IATROGENIC BILE DUCT INJURIES

Essay

Submitted in Partial Fulfillment for the Master Degree
In General Surgery

By

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2012

INTRODUCTION

Gallstone disease is common all over the world. Cholecystectomy is the treatment of choice for symptomatic gall stones ***(Vinay et al., ٢٠٠٩).***

Langenbuch performed the first open cholecystectomy (OC) in ١٨٨٢, and it remained the gold standard for the treatment of cholelithiasis ***(Langenbuch, ١٨٨٢).***

Laparoscopic cholecystectomy (LC) in the late ١٩٨٠ has replaced open cholecystectomy as the gold standard for surgical treatment of benign gallbladder disease.

Despite the advantages of laparoscopic cholecystectomy over open cholecystectomy, the incidence of iatrogenic bile duct injuries, which is the most common and serious complication during laparoscopic cholecystectomy, has increased from ٠,٢٪ to ٠,٧٪ compared with ٠,١٪ to ٠,٤٪ during open cholecystectomy ***(Zhi-Bing et al., ٢٠٠٩).***

Bile duct injuries may occur after gallbladder, pancreatic and gastric surgery, with laparoscopic cholecystectomy responsible for ٨٠٪-٨٥٪ of them ***(Karvonen et al., ٢٠٠٧)***.

Bile duct injury following cholecystectomy is an iatrogenic catastrophe associated with significant morbidity and mortality, reducing long-term survival and quality of life, and high rates of subsequent litigation ***(Wan-Yee Lau and Eric Lai, ٢٠٠٧).***

The mechanisms of injury, previous attempts of repair, surgical risk and general health status importantly influence the diagnostic and therapeutic decision-making pathway of every single case.

There are two general types of injuries-namely biliary obstructions and bile leaks and sometimes both can occur simultaneously. In addition, to bile duct injury, concomitant vascular injuries are often present, and resultant ischemia can more complicate matters, especially if immediate repair is performed and the vascular injury goes unrecognized ***(Yuhsin et al., ٢٠١٠)***.

Several classification systems have been proposed ***(Bektas et al., ٢٠٠٧)*** for iatrogenic bile duct lesions, reflecting the diversity of injury patterns and their sequelae such as Bismuth ***(Bismuth, ١٩٨٢)*** and Strasberg et al. classifications ***(Strasberg et al., ١٩٩٥)***.

Recognition and proper diagnosis of bile duct injuries is advantageous in preventing serious complications and obtaining high repair success rates. Unfortunately, most bile duct injuries are not recognized intraoperatively, and most patients are sent home immediately after or within the first few days. However, it is stressed that progressive vague abdominal symptoms should be evaluated for a bile duct injury.

The choice of the appropriate treatment for iatrogenic bile duct injuries is very important, because it may avoid these serious complications and improve quality of life in patients. Therefore, the question regarding the type of treatment for patients with iatrogenic bile duct injuries is still a matter of debate. Initially, endoscopic treatment is recommended in patients with iatrogenic bile duct injuries. When endoscopic techniques are not effective, different surgical reconstructions are performed ***(Vitale et al., ٢٠٠٨)***.

The goal of surgical treatment is reconstruction to allow good bile flow to the alimentary tract. In order to achieve this goal, many techniques are used.

Unfortunately, late diagnosis, multiple repair attempts and neglected medical care in order to avoid legal entanglements result in extension and increased complexity of bile duct repair. The late clinical course of bile duct injury leads to chronic liver disease, cirrhosis and portal hypertension, with liver transplantation the last hope of cure.

Therefore, more emphasis is placed on preventing these complications. In addition to adequate training, several techniques have been proposed to prevent bile duct injury ***(Norman Oneil Machado, ٢٠١١).***

Aim of the Work

This study aims to discuss the etiology, clinical presentation, and risk factors of iatrogenic bile duct injury and outline the appropriate management strategies based on the nature of injury presented, as well as practices that may help to decrease or prevent further injuries.

