258:164-167.

48. Lindenauer SM, Child CG. Disturbances of the liver function in biliary tract disease. Surg Gynaecol Obstet 1966; 123:1205-1211.

49. Meyer KA, Capos NJ et al. Personal experiences with 1261 cases of acute and chronic cholecystiitis and cholelithiasis. Surgery,1967;61:661-668.

50. Way LW, Admirand WH et al. Managemant of choledocholithiasis. Ann Surg 1972; 176:347-359.

51. Doran FS. The sites to which the pain is refferes from the common bile duct in man and its implications for the theory of referred pain. Br J Surg 1967; 54 : 599-606.

52. Toouli J. The function of the biliary tract and factors in the production of biliary pain. In: Blumgart LH et al(editors). Surgery of thr liver an the biliary tract, 3rd ed, Churchill Livingstone 2000; 1(6):121-134.

53. Abbound PA, Malet PF et al. Predctors of common bile duct stones prior to cholecystectomy: a meta analysis. Gastrointest Endosc 1996; 44(4):450-455.

54. Dandan IS, Saweid AM. Choledocholithiasis. www.emedicine.com 2002.

55. Diehl AK, Holleman DR Jr, Chapman JB et al. Gallstone size and risk of pancreatitis. Arch Intern Med 1997; 157:1674-1678.

56. Lee SP, Nicholls JF e al. Biliary sludge as a cause of acute pancreatitis. N Eng J Med 1992; 326:589.

57. Jensen MH, Karesen Rolf et al. Predictive ability of Choledoholithiasis indicators- A prospective evaluation, Ann Surg 1985; 202(1): 64-68.

58. Ashley SW, Hunter JG, McFadden DW et al. Symposium: Common Bile Duct Stones, Part1: Evaluation and assessment. Contemporary Surgery 2000; 56(10):592-602

59. Jensen MH, Karesen R et al, Predictive ability of choledocholithiasis indicators, A prospective evaluation, Ann Surg 1985; 202(1): 64-68.

60. Cranley B, Logan H. Exploration of the common bile duct- the relevance of clinical picture and importance of preoperative cholangiography. Br J Surg1980; 67:869-872.

61. Shapiro HA. Endoscopic diagnosis and treatment of biliary tract disease. Surg Clin N Am, 1981; 61:843-864.

62. Karam J, Roslyn JJ. Cholelithiasis and cholecystectomy. In: Zinner MJ, Shwartz SI, Ellis H(ed). Maingot's abdominal operations, 10 th edition, Mcgraw-Hill2001; 2(60): 1717-1738.

63. Laing FC et al. Choledocholithiasis and Cystic duct obstruction: Difficult ultrasonographic diagnosis, Radiology 1983; 146:475-479.

64. Cranan JJ, US diagnosis of Choledocholithiasis: A reappraisal, Radiology 1986; 161:133-134.

65. Gross BH et al, Ultrasonic evaluation of Common Bile Duct Stones: Prospective comparison with Endoscopic Retrograde Cholangiopancreatography, Radiology 1983; 146: 472-474

66. Csendes A, Burdiles P et al. Present role of classic open cholecystectomy in the surgical treatment of patients with common bile duct stones. W J Surg 1998; 22:1167-1170

67. Russell RCG. The gall bladder and the bile ducts. In: Russell RCG, Williams NS, Bullstrode CJK (editors). Bailey and Love's Short Practice of Surgery, 23rd ed, Arnold 2000; 54:966-986.

68. Motson RW et al. Gallstones. In: Hepatobiliary and Pancreatic Surgery, W.B Saunders 1997, 175-200.

69. Goldstein LI, Kadell BM et al. Thin needle cholangiography; experience with 50 patients. Ann Surg 1977; 186: 602-606.

70. Way LW, Admirand WH et al. Management of choledocholithiasis. Ann Surg 1972; 176: 347-359.

71. Johnson G Jr, Pearce C et al. Intravenous cholangiogrphy in biliary tract disease. Ann Surg 1960; 152:91-102.

72. Rubin JR, Bel JM. Diagnosis of Choledocholithiasis, Surg Gynaec Obstet 1983; 156:16-20.

73. Elias E. Cholangiography in jaundiced patients. Gut 1976; 17: 801-811.

74. Elias E, Hamlym AN, Jain S et al. A randomized trial of percutaneous transhepatic cholangiography with chiba needle versus endoscopic retrograde cholangiography for bile duct visualisation in jaundice. Gastroenterology 1976;72: 439-443.

75. Demartines N, Eisner L, Schnabel K, Fried R, Zuber M, Harder F. Evaluation of magnetic resonance cholangiography in the mangament of bile duct stones. Arch Surg 2000;135: 148-152.

76. Kim JH, Kim MJ, Park SI et al. MR cholangiography in symptomatic gallstones: Diagnostic accuracy according to clinical risk group. Radiology 2002; 224: 410- 416.

77. Van Hoe L, Gryspeerdt S, Vanbeckevoort D et al. Normal Vaterian sphincter complex: evaluation of morphology and contractility with dynamic single shot MR cholangiopancreaticography. AJR Am J Roentgenol 1998; 170:1497-1500.

