

# **MANAGEMENT OF BILE DUCT INJURIES RELATED TO LAPAROSCOPIC CHOLECYSTECTOMY**

**Essay**

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**General Surgery**

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## List of abbreviations

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|        |                                                                         |
|--------|-------------------------------------------------------------------------|
| BAP    | : Bioabsorbable Polymer patch.                                          |
| B.D.I. | : Bile duct injury.                                                     |
| CHD    | : Common Hepatic Duct.                                                  |
| CBD    | : Common Bile Duct.                                                     |
| CT     | : Computed Tomography.                                                  |
| DIC    | : Drip Infusion Cholangiography.                                        |
| ECG    | : Electrocardiomyography.                                               |
| ENBD   | : Endoscopic Nasobiliary Drainage.                                      |
| ENGBD  | : Endoscopic Nasogallbladder Drainage.                                  |
| ERCP   | : Endoscopic Retrograde Cholangiopancreatography.                       |
| G.B.   | : Gall Bladder.                                                         |
| HIDA   | : 99m-Technetium-labeled derivatives of dimethyl<br>iminodiacetic acid. |
| IBDI   | : Iatrogenic Bile Duct Injury.                                          |
| IOC    | : Intraoperative Cholangiography.                                       |
| ICG    | : Indocyanine Green.                                                    |
| LC     | : Laparoscopic Cholecystectomy.                                         |
| MRI    | : Magnetic Resonance Image.                                             |
| MRCP   | : Magnetic Resonance Cholangiopancreatography                           |
| NIRFC  | : Near Infra-Red Fluorescent Cholangiography                            |
| PTC    | : Percutaneous Transhepatic Cholangiography                             |
| PTBD   | : Percutaneous Transhepatic Biliary Drainage.                           |

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## **Introduction**

Over the last decade, laparoscopic cholecystectomy (LC) has gained worldwide acceptance and considered to be as "gold standard" in the surgical management of symptomatic calculous cholecystitis. However, the incidence of bile duct injury in laparoscopic cholecystectomy is still great compared to classic open surgery (*Savader et al., 2006*).

laparoscopic cholecystectomy is a safe procedure, although it is associated with some serious complications. The most usual complication during laparoscopic cholecystectomy is bile leakage, which remains a significant cause of morbidity. Early identification and management of these complications will minimize a potentially devastating outcome (*Lippincott Williams and Wilkins, 2009*).

Technical factors leading to biliary injury are often caused by errors of perception during dissection in Calot's triangle, including misidentification of anatomy, and failure to recognize injuries when they occur. In addition, acute cholecystitis, a difficult dissection, and bleeding are associated with higher rates of major bile duct injury during LC (*Stewart et al., 2004*).

The care of these patients has evolved over the last 14 years by trial and error, as well as by the individual surgeon or institutional philosophy. Collaboration among surgeons, gastroenterologists, and interventional radiologists is imperative in the care of these complex injuries (*Lillemoe et al., 2006*).

The management of patients following major BDI is a surgical challenge often requiring the skills of experienced hepatobiliary surgeons at tertiary referral centers (*Melton et al., 2006*).

Some patients treated via nonsurgical means, such as percutaneous or endoscopic balloon dilatation and stenting of an existing biliary stricture to be repaired after injury during LC (*Stewart et al., 2004*).



