

INTRODUCTION

The incidence of common bile duct stones among patients undergoing cholecystectomy is 10% and the incidence of common bile duct stones unsuspected on preoperative investigations but discovered at the time of routine intra-operative cholangiography is from 3% to 5% (*Nataly et al., 2002*).

Primary calculi originating inside the duct are uncommon. The majority of these stones is secondary calculi, having been produced in the gall bladder and migrates to the common bile duct (*Chen et al., 2005*).

Many common bile duct stones are small and therefore can pass spontaneously into duodenum; the larger ones can be impacted in common bile duct due to narrowing in the ampulla of vater and cause jaundice, cholangitis or biliary pancreatitis. Twenty-five to 50% of asymptomatic case may eventually develop symptoms and so this group will require treatment as well, the procedures of removal of the common bile duct stones are controversial (*Chen et al., 2005*).

The modern era of common bile duct surgery started with Mirizzi, who introduced the intra-operative cholangiography in 1932. Intra-operative choledochoscopy had been developed as an adjunctive to intra-operative cholangiography, which helped to detect the common bile duct stones in an additional 10% to 15% of instances that

otherwise an important technique for efficient and effective management of common bile duct stones. Efforts have been exerted to treat patients with common bile duct stones in one session and avoid potential complications of endoscopic sphincterotomy (*Lyass and Phillips, 2006*).

Laparoscopic bile duct clearance, which was first carried out in April 1990, has since then been shown to be potentially preferable option when compared with endoscopic retrograde cholangio-pancreatography (ERCP), allowing the surgeon to reclaim the treatment of common bile duct stones detected at routine intra-operative cholangiography (*Andrew et al., 2008*).

Martine et al reported on 300 consecutive patients undergoing laparoscopic exploration of common bile duct suggesting that the procedure was an equally effective alternative to ERCP with the benefit of cost reduction by means of a single stage and avoidance of known morbidities associated with ERCP, the findings of decreased hospital stay associated with laparoscopic common bile duct exploration and correspondingly lower cost of treatment has raised suggestions of superiority of single stage treatment (*Martine et al., 2006*).

Various short and long term complications of ERCP and endoscopic sphincterotomy have been reported in young patients. The complications include failure of cannulation or stone extraction, bleeding, pancreatitis,

perforation, recurrent stone formation, duodenal reflux and ascending cholangitis. Thus cautious approach is required when electing a two-stage approach with common bile duct stones (*Fujita et al., 2003*).

Recently, single stage laparoscopic cholecystectomy and laproscopic exploration of common bile duct is the primary apporach for patients with common bile duct stones, except in the presence of severe biliary sepsis (*Tang et al., 2006*).

AIM OF THE WORK

The aim of our work is to evaluate the role of Laparoscopic exploration of common bile duct in the management of common bile duct stones.

ANATOMY OF THE EXTRAHEPATIC BILIARY SYSTEM

Biliary exposure and precise dissection are the most important steps in any biliary operative procedure. A thorough anatomical knowledge is essential if optimal results are to be obtained (*Blumgart and Hann, 2007*).

The extrahepatic bile ducts are represented by the extrahepatic segments of the right and left hepatic ducts joining to form the biliary confluence and the accessory biliary apparatus, which constitutes a reservoir, comprising the gallbladder and the cystic duct (*Blumgart and Hann, 2007*).

The right hepatic duct:

The right hepatic duct drains segments V, VI, VII and VIII of liver which constitute the right liver. It is formed by union of right anterior and right posterior sectoral ducts. Its extra hepatic length is about 0.9cm in average (*Skandalakis et al., 2009*).

The left hepatic duct:

The left hepatic duct drains three segments (II,II and IV) which constitute the left liver. It traverses beneath the left liver at the base of segment IV to joins the right hepatic duct to constitute the hepatic ductal confluence (*Blumgart and Hann, 2007*).

The left duct is longer (1.7 cm, average) than the right duct (0.9 cm, average). The junction of these two ducts lies 0.25-2.5 cm from the surface of the liver (*Skandalakis et al., 2009*).