78. Sherlock S, Dooley J. Gallstones and inflammatory Gall Bladder diseases. In: Diseases of the liver and the biliary system, 11th ed, Blackwell pub2002;(34):597-628.

79. Lipsett PA, Pitt HA. Acute cholangitis. In: Biliary Tract Surgery, Surg Clin N Am 1990; 70(6) : 1297-1312.

80. Thompson JE Jr, Tompkins RK, Longmire WP Jr. Factors in the management of acute cholangitis. Ann Surg 1982; 195: 137-145.

81. Gigot JF, Leese T et al. Acute cholangitis: Multivariate analysis of risk factors. Ann Surg 1989; 209:435.

82. Marks CG, Kelvin FM.. Operative cholangiography: Criteria which make exploration of the common bile duct desirable. Br J Surg 1976;63:51.

83. Cuschieri A. Common bile duct exploration, In: Zinner MJ, Schwartz SI, Ellis H (ed). Maingot's abdominal operations, 10th ed, Mcgraw-Hill 2001;2(69): 1875-1895.

84. Mirizzi PL. Operative cholangiography, Surg Gynaecol Obstet 1937; 65:702-707.

85. DenBensten L, Doty JE. Pathogenesis and management of choledocholithiasis. Surg Clin N Am 1981; 61(4): 893-907.

86. Bose SM. Predictors of Choledocholithasis. Ind J Surg 2002; 64:335-338.

87. Jones SA, Steedman RA et al. Transduodenal Sphincteroplasty(not sphincterotomy) for biliary and pancreatic disease: Indications, Contraindications and results. Am J Surg 1969; 118: 292.

88. Lygidakis NJ, Surgical approaches to recurrent choledocholithiasis, Choledochoduodenostomy vs T-tube drainage after Choledochotomy, Am J Surg 1983; 145:636-639.

89. Allen B, Shapiro H, Way L. Management of Recurrent & Residual Common Duct stones, Am J Surg 1981;142:41-47.

90. Somnay K, Carr- Locke DL. Stones in the bile duct: endoscopic approaches. In:Blumgart et al (editors). Surgery of the liver and biliary tract, 3rd ed, Churchill Livingstone2000; 1(4):749.

91. Binmoeller KF, Bruckner M et al. Treatment of difficult stones using mechanical, electrohydraulic and extracorporeal shockwave lithotripsy. Endosc 1993; 25: 201.

92. Gordon RL, Shapiro H. Non-operative management of Bile Duct Stones. Surg Clin N Am 1990; 70(6): 1313-1328.

93. Freeman ML, Nelson DB et al. Complications of endoscopic biliary sphincterotomy. N Engl J Med 1996; 335: 909-918.

94. Chespak LW. Ring EJ et al Multidisciplinary approach to complex endoscopic biliary intervention. Radiology 1989; 170: 995-997.

95. Huibregtse K, Katon RM et al. Pre-cut papillotomy via a fine needle knife papilotome: A safe and effective technique. Gastintest Endosc 1986; 32: 403-405.

96. Seitz U, Bohnacker S et al. Advances in Therapeutic Endoscopic Treatment of Common Bile Duct Stones. W J Surg 1998; 22: 1133-1144.

97. Keulemans YCA, Rauws EAJ et al. Current management of the gallbladder after endoscopic sphincterotomy for common bile duct stones. Gastrointest Endosc 1997; 46: 514-519.

98. Moreaux J. Traditional surgical management of common bile duct stones: a prospective study during a 20 year experience. Am J Surg 1995; 169: 220-226.

99. Hammarstrom L-E, Holmin T et al. Long term follow up of a prospective randomized study of endoscopic versus surgical treatment of bile duct calculi in patients with gallbladder in situ. Br J Surg 1995; 82: 1516-1521.

100. Targarona EM, Ayuso RMP et al. Randomised trial of endoscopic sphincterotomy with gallbladder left in situ versus open surgery for common bile duct calculi in high risk patients. Lancet 1996; 347: 926-929.

101. Winslet MC, Neoptolemos JP. The place of endoscopy in the management of gallstones. Baillieres Clin Gastroenterol 1991; 5: 99-129.

102. Panis Y, Suc B et al. Surgery vesus endoscopic sphincterotomy for choledocholithiasis: results of a prospective randomized study. Gastroenterology 1995; 108: A431.

103. Lai EC, Mok FP et al. Endoscopic biliary drainage for severe acute cholangitis. N Engl J Med 1992; 326: 1582-1586.

104. Hill J, Martin DF, Tweedle DEF. Risks of leaving the gallbladder in situ after endoscopic sphincterotomy for bile duct stones. Br J Surg 1992; 78: 554-7.

105. Wittgen CM, Andrus JP, Andrus CH, Kaminski DL. Cholecystectomy. Which procedure is best for the high-risk patient? Surg Endosc 1993; 7:395-9.

106. Perez MR, Oleaga JA et al. Removal of distal common bile duct stone through percutaneous transhepatic catheterization. Arch Surg 1979; 114: 107-109.

107. Stokes KR, Falchuk KR et al. Biliary duct stones; Update on 54 cases after percutaneous transhepatic removal. Radiology 1989; 170: 990-1001.