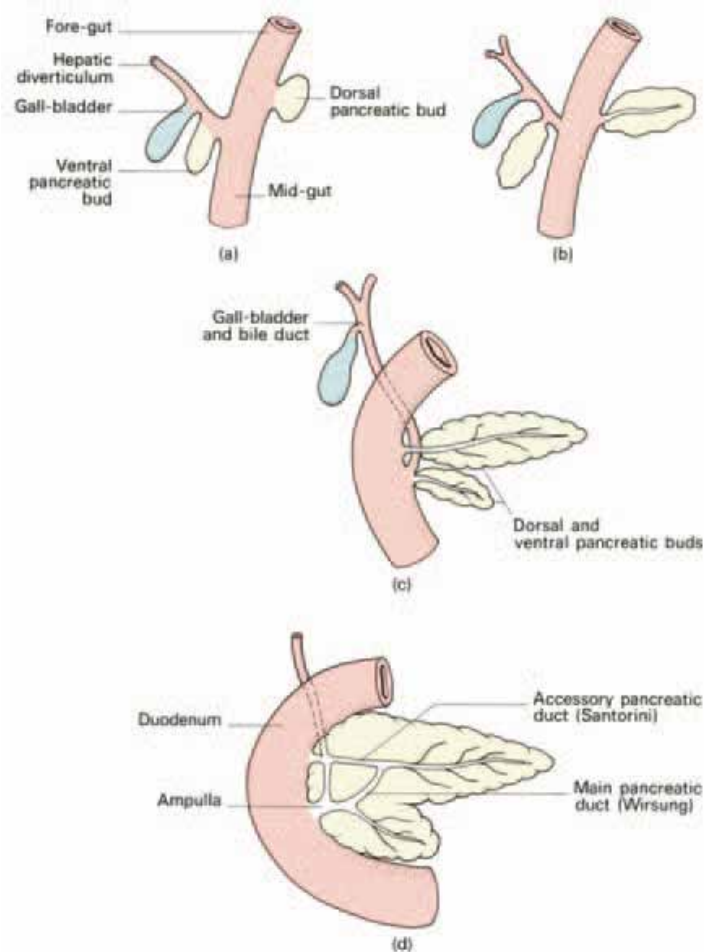
## **Aim of The Work**

**The aim of this work is to highlight the different types of bile duct injuries, possible causes & recent management whether by conservative, endoscopic or surgical methods.**

## **I- Embryology and Anatomy of the Extra-hepatic Biliary system**

### **1- Embryology of extra-hepatic biliary system**

Biliary anomalies are not uncommon and over 50 % of all patients undergoing a biliary tract procedure will have either a ductal or an arterial anomaly. The failure to recognize such a congenital problem can result in significant per operative morbidity (*Rosylan and Zinner, 1999*).



**Fig.(1):**Development of the intestinal adnexae (*Harold Ellis,2006*).

The liver and the biliary tract are derived from the distal part of the foregut. The liver first appears in the 3 week embryo as a hollow endodermal bud from the foregut. This bud, the future hepatic diverticulum, consists of rapidly proliferating cells that penetrate into the septum transversum in the ventral mesogastrium. These cells eventually develop into the liver, the connection between the hepatic diverticulum and the foregut is preserved to form the bile duct. A ventral outgrowth of the bile duct gives rise to the gallbladder and the cystic duct.

As the intestine rotates, the entrance from the bile duct into the duodenum moves to a position and the common bile duct comes to lie behind the duodenum and the pancreas (*Britton et al., 1999*).

## **2- Anatomy of Biliary tree:**

The right and left hepatic ducts fuse in the porta hepatis to form the common hepatic duct (4 cm). This joins with the cystic duct (4 cm), draining the gall-bladder, to form the common bile duct (10cm) (*Harold Ellis, 2006*).

### ***A- Gallbladder :***

The gall bladder is pear-shaped organ adherent to the undersurface of the liver, lying in a fossa which separates the morphological right and left lobes. It acts as a reservoir for bile, which it also concentrates. It holds about 50 mL of bile when physiologically distended. The gall bladder consists of a fundus, a body and a neck, the latter opening into the cystic duct which conveys bile to and from the common bile duct. The lumen of the cystic duct contains a mucosal valve, the spiral valve of Heister, which offers mild resistance to bile flow. The gall bladder is related inferiorly to the duodenum and transverse colon. An inflamed gallbladder may ulcerate into either of the duodenum or transverse colon, most commonly the second part of the duodenum.

cholecystoduodenal fistula may result with passage of a gall stone into the small bowel. If the stone is large enough, gall stone 'ileus' will result. A small pouch may be present on the ventral aspect of the gall bladder just proximal to the neck which projects downwards and backwards towards the duodenum. This is called Hartmann's pouch. Originally thought to be a constant feature of the normal gall bladder, it is now recognized as being associated with a dilated and pathological gall bladder. A stone may become lodged in the pouch (**Andrew T. Raftery, 2008**).

### ***Blood supply :-***

The gall bladder is supplied by the cystic artery, which usually arises from the right hepatic artery. It lies in a triangle made up of the liver, the cystic duct and the common hepatic duct, (Calot's triangle). The cystic artery passes behind the common hepatic and cystic ducts to gain the upper surface of the neck of the gall bladder. Occasionally, the cystic artery arises from the main hepatic artery, and crosses in front of or behind the common bile duct or common hepatic duct prior to reaching the gall bladder. Other vessels derived from the right hepatic artery pass directly to the gall bladder from its bed in the liver. Venous drainage is via small veins draining directly through its bed into the liver. Variations in the anatomy of the extrahepatic biliary system are not uncommon (**Andrew T. Raftery, 2008**).

### ***Nerve supply :-***

The gall bladder receives parasympathetic innervation, which gives motor nerves to the gall bladder and secretory fibers to the ductal epithelium. Sympathetic afferents mediate the pain of biliary colic. The gall bladder is lined by columnar epithelium, the luminal surface possessing microvilli to aid its absorptive capacity. When the organ is collapsed the mucosa is thrown into prominent folds. The wall of the gall

bladder and cystic duct contains smooth muscle, but this is virtually absent in the bile duct, hence little pain from a gall stone in the bile duct (**Andrew T. Raftery, 2008**).

## **B- Hepatic duct:**

### **(I) Intra-hepatic Bile Duct Anatomy :**

The liver is divided into 2 major portions and a dorsal lobe “caudate lobe”. The right liver and the left liver are respectively drained by the right and left hepatic ducts, whereas the dorsal lobe “caudate lobe” is drained by one or several ducts joining both the right and left hepatic ducts (**Harold Ellis, 2006**).