The common hepatic duct (CHD):

The common hepatic duct is about 4cm long, 4mm in diameter. It is formed by the junction of the right and left hepatic ducts the junction lies 0.25-2.5 cm from the surface of the liver, it descends within the free margin of the lesser omentum to join the cystic duct forming the common bile duct (*Blumgart and Hann, 2007*).

The common bile duct:

The length of the common bile duct varies from 5 to 15 cm. depending on the position of the entrance of the cystic duct. The duct may be divided arbitrarily into four portions (Figure.1):

- 1- **Supraduodenal:** Average length 2cm, ranges from 0-4cm.
- 2- **Retroduodenal:** Average length 1.5cm, ranges from 1.0-3.5cm.
- 3- **Pancreatic:** Average length 3cm, ranges from 1.5-6cm.
- 4- **Intramural:** Average length 1.1cm ranges from 0.8-2.4cm.

(*Skandalakis et al., 2009*)

The *supraduodenal* portion lies between the two leaves of the hepatoduodenal ligament, in front of the foramen of Winslow, to the right of the hepatic artery, and anterior to the portal vein (**Skandalakis et al., 2009**).

The *retro duodenal* portion lies between the superior margin of the first part of the duodenum and the superior margin of the head of the pancreas. The gastro duodenal artery is to the left and the posterior superior pancreaticoduodenal artery crosses first anterior to the bile duct and then posterior to the duct just before it enters the duodenum (**Skandalakis et al., 2009**).

Pancreatic portion: The common bile duct may be partly covered by a tongue of pancreas (44%), completely within the pancreatic substance (30%), uncovered on the pancreatic surface (16.5%) or completely covered by two tongues of pancreas (9.5%) (**Skandalakis et al., 2009**).

Intramural portion passes obliquely through the duodenal wall together with the main pancreatic duct. Within the wall, the length averages 15mm. As it enters the wall, the common bile duct decreases in diameter from about 5.7 to 3.3mm. The two ducts lie side by side with a common adventitia for several millimeters. The dividing septum becomes reduced to a mucosal membrane just before the confluence of the duct. The normal outside diameter of the first three regions of the common bile duct is variable, but a common bile duct diameter more than 8

mm in diameter is definitely enlarged and, therefore, pathologic (*Skandalakis et al., 2009*).

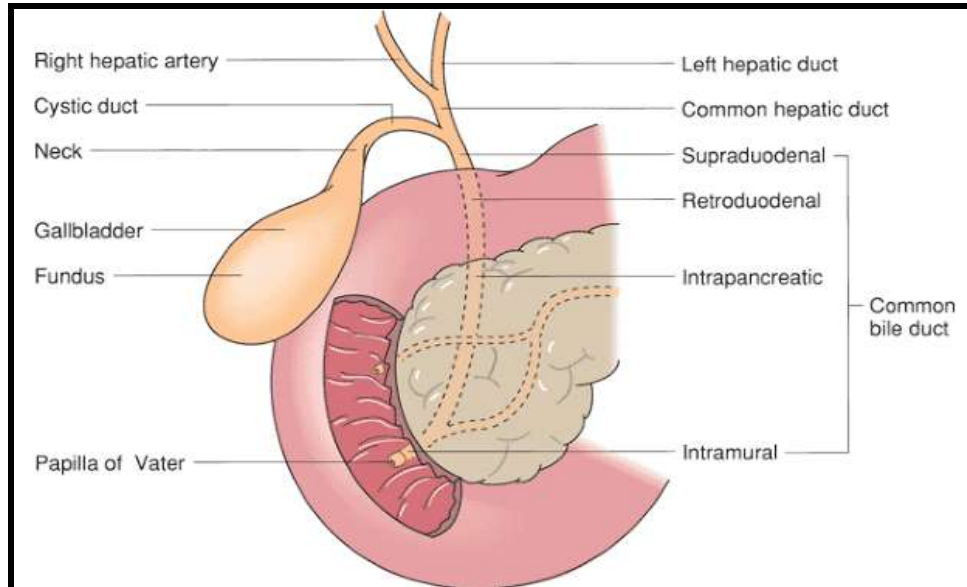


Figure (1): The extrahepatic biliary tract and the four portions of the common bile duct (*Quoted from Greenfield's Surgery, 2006*).