SURGICAL ANATOMY OF BILIARY SYSTEM

Accurate biliary exposure and precise dissection are the two most important steps in any biliary operative procedure and are both totally dependent on a thorough anatomical understanding of these structures.

Intrahepatic bile duct anatomy

The individual biliary drainage system is parallel to the portal venous supply (Fig. ١). The right hepatic duct drains the segments of the right liver lobe (V–VIII) and has two major branches: the right posterior duct draining the posterior segments, VI and VII, and the right anterior duct draining the anterior segments, V and VIII. The right posterior duct usually runs posterior to the right anterior duct and fuses it from a left (medial) approach to form the right hepatic duct (Fig. ٢). The left hepatic duct is formed by segmental tributaries draining segments II–IV (Fig. ٣) ***(Mortelé and Ros, ٢٠٠١).***

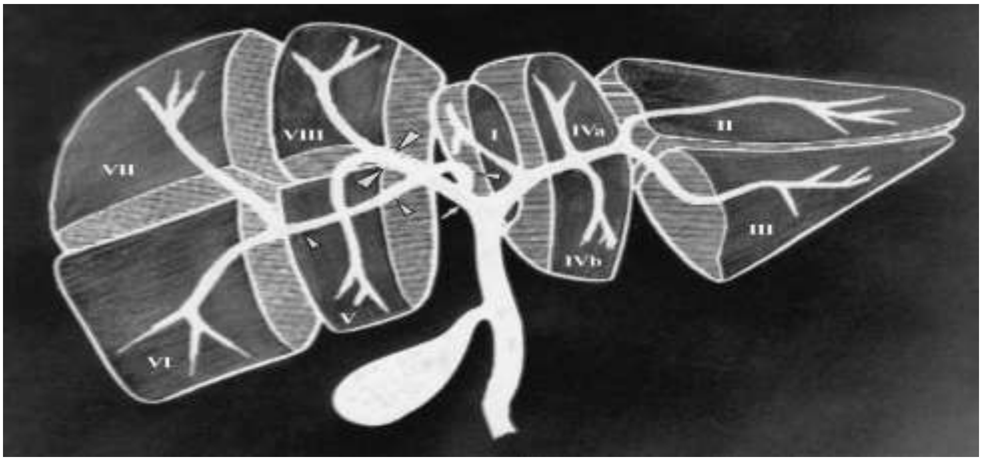


Fig. (١): Drawing shows normal hepatic biliary segmental anatomy.

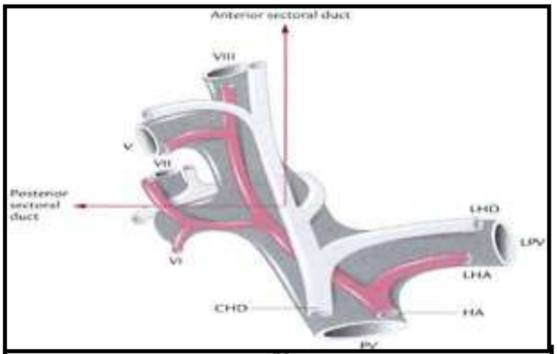


Fig. (٢): Biliary and vascular anatomy of the right liver. Note the horizontal course of the posterior sectoral duct and the vertical course of the anterior sectoral duct.

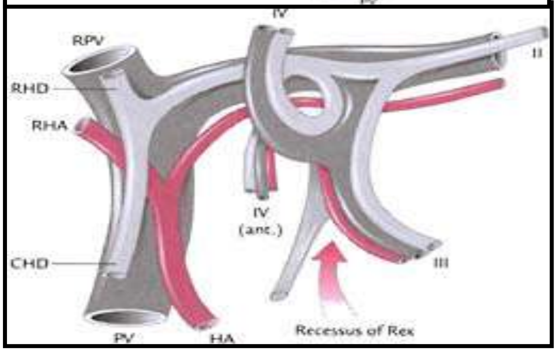


Fig. (٣): Biliary and vascular anatomy of the left liver. Note the position of segment III duct above the corresponding vein.