108. Cushieri A. Disorder of the biliary tract. In: Cushieri A, Steele RJC, Moosa AR, eds. Essential surgical practice, 4th ed. London: Butterworth Heinemann; 2002.p.375–454.

109. Menezes N, Marson LP, deBeaux AC, Muir IM, Auld CD Prospective analysis of a scoring system to predict choledocholithiasis. Br J Surg 2000; 87:1176–81.

110. Livingston EH, Miller JA, Coan B, Rege RV. Indication for selective intraoperative cholangiography. J Gastrointest Surg 2005;9:1371–7.

111. Materia A, Pizzuto G, Silecchia G, Fiocca F, Fantini A, Spaziani E, Basso N. Sequential Endoscopic-Laparoscopic Treatment of Cholecystocholedocholihiasis. Surg. Laparoscopy and Endoscopy 6(4):273-277, 1996

112. Bergamaschi R, Tuech JJ, Braconier L, Walsoe HK, Marvik R, Boyet J , Arnaud JP. Selective Endoscopic Retrograde Cholangiography prior to Laparoscopic Cholecystectomy for Gallstones. The Am. J. of S urg. 178(1): 46-49 July 1999.

113. Jacques JGHM Bergma n, Suzanne va n der Mey, Eric AJ Rauws, Ja n GP Tijssen, Dirk- Ja n Gouma, Guido NJ Tytgat, Kees Huibregtse. Long- term follow-up after endoscopic sphincterotomy for bile duct stones in patients younger than 60 years of age. Gastrointestinal Endoscopy 44, No. 6: 643- 649 1996.

114. Sugiyama M, Atomi Y. Follow- up of more than 10 years after endoscopic sphincterotomy for cholelithiasis in young patients. The British J. of S urg. 85(7): 9 17-92 1 1998.

115. Tana ka M, Ikeda S, Yoshimoto H, Matumoto S. The long- term fate of the gallbladder after endoscopic sphincterotomy. Complete follow- up study of 122 patients. Am. J. Surg. 154(5): 505-509 Nov 1987.

116. Eric Kullma n, Kurt Borch, Lars- Gran Dahlin and gustav Liedberg. Long-Term Follow- Up of patients with gallbladder in situ After Endoscopic Sphincterotomy for Choledocholithiasis. Eur. J. Surg. 157:13 1- 135, 1991.

117. Hammarstrm LE, Holmin T & Stridbeck H. Endoscopic treatment of Bile Duct Calculi in Patients with gallbladder in Situ - Long- Term Outcome and Factors Predictive of Recurrent Systems. Scand. J. Gastroenterol. 3 1:294-30 1, 1996.

118. Ingoldby CJ, El- Saadi J, Hall RI, De nyer ME. Late Results of Endoscopic Sphincterotomy for Bile Duct Stones in Elderly Patients with Gall Bladder in situ. Gut 30(8): 1129- 113 1, Aug 1989.

119. Hill DF, Martin and DEF Tweedle. Risks of Leaving the Gallbladder in situ after Endoscopic Sphincterotomy for Bile Duct S tones. Br. J. Surg. Vol. 78:554-557, May 1991.

120. Harry S. Himal, MD, FRCSC, FACS. Role of Endoscopic Sphincterotomy Alone in Patients with Cholesocholithiasis and Cholelithiasis. CJS, 1996 June; 39 (3):

121. Soon KK, Byung SL et al. Is Cholecystectomy Necessary after ERCP for Bile Duct Stones in Patients with Gallbladder in situ? Korean J Intern Med. 2001;16(4):254-259.

122. Kumar D, Garg PK, Tandon RK. Clinical and biochemical comparative study of different types of common bile duct stones. Indian J Gastroenterol 2001; 20:187-190.

123. Nathanson LK, O'Rourke NA et al. Postoperative ERCP versus laparoscopic choledochotomy for clearance of selected bile duct calculi: A randomized trial. Ann of Surgery 2005; 242(2): 188-92.

124. Sgourakis G, Karaliotas K. Laparoscopic common bile duct exploration and cholecystectomy versus endoscopic stone extraction and laparoscopic cholecystectomy for choledocholithiasis. A prospective randomized study.Minerva Chirurgica 2002; 57(4):467-74.

125. Agarwal JB, Patel RA. Surgical manage,ent of obstructive janundice. J. Ind. Med ass. 1974; 62(12):414-416.

126. Nandkarni KM, Jahagirdar RR, Kagzi PS, Pinto AC, Bhale rao , Surgical obstructive jaundice. A study of 26 cases. J. Post graduate medicine. 1981; 27(1):33-39.

127. Neoptolemos JP, Shaw DE, Carr-Locke DL. A multivariate analysis of preoperative risk factors in patients with common bile duct stones, Imp

128. Laing FC et al. Choledocholithiasis and Cystic Duct obstruction: Difficult ultrasonographic diagnosis, Radiology 1983; 146: 475-479.