The gallbladder (GB):

The gall bladder is pear-shaped sac lying on the undersurface of the liver, it has a capacity of 30 to 50 ml and 7-10cm in length (*Snell, 2005*).

The gallbladder is located on the visceral surface of the liver in a shallow fossa at the plane dividing the right lobe from the medial segment of the left lobe (the GB-IVC line). The gallbladder is separated from the liver by the connective tissue of Glisson's capsule. Anteriorly, the peritoneum of the gallbladder is continuous with that of the

liver, and the fundus is completely covered with peritoneum (*Skandalakis et al., 2009*).

The cystic duct:

The cystic duct is about 1.5inch long and connects the neck of the gall bladder to the common hepatic duct to form the common bile duct (*Snell, 2005*).

Very rarely, the cystic duct is absent and the gall bladder opens directly into the common bile duct, in such cases the common bile duct may be mistaken for the cystic duct (*Skandalakis et al., 2009*).

Hepatocystic triangle and triangle of Calot:

The hepatocystic triangle is formed by the proximal part of the gallbladder and cystic duct to the right, the common hepatic duct to the left, and the margin of the right lobe of the liver superiorly. The triangle originally described by Calot defined the upper boundary as the cystic artery (*Skandalakis et al., 2009*).

It is a fold of peritoneum containing the cystic artery, cystic node and a variable amount of fat. It also contains the right hepatic artery which usually enters the triangle behind the common hepatic duct. The cystic lymph node is most commonly situated at the junction of the cystic duct with the common hepatic duct (Fig. 2) (*Cuschieri et al., 2002*).

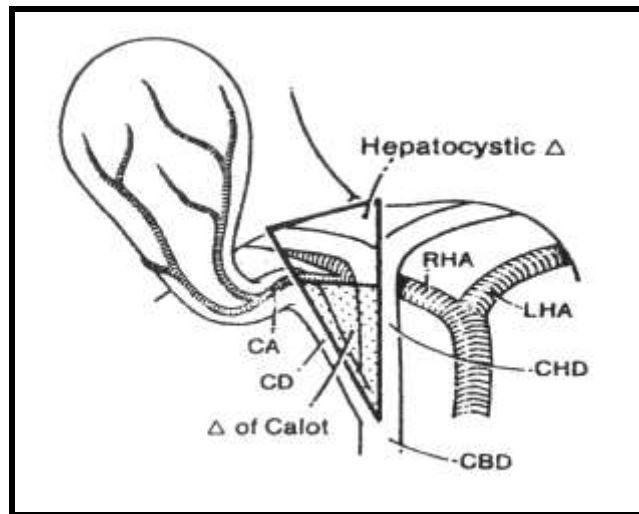


Figure (2): The hepatocystic triangle and the triangle of Calot. The upper boundary of the hepatocystic triangle is the margin of the liver; that of the triangle of Calot is the cystic artery; the triangle of Calot is stippled. CA= cystic artery; CD=cystic duct; CBD= common bile duct; RHA= right hepatic artery; LHA= left hepatic artery; CHD= common hepatic duct (*Quoted from Skandalakis et al., 2009*).

Arterial supply:

The right and the left hepatic ducts receive their blood supply from small side branches arising from the right and the left branches of the hepatic artery proper (*Adkins et al., 2000*).

The arterial supply to the common bile duct is derived from the gastro-duodenal and the right hepatic arteries, these arteries anastomose freely within duct walls (*Schwartz, 2010*).