Extrahepatic bile duct anatomy

The extrahepatic biliary tract is represented by the extra hepatic segments of the right and left hepatic ducts joining to form the biliary confluence and the main biliary channel draining to the duodenum,also the accessory biliary apparatus, which constitutes a reservoir, comprises the gallbladder and cystic duct (fig. ٤).

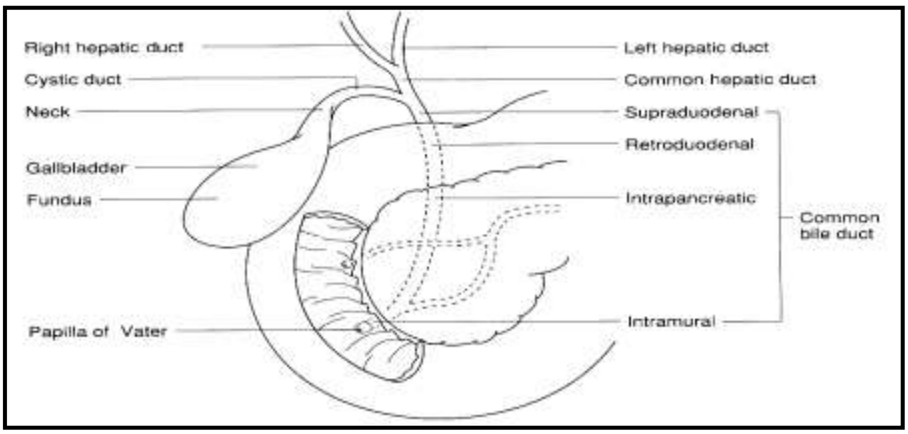


Fig. (٤): Gross anatomy of the extrahepatic biliary tract.

Bile duct of luschka:

Subvesicular bile ducts (bile duct of luschka), found in approximately ٣٥٪ of individuals, are small blind ducts emerging from the right lobe of liver and lying in the bed of gallbladder. They do not communicate with the gallbladder. The surgical significance of these ducts is that if they are injured during cholecystectomy, they should be ligated, or a biliary fistula will result (usually close with time). There are no consequences resulting from ligation of these ducts because they are not end segmental ducts, draining an isolated segment, but rather from an additional anastomotic loop between intra- and extra-hepatic ducts ***(Sharif et al., ٢٠٠٣).***

The main bile duct:

The main bile duct runs from the confluence of the hepatic ducts to ampulla of Vater. It is normally ١٠ to ١٢cm in length and about ٦mm in diameter in anatomical specimen. In life, the upper limit of normal diameter on ultrasound is ٧mm. On direct cholangiography, when the duct is deliberately distended, it is up to ١٢mm. the enterance of cystic duct divides the main bile duct into the common hepatic duct above the enterance and the common bile duct below ***(Majeed, ١٩٩٩).***

Continuing the course of the hepatic duct, the common bile duct has an arciform course with a right and anterior concavity, going to the descending segment of the duodenum where, after the joining with the main pancreatic duct, it will open on the hepato-pancreatic ampulla, in the middle third of this duodenal segment. The common bile duct consists of four parts:

A. The supraduodenal segment

The supra-duodenal segment founded in the right border of the lesser omentum is a part of the hepatic pedicle. In this case, the supraduodenal segment has posterior relations with the portal vein, via a thin layer of connective tissue. On the left side of the common bile duct arises the proper hepatic artery ***(Dana Blidaru et al., ٢٠١٠).***

B. The retroduodenal segment

The retroduodenal segment is a part of the anterior wall of the Winslow’s hiatus. The common bile duct descends posterior to the superior segment of the duodenum, in relation with the superior duodenal flexure, and describes an arch with anterior concavity.