129. Cronan JJ, US diagnosis of choledocholithiasis: A reappraisal, Radiology 1986; 161: 133-134.

130. Lambert ME, Betts CD et al. Endoscopic sphincterotomy: The whole truth. Br J Surg 1991; 78: 473-476.

131. Bose SM. Predictors of Choledocholithiasis. Ind J Surg 2002; 64: 335-338.

132. Schreurs WH, Vles WJ, Stuifbergen WH, Oostvogel HJ. Endoscopic management of common bile duct stones leaving the gallbladder in situ. A cohort study with long-term follow-up. Dig Surg 2004; 21(1): 60-4.

133. Martin DJ, Vernon DR, Toouli J. Surgical versus endoscopic treatment of bile duct stones. Cochrane Database of Systematic Reviews 2006, Issue 2. Art. No.: CD003327. DOI: 10.1002/14651858.CD003327.pub2

134. Stephen CS, Hartley C. Choledocholithiasis: Endoscopic Sphincterotomy or Common Bile Duct Exploration. Ann Surg. June 1991; 627-633.

ANNEXURE I

ABBREVIATION

1. SYMPTOMS

   a. ICT Icterus

   b. PN Pain

   c. FV Fever

   d. PNC Pancreatitis

   e. PAS Pale Stools

   f. PRU PRURITIS

   g. CHI Chills

   h. N/V Nausea/Vomiting

2. HOJ History of Jaundice

3. HOS History of Surgery

   a. CHOLE CHOLECYSTECTOMY

   b. ER

4. MRF Medical Risk Factor

   a. DM DIABETES MELLITUS

   b. HTN HYPERTENSION

   c. IHD ISCHAEMIC HEART DISEASE

5. ULTRASONOGRAPHY

   a. USG DL Ultrasonography Dilatation of CBD

   b. USG ST Ultrasonography Stones

c. USG GB ST Ultrasonography Gall Bladder Stones

d. USG GB T Ultrasonography Gall Bladder Thickened

6. CHLN Cholangitis

7. MRCP & CT

8. CDL Choledocholithiasis

9. CDL + CL Choledocholithiasis + Cholelithiasis

10. PRC Procedure

a. ER ERCP ONLY

b. ER + LC ERCP + LAPAROSCOPIC CHOLECYSTECTOMY

c. ER + OC ERCP + OPEN CHOLECYSTECTOMY

d. CBDE CBD EXPLORATION

e. CBDE + C CBD EXPLORATION WITH CHOLECYSTECTOMY

f. CBDE + T CBDE + TRANSDUODENAL SPHINCTEROPLASTY

g. CBDE + CJ CBDE + CHOLEDOCHOJEJUNOSTOMY

11. CMP Complication

a. WI Wound Infection

b. CI Chest Infection

c. ARF Acute Renal Failure

d. BL Bile Leak

e. H Hemorrhage

12.	TTC	T Tube Cholangiogram
13.	HS	Hospital stay
14.	LIVER FUNCTION TESTS	
	a. TB	Total Bilirubin
	b. DB	Direct Bilirubin
	c. ALP	Alkaline Phosphatase
	d. TP	Total Protein
	e. SA	Serum Albumin
	f. OT	SGOT
	g. PT	SGPT

ANNEXURE II

Sumandeep Vidyapeeth University
S.B.K.S Medical Institute and Research Centre

Piparia, Ta. Waghodia, Dist. Vadodara Pin 391760

PARTICIPANT INFORMATION SHEET

Study No. _____ Date _____

Invitation to participant

1. Introduction

This study entitles reviewing the patient coming in the outpatient department with signs and symptoms of choledocholithiasis, getting the patient investigated and provide him/her with the required treatment.

2. What is the purpose of this study?

The purpose of this study is to throw light upon the topic of "*Study of clinical profile and management of choledocholithiasis".*

3. Why have I been chosen?

The patients coming to the outpatient department with choledocholithiasis shall be selected.

4. Do I have to take part?

The participation in the study is totally voluntary and is to be decided by the patient if he/she is willing to give his/her support for the the same.

5. How long will the study last?

This study will last from November 2015 to October 2017

6. What will happen to me if I take part?

This is an observational study.

When the patient approaches the doctor he/she will be examined, later investigated and then if required will undergo surgery or will be treated conservatively depending on the severity of the disease.

7. What do I have to do?

The patient has to allow the treating doctor to examine him/her, get the required inverstigations done and if required for the treatment give consent to get operated for the same.

8. What are the benefits of the study?

This study has both individual and community benefits. This study will provide data about various presentations of patients with choledocholithiasis, diagnostic modality and management.

9. What are the side effects of the treatment received during the study?

This is an observational study hence there are no side effects of this study.

10. What if new information becomes available?

After this study the information regarding the diagnostic techniques of the patients with choledocholithiasis based on sole clinical presentation and clinical presentation along with imaging techniques and newer techniques of its treatment shall be developed.

11. What happens when the study stops?

When the study stops more information on diagnosing the patient based solely on clinical examination would be established.

12. What if something goes wrong?

If any type of threat or untoward event, consequent to present study, is met with, the patient will be provided every type of protection. Nature of this protection can be decided when such an event actually is faced with.

13. Will my taking part be kept confidential?

All the details of the patient including her identity, her disease and her further management will be kept totally confidential.

14. What else should I know?

In case additional information is required, the patient may be contacted to inquire about past, personal and family history. Also religious background, social customs, beliefs etc can be inquired into.