The arterial blood supply of the gall bladder is mainly by the cystic artery and many small vessels from its hepatic

bed, the cystic artery usually arises from the right hepatic artery crossing anterior or posterior to the common bile or common hepatic duct (in the Calot's triangle) to reach the gall bladder, it may arise from the hepatic trunk, left hepatic, gastro duodenal, celiac trunk or superior mesenteric artery (*Gadzijev, 2002*).

An accessory cystic artery may be present and arises from the common hepatic artery or one of its branches (*Gadzijev, 2002*).

Venous drainage:

Veins of the ductal system drain upwards to the liver and downwards to the portal vein, an epicholedochal venous plexus help surgeons to identify the common bile duct (*Skandalakis et al., 2009*).

The venous drainage of the gall bladder is by multiple small veins in the gall bladder bed into the substance of the liver and so into the hepatic veins, one or more cystic veins may present and run from the neck of the gall bladder into the right portal vein (figure, 3) (*Gadzijev, 2002*).

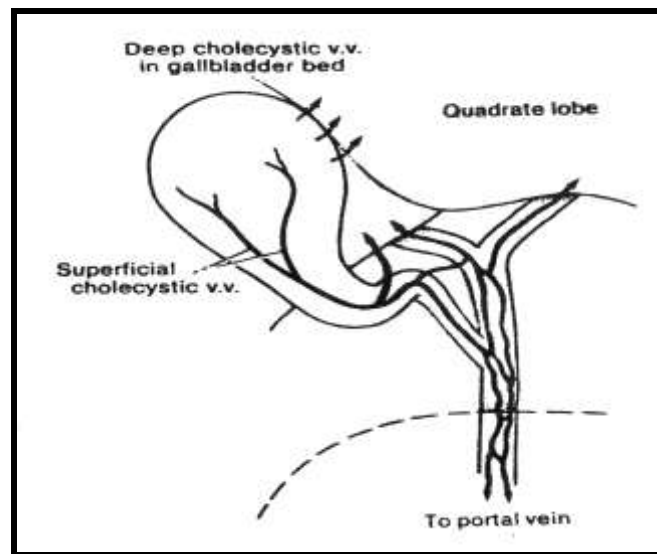


Figure (3): Venous drainage of the biliary tract. Most of the drainage is from the gallbladder bed into the quadrate lobe of the liver. Veins of the duct system drain upward to the liver and downward to the portal vein (*Quoted from Skandalakis et al., 2009*).

Innervation

The biliary tree receives parasympathetic and sympathetic innervation. The former contains motor fibers to the gallbladder and secretory fibers to the ductal epithelium. The afferent fibers in the sympathetic nerves mediate the pain of biliary colic (*Way and Doherty, 2003*).

Lymphatic drainage:

Collecting lymphatic trunks from the gallbladder drain into the cystic node, then to the node of the hiatus and posterior pancreatico-duodenal nodes. The pericholedochal nodes receive lymphatics from the extrahepatic bile ducts and from the right lobe of the liver (Fig. 4) (*Skandalakis et al., 2009*).

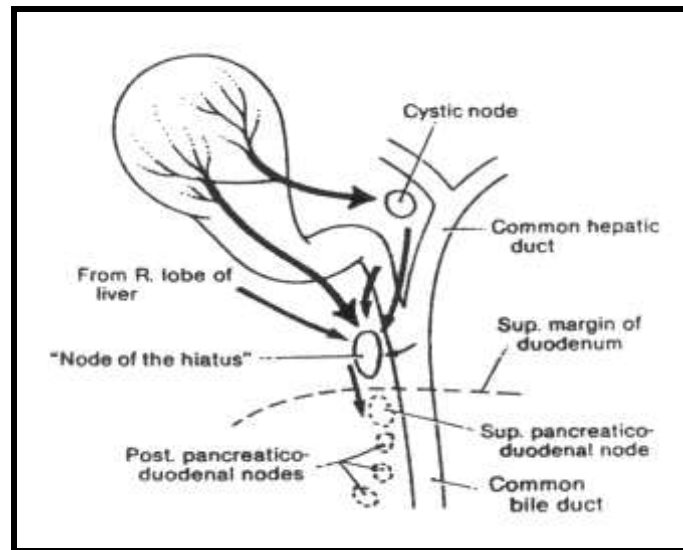


Figure (4): Lymphatic drainage of the biliary tract, the cystic node and the node of the hiatus are relatively constant. Drainage from the gallbladder, the cystic duct, and the right lobe of the liver reaches the posterior pancreatico-duodenal nodes (*Quoted from Skandalakis et al., 2009*).