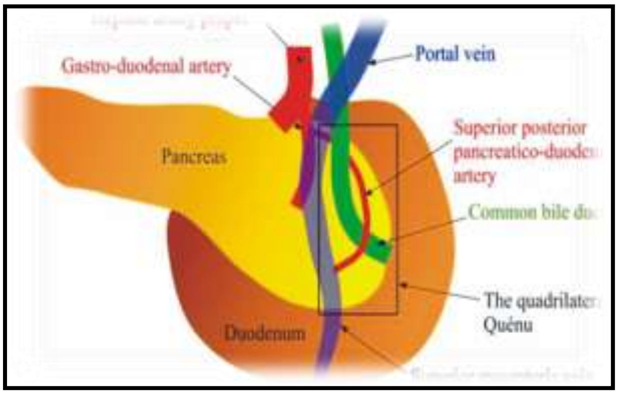
The portal vein is passing through the triangle forms by the superior border of the pancreas, the common hepatic artery to the left and the gastro-duodenal artery to the right. In this triangle and on the left side of the common bile duct there are present one or two lymph nodes. There, it is also present the end of the gastric coronary vein, which passes downward and it opens in the portal or splenic vein, posterior to the pancreas ***(Dana Blidaru et al., ٢٠١٠)***.

C. The retropancreatic segment

The common bile duct descends through a groove or a canal on the posterior side of the pancreas. In this segment, the common bile duct has the following relations: anterior, the head of the pancreas and the superior posterior pancreatico-duodenal artery or superior right pancreatico-duodenal artery, which, after it passes anterior to the common bile duct from left to right, will pass on the right margin of the common bile duct, and then crosses again the duct, this time on its posterior aspect. The retropancreatic part passes through Quénu space bordered by the three segments of duodenum and the superior mesenteric vein/the portal vein (Fig. ٥).

This part of the common bile duct may be: Partly covered by a tongue of pancreas (٤٤٪); Completely within the pancreatic substance (٣٠٪); Uncovered on the pancreatic surface (١٧٪); Completely covered by two tongues of pancreas (٩٪). Even when completely covered, the groove or tunnel occupied by the duct may be palpated by passing the fingers of the left hand behind the second part of the duodenum after mobilization with Kocher's maneuver ***(Skandakis et al., ٢٠٠٠)***.

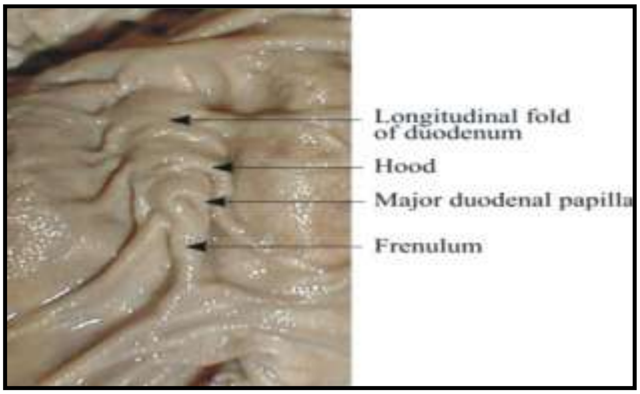
Fig. (٥): Relations of the retro-pancreatic common bile duct – posterior view (original sketch)



D. Intra-parietal segment

Reaching the descending duodenum, the common bile duct passes through its medial wall and will open together with the main pancreatic duct at the level of the hepato-pancreatic ampulla. On its intra-parietal course, the common bile duct elevates the mucosa of the duodenum and forms the longitudinal fold of duodenum (Fig. ٦). In the inferior end of this fold, there is a prominence – the major duodenal papilla where the hepato-pancreatic ampulla is found. The duodenal mucosa covers the papilla like a hood. The tip of the papilla is traced down by a fold called the frenulum, which is placed in a sagittal plane ***(Dana Blidaru et al., ٢٠١٠)***.

Fig. (٦): Duodenal mucosa in the area of the major duodenal papilla.