15. Additional Precautions

No additional precautions are required for this study.

16. Who to call with questions?

If any problem develops, you can contact:

NAME: Dr. Naveen Kumar

ADDRESS: Department of General Surgery, Dhiraj General Hospital. Piparia. Tal: Waghodia. Dist: Vadodara.

MOBILE NO: 8758877420

સુમનદીપ વિદ્યાપીઠ યુનીવર્સિટી

એસ.બી.કે.એસ. મેડિકલ ઈન્સ્ટટ્યુટ એન્ડ રીસર્ચ સેન્ટર

પીપરીયા, તા. વાઘોડીયા, જી. વડોદરા -391760

અભ્યાસનુંનામ:"ધિરજ જનરલ હોસ્પિટલ, પિપરિયા ખાતે "સ્તુડી ઓફ કલીનીકલ પીચર એન્ડ મેનેગ્મેન્ત ઓફ ચોલેદોચોલિથિઆસીસ"

અભ્યાસક્રમાંક:_____ **તારીખ:**_____

સહભાગીને આમંત્રણ

1. પરિચય

આ અભ્યાસમા ઑ.પી.ડી.મા પિતની નળીમાં પાથરીના લક્ષણો લઈને આવતા દર્દીની તપાસ થશે, જરૂર પડતી જાંચ કરવામાં આવશે અંદ જરૂર પડતી સારવાર આપવામાં આવશે.

2. આ અભ્યાસનો હેતુ શુ છે?

આ અભ્યાસનો હેતુ "સ્તુડી ઓફ કલીનીકલ પીચર એન્ડ મેનેગ્મેન્ત ઓફ ચોલેદોચોલિથિઆસીસ" ના વિષય પર વધારે જાણકારી મેળવવાનો છે.

3. આ અભ્યાસમા મારી પસંદગી કેમ થઈ છે?

જે દર્દીઓ ને પિતની નળીમાં પાથરી હશે તેઓની આ અભ્યાસ માટે પસંદગી થયેલ છે.

4. શુ મારે આ અભ્યાસ મા ભાગ લેવો જરૂરી છે?

અભ્યાસમાં ભાગ લેવો સંપુર્ણ પણે મરજીયાત છે.અભ્યાસમાં ભાગ લેવા માટે સહમત થયા પછી સહભાગીએ તપાસ કર્તાને તમામ સુસંગતતથ્યો તેમજ તપાસમાં સંપુર્ણ સહકાર આપવો પડશે.

5. આ અભ્યાસ કેટલો સમય ચાલશે?

આ અભ્યાસ નવેમ્બર ૨૦૧૫ થી ઓક્ટોબર ૨૦૧૭ સુધી ચાલશે.

6. આ અભ્યાસમા ભાગ લીધા બાદ મારી સાથે શુ થશે?

આ અભ્યાસમા ફક્ત નિરીક્ષણ કરવામા આવશે. એક વાર અભ્યાસ માટે સંમતી આપ્યા બાદ દર્દીની તપાસ થશે, લેબોરેટરીમા જરૂરી તપાસ થશે, જરૂર પડતી જાંચ કરવામાં આવશે અને બીમારીની તીવ્રતા જોતા જરૂર પાડવા પર ઓપેરતિઓન કરવું પડશે.

7. મારે શુ કરવાનુ આવશે?

દર્દીએ તેમની સારવાર કરતા ડોક્ટોરને તપાસ કરવાની પરવાંગી આપવાની થશે, જાંચ કરવી પડશે અને જો સાજા થવા જરૂર પડે તો ઑપરેશન કરવાની પરવાંગી આપવી જરૂરી છે.

8. આ અભ્યાસના શું ફાયદા છે?

આ અભ્યાસથી દર્દી તથા સમાજને ફાયદો થશે. આ અભ્યાસથી પિતની નળીમાં પાથરી વિષે માહિતી, તેના નિદાન માટેની તપાસ અને સારવાર માટેની રીતો વિષે વધારે જાણકારી મડશે.

9. આ અભ્યાસમા થતી સારવારના શુ ગેરફાયદા છે?
આ અભ્યાસમા ફક્ત નિરીક્ષણ થવાથી એના કાય ગેરફાયદા નથી.

10. જો આ અભ્યાસ પછી નવી જાણકારી મડશે તો એનુ શુ કરવાનુ?
આ અભ્યાસ પછી ખાલી નિરીક્ષણ કરીને જ પિતની નળીમી પાથરીનું નિદાન કરી શકાશે તે ઉપરાંત તેના સારવાર માટે નવી રીતો અને ઓપેરશનથી થતા ફાયદા જોવા મળશે.

11.આ અભ્યાસ પતશે ત્યારે શુ થશે?
આ અભ્યાસ પછી ખાલી નિરીક્ષણ કરીને જ પિતની નળીમી પાથરીનું કેવી રીતે નિદાન કરી શકાય તે માટેની જાણકારી મડશે.

12. આ અભ્યાસ દરમિયાન કોઈ પણ અણબનાવ બનેતો શુ થશે?
ઉપરોક્ત અભ્યાસને સુસંગત કોઇપણ પ્રકારના અણબનાવ સામે સહભાગીને યોગ્ય રક્ષણ પુરૂ પાડવામાં આવશે. રક્ષણનો પ્રકાર આવો કોઈ બનાવ બને ત્યારે નક્કિ કરવમા આવશે.