Congenital anomalies of extrahepatic biliary tree:

A knowledge of such anomalies is of great importance to the surgeon, as failure to recognize these anomalies at operations may lead to complications (*Farquharson and Brendan, 2005*).

Anomalies of the gallbladder

- Phrygian cap is the most common anomaly of the gallbladder where the fundus is constricted and turned back on itself.
 - Congenital absence of the gall bladder is due to failure of the distal end of the cystic duct to expand which is the original biliary sacculation. This result in either
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hypoplasia or agenesis of the gall bladder that is usually discovered on laparotomy and the possibility of a completely intrahepatic gall bladder must be ruled out (*Singh et al., 2002*).

- Fully intrahepatic gallbladder is rare.
 - Floating gallbladder, which has a complete serosal covering and a dorsal mesentery, is relatively uncommon.
 - Elongated sausage-shaped gallbladder frequently accompanies congenital cystic disease of the bile duct.
 - Trabeculated gallbladder is rare and associated with abnormal gallbladder emptying.
 - Left-sided gallbladder is an integral component of situs inversus.
 - Malposition: Two types have been described:
 - Medioposition: in which the gallbladder is displaced medially to lie on the undersurface of the quadrate lobe, but still on the right side of the round ligament.
 - Sinistroposition: in which the gallbladder lies under the left lobe, to the left of the round ligament. In this position, the cystic artery always crosses in front of the common hepatic duct from right to left and the cystic duct may open on the left or right side of the common hepatic duct (Fig. 5) (*Cuschieri et al., 2002*).
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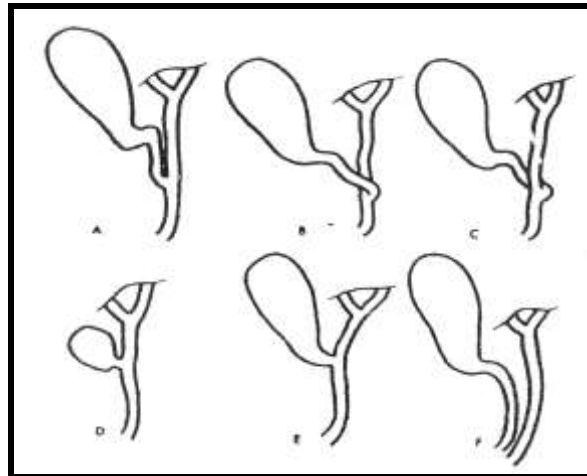


Figure (5): Types of cystohepatic junction. (A) parallel type; (B and C) spiral types; (D and E) short cystic ducts; (F) a long cystic duct ending in the duodenum. This may also be called "absence of the common bile duct" (*Quoted from Skandalakis et al., 2009*).

Ductal anomalies:

- They are sometimes referred to as aberrant ducts and are encountered in 15-19% of cases. In fact these anomalous ducts represent an extrahepatic confluence of a segmental duct and in the vast majority (95%) it affects the right system, when the aberrant duct joins the right hepatic duct extra-hepatically, or common hepatic duct, or cystic duct, and very rarely the gallbladder (Fig. 6) (*Cuschieri et al., 2002*).
 - In 3% there is an absence of the hepatic duct confluence.
 - Congenital obliteration of the ducts (biliary atresia is one of the causes of neonatal jaundice).
 - Absence of the cystic duct, the gallbladder opens directly into the side of the common hepatic duct.
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