Ampulla of Vater:

The union of the common bile duct and the pancreatic duct forms the ampulla of Vater. The distance between the point of junction of the pancreatic and common bile duct with the duodenal papilla is variable. A normal papilla will permit the passage of a dilator ٣mm in diameter ***(Avisse et al., ٢٠٠٠).***

Papilla of Vater:

The common bile duct passes obliquely through the postero-medial wall of the duodenum, and the site of entry into the duodenal lumen is marked by a papilla (the major papilla or papilla of Vater). The usual position of the papilla is in the second part of the duodenum, an average of ٨ cm from the pylorus ***(Lamah et al., ١٩٩٩).***

Sphincter of Oddi:

The distal common bile duct at the papilla of Vater is regulated by a sphincteric mechanism that originally was named the sphincter of Oddi but more accurately has been described by Boyden, who has defined a complex of four sphincters composed of unique circular or spiral smooth muscle fibers, distinguishable from the adjacent smooth muscle fibers, surrounding the intramural portion of the common bile duct and pancreatic ducts ***(Menees et al., ٢٠٠٥).***

Calot's triangle:

This famous triangle was described by Calot in ١٨٩١ and is bound by the cystic duct, the bile duct and the cystic artery in its original description. In its present interpretation the upper border is formed by the inferior surface of the liver with the other two boundaries being the cystic duct and the bile duct (Fig. ٧). Its content usually include the right hepatic artery (RHA), the cystic artery, the cystic lymph node(of Lund), connective tissue, and lymphatics. Occasionally it may contain accessory hepatic ducts and arteries.

It is this triangular space, which is dissected in a cholecystectomy to identify the cystic artery and cystic duct before ligation and division. In reality, it may be a small potential space rather than a large triangle making the dissection of its contents without damaging the bordering structures the most challenging step of a cholecystectomy. In addition the space may be obscured and shrunken by various mechanisms. The left (or medial) boundary of the triangle formed by the bile duct is the most important structure, which needs to be safe guarded ***(Nagral et al., ٢٠٠٥).***

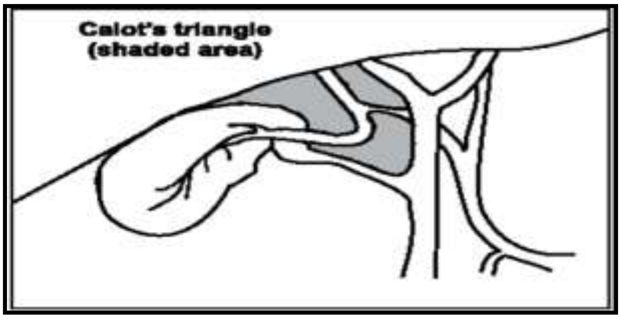


Fig. (٧): Calot's triangle**.**

The gall bladder:

The gall bladder is a pear shaped organ situated in a fossa on the liver undersurface. It is variable in shape and volume. Normally present at the junction of segments ٤ and ٥ (and at the lower limit of the principal plane or Cantlie's line). Its position in relation to the liver may vary. It may be partially or completely embedded within the liver parenchyma, the so-called 'intrahepatic' gall bladder. This may create difficulties in dissection and may increase the chance of intraoperative injury to the liver. Although the main right pedicle is fairly deep in the liver parenchyma, large portal, and hepatic venous branches traverse the liver at a depth of around one cm from the gallbladder. Thus, a deep liver tear during the dissection of the gall bladder off its fossa can occasionally bleed profusely ***(Nagral, ٢٠٠٥).***

The gallbladder is about ٤ cm wide and ٧ to ١٠ cm long in most adults. It is composed of a fundus, body, and neck. The fundus is the blind-ending portion that projects below the inferior edge of the liver where it is in contact with the anterior abdominal wall at the level of the ninth costal cartilage. The body is the largest part of the gallbladder and is pointed up and to the left close to the right side of the porta hepatis. The body decreases in width and forms the infundibulum as it becomes the neck of the gallbladder with an average length of ٥ to ٧ mm.