13.શુ મારૂ ભાગ લેવાનુ ગુપ્ત રેહશે?
દર્દીની ઓઢખ, તેની બિમારી અને તેની સારવાર વિષેની જાણકારી સંપૂન્ન પણે ગુપ્ત રાખવામા આવશે.

14.મારે બિજુ શુ જાણવુ જરૂરી છે?
જો કંઈ વધારે જાણકારી દર્દી ના પેહલાની બિમારી, તેના સગાની બિમારી કે તેના પોતાના વિષેની જાણકારી જો જોઇતી હશે તો દર્દીનો સંપર્ક કરવામા આવશે. તેમના ધર્મ, રીતિ-રિવાજ, માન્યતાઓ વિષેની જાણકારી મેદવવાની જરૂરી પાડી શકે છે.

15.બિજુ શુ ધ્યાન રાખવાની જરૂર છે?
આ અભ્યાસ માટે બિજુ કંઈ ધ્યાન રાખવાની જરૂર નથી.

16.કોઈ પણ સવાલ હોઈ તો કોનો સંપર્ક કરવો?
ડૉ. નવીન કુમાર
જનરલ સર્જરી વિભાગ, એસ.બી.કે.એસ. મેડિકલ ઈન્સ્ટટ્યુટ એન્ડ રીસર્ચ સેન્ટર
પીપરીયા, તા. વાઘોડીયા, જી. વડોદરા.
મોબાઇલ નંબર: ૮૭૫૮૮૭૭૪૨૦

ANNEXURE III:

INFORMED CONSENT FORM

SUMANDEEP VIDYAPEETH UNIVERSITY

Piparia, Ta. Waghodia, Dist. Vadodara Pin: 391760

Informed Consent Form (ICF) for Participants in Research Programmes involving studies on human beings

STUDY TITLE: "**Tamsulosin versus Tadalafil as medical expulsive therapy of distal ureteric stones: A comparative study**"

Study No: SVU/SBKS/_____ /2016-_____

Participants Initials: _____ Participants Name: _____

Date of Birth: _____ Age: _____Years

1. I confirm that I have read and understood the information sheet dated _____ for the above study and have had the opportunity to ask questions.
2. I understand that my participation in the study is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected.
3. I understand that the investigator of this study, others working on the investigators behalf, the Ethics committee and the regulatory authorities will not need my permission to look at my health records, both in respect of the current study and further research that may be conducted in relation to it, even if I withdraw from the study. I agree to this access. However, I understand that my identity will not be revealed in any information related to the third party or get published.
4. I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s).
5. I agree to take part in the above study.

Signature/Thumb impression of the participant _____

Legally acceptable representative _____

Signatory's Name _____ Date _____

Signature of the investigator _____ Date _____

Study Investigator's Name _____ Date _____

Signature of the impartial witness _____Date _____

Name of the witness _____

સુમનદીપવિદ્યાપીઠયુનીવર્સિટી

એસ.બી.કે.એસ. મેડિકલ ઈન્સ્ટટ્યુટ એન્ડ રીસર્ચ સેન્ટર

પીપરીયા, તા. વાઘોડીયા, જી. વડોદરા.

અભ્યાસ માં ભાગ લેવા માટે (સંશોધન)સહભાગી દ્વારા સમજી વિચારીને આપેલી પરવાનગીનુ સંમતિ પત્રક

અભ્યાસનું નામ: :"ધિરજ જનરલ હોસ્પિટલ, પિપરિયા ખાતે "સ્તુડી ઓફ કલીનીકલ પીચર એન્ડ મેનેગ્મેન્ત ઓફ ચોલેદોચોલિથિઆસીસ"

અભ્યાસ ક્રમાંક :SVU/SBKS/ /૨૦૧૨-___

સહભાગીનું પુરુ નામ:

સહભાગીનું ટુંકુ નામ:

સહભાગીની જન્મતારીખ વર્ષ_____ / _____ **:ઉંમર /**

૧) મેંઆ અભ્યાસ(સંશોધન)સંબંધીતારીખ: / /નીમાહિતીપત્રિકાવાંચેલઅનેસમજેલછેતેમજમનેમારાડોકટર (તપાસકર્તા) નેપ્રશ્નોપુછવાનીઅનેચર્ચાકરવાનીપણતકમળીછે.

૨) મનેસમજાવેલછેકેઆઅભ્યાસ (સંશોધન)માંભાગલેવોએસંપૂર્ણમારીમરજીઉપરછેતેમજહુંગમેત્યારેકારણઆપ્યાવગરપણઆમાંથીનીકળીશકું છું, અને આમ કરવાથી મારી તબીબી સારવાર કે કાયદેસરના હક્કોને કોઇ અસર નહીં થાય.