The intrahepatic ducts are tributaries of the corresponding hepatic ducts which form part of the major portal tracts and which penetrate the liver invaginating the Glisson’s capsule at the hilus of the different biliar and vascular elements of major portal triads, the hepatic arterial branches, portal veins and biliary tract. The least liable to variation are portal venous components. In particular, the left branch of the portal vein tends to be constant in location (**Couinaud, 1997**).

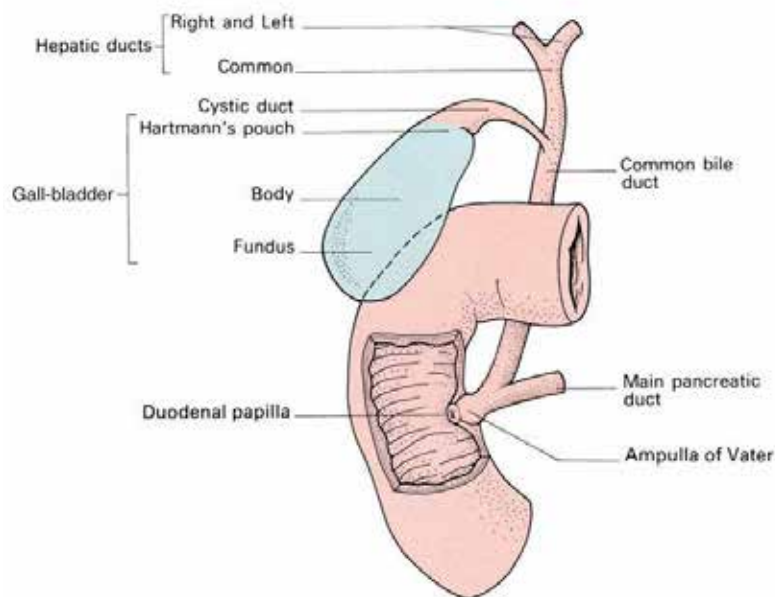
Bile ducts are usually located above the corresponding portal branches, whereas hepatic arterial branches are situated anterior to the veins. Each branch of the intrahepatic portal veins corresponds to one or two bile ducts which form outside the liver, the right and left hepatic ductal systems, converging at the liver hilus to constitute the common hepatic duct. The umbilical fissure divides the left liver passing between segment III and segment IV where it may be bridged at its base by a tongue of liver tissue. The ligamentum teres passes through the umbilical fissure to join the left branch of the portal vein within the recesses of Rex. All these biliary and

vascular elements are liable to anatomical variation (**Blumgant et al., 2003**).

### **1- The left hepatic duct :**

It drains the three segments “II, III and IV” which constitute the left liver. The duct draining segment III is located slightly behind the left horn of the umbilical recesses, running backwards to join the segment II at the point where the left branch of the portal vein turns forward and caudally at the recessus of Rex (**Couinaud, 1997**).

The left hepatic duct transverses beneath the left liver at the base of segment IV, just above and behind the left branch of the portal vein crosses the anterior edge of that vein and joins the right hepatic duct to constitute the hepatic ductal confluence. In its transverse portion it receives one to three small branches from segment IV (**Couinaud, 1997**).



**Fig. (2):** The gall-bladder and its duct system. (The anterior wall of the second part of the duodenum has been removed) (**Harold Ellis, 2006**).

## **2- The right hepatic duct :**

It drains segments V, VI, VII and VIII and arises from the junction of two main sectoral ductal tributaries, the posterior or lateral duct and the anterior or medial duct each a satellite of its corresponding vein (**Last, 1996**).

The right posterior sectoral duct has an almost horizontal course and is constituted by the confluence of the ducts of segments VI and VII. The duct then runs to join the right anterior sectoral duct as it descends in a vertical manner (**Skandalkis et al., 2004**).

The right anterior sectoral duct is formed by the confluence of the ducts draining segment V and segment VIII. The junction of these two main right biliary channels usually takes place above the right branch of the portal vein (**Blumgart et al., 2003**).

The right hepatic duct is readily approached by dividing the peritoneum and fat overlying it in the portahepatis. The right hepatic artery runs inferior to it, while the right branch of the portal vein lies posterior to these two structures (**Last, 1996**).

## **(II) Extra-hepatic Biliary Anatomy :**

The extra-hepatic bile duct are presented by the extrahepatic segment of the right and left hepatic ducts joining to form the biliary confluence and main biliary channel draining into the duodenum. The accessory biliary apparatus, which constitutes a reservoir, comprises the gallbladder and cystic duct (**Last, 1996**).

The confluence of the right and the left ducts takes place at the right of the hilum of the liver anterior to the portal venous bifurcation and overlying the origin of the right branch