On the right side of the neck, sometimes as a result of chronic dilatation, there may be a recess that projects toward the duodenum called the Hartmann pouch.The neck of the gallbladder is connected to the cystic duct which join the common hepatic duct to form the CBD ***(Vakili et al., ٢٠٠٨).***

The cystic duct:

In the study by Moosman and Coller, the mean diameter of cystic duct was about ٤ mm and its length ranged from ٤ to ٦٥ mm with a mean length of ٣٠ mm. In greater than ٧٠٪ of cases, the cystic duct joins the right lateral edge of the common hepatic duct superior to the pancreas and about ٢ cm inferior to the RHD and LHD. In ١٠٪ of cases, the cystic duct joined the CHD on its anterior or posterior aspect. On rare occasions, the cystic duct may join the hepatic duct near the confluence of the RHD and the LHD creating a trifurcation. The union of the cystic duct with the CHD has been described as angular (٧٥٪), parallel (٢٠٪), or spiral (٥٪) (Fig. ١٣) ***(Vakili et al., ٢٠٠٨)***

Blood supply, lymphatic drainage and innervation of the biliary tract

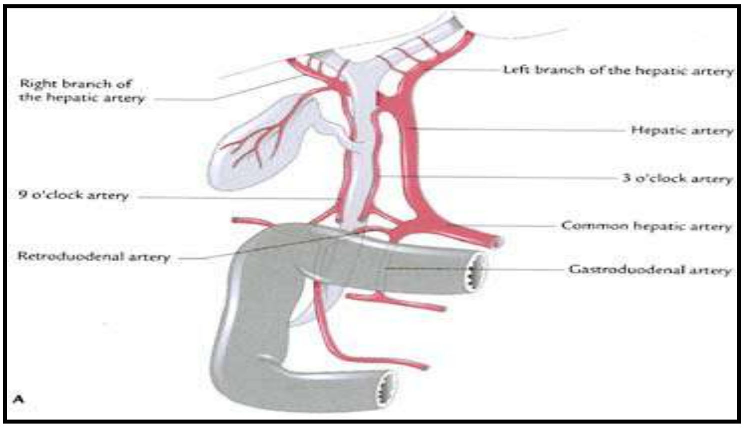
A) Arterial supply

The hepatic artery

The hepatic artery usually arises as one of the three named branches of the coeliac trunk along with the left gastric and splenic arteries. The first named branch of the hepatic artery is the gastroduodenal artery and either of these arteries may then give rise to the right gastric and retroduodenal arteries. The hepatic artery then divides into right (giving rise to the cystic artery) and left hepatic arteries. This arrangement holds true for ٥٠٪ of cases (Fig. ٨).

In nearly ٢٥٪ of cases the right hepatic artery arises separately from the superior mesenteric artery, indicative of the joint fore and midgut origin of the liver, and in nearly another ٢٥٪ of cases the left hepatic artery arises from the left gastric artery. In a small number of people other variations of these arrangements will occur.

Fig. (٨): The biliary duct blood supply



The cystic artery

The cystic artery usually arises from the right hepatic artery as it traverses the hepatocystic triangle to the right of the common hepatic duct

(Fig. ٨). The lymph node of Calot usually lies just superficial to the position of the cystic artery in the cystic triangle, and can be a good guide to finding and ligating it. Reaching the gallbladder behind the common hepatic duct, the cystic artery usually branches into an anterior superficial branch and a posterior deep branch. These branches anastomose and send arterial twigs to the adjacent liver ***(Mirilas et al., ٢٠٠٤)***.

The extrahepatic biliary system receives a rich arterial blood supply, which is divided into three sections.

The hilar section receives arterioles directly from their related hepatic arteries and these forms a rich plexus with arterioles from the supra-duodenal section.

The blood supply of the supraduodenal section is predominantly axial, most vessels to this section arising from the retroduodenal artery, the right hepatic artery, the cystic artery, the gastroduodenal artery and the retro-portal artery. Usually, eight small arteries, each ٠,٣ mm in diameter, supply the supraduodenal section. The most important of these vessels run along the lateral borders of the duct and are referred to as the ٣ o’clock and ٩ o’clock arteries.

The retro-pancreatic section of the bile duct receives its blood supply from the retro-duodenal artery.

B) Venous drainage

The veins draining the bile duct mirror the arteries and also drain the gallbladder. This venous drainage does not enter the portal vein directly but seems to have its own portal venous pathway to the liver parenchyma.

The veins from the hepatic ducts and proximal part of the CBD enter the liver directly. The distal part of the CBD drains to the posterior superior