૩) હું જાણુ છું કે આ અભ્યાસ (સંશોધન)ના તપાસકર્તા, તેમના મદદનીશો, એથિકલટીમ અને તેના ઉપર દેખરેખ રાખતા અધિકારીઓને મારા સ્વાસ્થ્યની કોઇપણ જાતની માહિતી, સદર અભ્યાસ (સંશોધન)ને લગતી કે તે સિવાયની, મેળવવા માટે મારી પરવાનગીની જરૂર રહેશે નહીં, ભલે પછી હું અભ્યાસ (સંશોધન)માંથી ખસી જાઉં. હું જાણું છું કે મારી આ પ્રકારની માહિતી અન્ય કોઇને જાણ કે પ્રસિધ્ધ નહીં કરવામાં આવે.

૪) આ અભ્યાસ (સંશોધન) દરમ્યાન, અથવા તેના અંતે પ્રાપ્ત થતી માહિતી, કોઇપણ જાતની વૈજ્ઞાનિક શોધ માટે ઉપયોગ કરવા માટે હું સ્વૈચ્છિક રીતે છુટ આપું છું

૫) હુંઆઅભ્યાસ (સંશોધન)માંભાગલેવા/ જોડાવામાટેમારીસંમતિઆપુંછું.

સહભાગીનું નામ:_____સહભાગીનીસહીઅથવાડાબાઅંગુઠાનુંનિશાન:_____

સંમતિલેનારનુંનામ:_____સંમતિલેનારનીસહી:_____

સાક્ષીનુંનામ:_____સાક્ષીનીસહીઅથવાડાબાઅંગુઠાનુંનિશાન:_____

સ્થળ:_____તારીખ:_____

ANNEXURE IV:

PROFORMA :

1. Name:
2. Reg. No.:
3. Age/Sex:
4. Ward:
5. Address:
6. Clinical History:
7. Investigations done:
8. Date of Admission:
9. Date of Operation:
10. Date of Discharge:
11. PRESENTING COMPLAINTS:
    1. Jaundice
    2. Fever
    3. Pain in right Hypochondrium
    4. Pruritis
    5. Dark colored urine
    6. Clay colored stool
12. CLINICAL EXAMINATION

- Vitals
    - General Condition
    - B.P
    - Pulse

- Temperature
- Respiratory Rate

- Pallor / Icterus / Cyanosis / Clubbing / Edema / Lymphadenopathy
- System Review
  - PER ABDOMEN
  - RS
  - CVS
  - CNS

MASTER CHART

Sr. No	AGE	SEX	ICT	PN	FV	PNC	PAS	PRU	CHILL	N/V	HOJ	HOS	MRF	USG DL	USG ST	USG GB ST	USG GB T	MRCP	CT	ERCP/ES	CHLN	PRC	CMP	TTC	HS	TB	DB	OT	PT	ALP	TP	SA
1	65	M	YES	YES	YES	NO	NO	NO	YES	YES	YES	CHOLE	DM	YES	NO	NO	NO	CDL	CDL	YES	YES	ER	NIL	NO	6	3.9	2.6	36	74	414	6.4	3.2
2	49	M	YES	YES	NO	NO	NO	NO	NO	NO	NO	CHOLE	DM	YES	YES	NO	NO	NO	NO	NO	NO	CBDE+CJ	WI	NO	18	0.4	0.1	24	19	210	4.6	2.1
3	31	F	YES	YES	YES	NO	NO	NO	YES	NO	YES	NO	NIL	NO	YES	YES	YES	NO	NO	YES	NO	ER+LC	NIL	NO	3	1.4	1.2	39	35	67	6.6	3.1
4	70	M	NO	YES	NO	NO	YES	NO	NO	NO	NO	ER	NIL	YES	NO	YES	NO	CDL + CL	CDL+CL	YES	NO	CBDE+C	WI	YES	27	0.8	0.4	21	10	153	6.6	3.4
5	58	F	YES	NO	YES	NO	NO	NO	YES	NO	NO	NO	HT	YES	YES	YES	YES	NO	NO	NO	NO	CBDE+T	CI	YES	28	7	5.3	94	153	289	6.4	3.2
6	49	F	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	HTN + DM	NO	YES	NO	NO	NO	NO	YES	NO	ER	NIL	NO	4	4.2	3.6	110	56	1526	6.6	2.6
7	70	F	YES	YES	NO	NO	NO	NO	NO	YES	NO	NO	DM	YES	YES	YES	NO	NO	NO	YES	NO	ER+LC	NIL	NO	15	3.8	2.9	142	70	851	4.9	2.2
8	65	M	NO	YES	NO	NO	NO	NO	NO	NO	NO	NO	NIL	YES	NO	YES	YES	CDL + CL	CDL+CL	NO	NO	CBDE+C	NIL	YES	30	1	0.5	53	67	241	7.3	4
9	40	M	YES	YES	YES	NO	NO	NO	NO	YES	NO	NO	NIL	YES	YES	NO	NO	NO	NO	YES	YES	ER	NIL	NO	18	9.5	4.9	206	115	164	5.4	2.2
10	45	M	YES	YES	NO	NO	NO	NO	NO	YES	NO	NO	NIL	NO	YES	NO	NO	NO	NO	YES	NO	ER	NIL	NO	8	1.6	0.3	30	102	149	6.6	3.2
11	65	F	YES	YES	YES	NO	YES	YES	YES	YES	YES	CHOLE	DM	YES	YES	NO	NO	NO	NO	YES	YES	ER	ARF	NO	6	10.2	5.4	85	36	407	5.7	2.9
12	70	M	YES	YES	YES	NO	YES	YES	YES	YES	YES	NO	IHD	YES	NO	YES	YES	CDL + CL	CDL+CL	NO	YES	CBDE+C	NIL	YES	22	9.3	5.7	87	70	224	6.1	3.3
13	45	F	YES	YES	NO	NO	NO	NO	NO	NO	NO	ER	NIL	YES	YES	YES	NO	NO	NO	NO	NO	CBDE+C	NIL	YES	22	2.7	1.5	107	144	949	7.7	3.3
14	57	M	YES	NO	YES	NO	NO	NO	YES	NO	NO	NO	NIL	YES	YES	NO	NO	NO	NO	YES	NO	ER	NIL	NO	12	1.1	0.5	57	22	334	5.1	2.1
15	85	F	NO	YES	YES	NO	NO	NO	YES	NO	NO	NO	DM + HTN	YES	NO	NO	NO	CDL	CDL	YES	NO	ER	NIL	NO	5	1.4	0.6	45	56	126	5	2.2
16	80	F	YES	YES	YES	NO	NO	NO	YES	YES	NO	NO	DM + HTN	YES	NO	YES	YES	CDL + CL	CDL+CL	NO	YES	CBDE+C	NIL	YES	42	7.1	5.2	38	26	225	5.7	2.1
17	50	F	YES	YES	NO	NO	NO	NO	NO	YES	NO	NO	HTN	YES	YES	YES	YES	NO	NO	YES	NO	ER+LC	NIL	NO	16	0.9	0.4	19	17	108	6.6	2.9
18	65	F	NO	YES	NO	NO	NO	NO	NO	YES	YES	NO	DM,IHD	YES	YES	YES	YES	NO	NO	YES	NO	ER+OC	NIL	NO	15	0.7	0.5	56	49	176	7.4	3.1
19	60	F	NO	YES	NO	NO	NO	NO	NO	YES	NO	NO	DM	YES	YES	YES	NO	NO	NO	YES	NO	ER+LC	NIL	NO	24	0.4	0.2	32	30	103	5.8	2.5
20	37	F	YES	YES	NO	NO	NO	NO	NO	NO	YES	NO	NIL	YES	YES	YES	YES	NO	NO	YES,FAILED	NO	CBDE+C	NIL	YES	25	5	3.4	65	92	428	6.8	3.1
21	30	M	YES	YES	YES	YES	NO	NO	NO	YES	NO	NO	NIL	YES	YES	NO	NO	NO	NO	YES	YES	ER	NIL	NO	10	4.9	2.1	271	405	151	5.6	2.8
22	75	M	YES	YES	NO	NO	NO	NO	NO	YES	NO	NO	NIL	YES	NO	YES	YES	CDL+CL	CDL+CL	YES,FAILED	NO	CBDE+C	BL	YES	26	0.3	0.2	20	18	98	6.6	2.6
23	48	M	YES	YES	YES	NO	NO	NO	NO	YES	YES	CHOLE	NIL	YES	YES	NA	NA	NO	NO	YES	YES	ER	NIL	NO	9	8.6	7.5	53	118	92	5.9	2.8
24	41	M	YES	YES	NO	YES	NO	NO	NO	YES	YES	NO	NIL	YES	NO	NO	NO	CDL	CDL	YES	YES	ER	NIL	NO	9	1.4	1.2	162	281	250	7.4	3.4
25	62	F	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NIL	YES	NO	YES	YES	CDL+CL	CDL+CL	NO	NO	CBDE+C	NIL	NO	30	15.2	14	140	74	551	6.1	2.1
26	42	M	YES	YES	YES	NO	NO	NO	NO	YES	YES	NO	DM	YES	YES	YES	YES	NO	NO	YES	NO	ER+LC	NIL	NO	19	0.8	0.4	52	42	61	6.3	2.7
27	55	F	YES	YES	NO	NO	NO	NO	NO	YES	YES	NO	HTN	YES	YES	YES	YES	NO	NO	YES	NO	ER+OC	CI		20	5	4.3	78	94	132	5.6	2.4
28	40	F	YES	YES	NO	NO	NO	NO	NO	YES	NO	NO	NIL	YES	YES	YES	NO	NO	NO	NO	NO	CBDE+C	H	YES	21	0.9	0.5	20	16	50	5.8	3.8
29	55	M	YES	YES	NO	NO	NO	NO	NO	YES	YES	NO	DM	YES	YES	YES	YES	NO	NO	YES	NO	ER+OC	NIL	NO	16	1.9	1.2	22	30	134	6.3	1.7
30	70	M	YES	YES	NO	NO	NO	NO	NO	NO	YES	NO	HTN	YES	YES	YES	NO	NO	NO	YES	NO	ER+LC	NIL	NO	10	8.4	7	102	254	205	7.6	3.9
31	60	M	YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NIL	YES	YES	YES	YES	NO	NO	YES,FAILED	NO	CBDE+C	NIL	YES	29	4.9	4.3	164	245	284	7	2.8