

Post Cholecystectomy Iatrogenic Biliary Injury

Thesis

*Submitted for the partial fulfillment of the M.Sc.
Degree in General Surgery*

By

Ahmed Aly Abdel Rahman
(M.B.,B.Ch.)
Faculty of Medicine
Cairo University

Supervised by

Prof. Dr. Ramadan Ahmed N. Morra
Professor of General Surgery
Faculty of Medicine
Cairo University

Prof. Dr. Ibrahim Kamel Eyada
Professor of General Surgery
Faculty of Medicine
Cairo University

Prof. Dr. Ali Ahmed Shafik
Assistant professor of General Surgery
Faculty of Medicine
Cairo University

Faculty of Medicine
Cairo University
2007

ABSTRACT

Bile duct injuries represent an important complication of cholecystectomy whether open or laparoscopic. The commonest cause of major bile duct injury is failure to identify correctly the anatomy of Calot's triangle as well as incomplete knowledge of the possible embryological anomalies.

Early diagnosis of patients with suspected biliary injury is important to get the best results of repair. Management of biliary injuries after cholecystectomy entails conservative measures, endoscopic treatment and surgical treatment. The ideal surgical treatment for biliary injuries is Roux-en-Y, choledocho or hepaticojejunostomy.

Key Words:

- Cholecystectomy.
- Biliary injury.
- Iatrogenic.

ACKNOWLEDGEMENT

Thanks to "ALLAH" who inspired me the will and effort to complete this work.

I wish to express my supreme gratitude and appreciation to **Prof. Dr. Ramadan Ahmed Nabawy Morra**, professor of general surgery, Cairo University who gave me a lot of his valuable time for support and guidance in preparation of this work and for whom no words of gratitude are sufficient.

I am indebted to **Prof. Dr. Ibrahim Kamel Eyada**, professor of general surgery, Cairo University for his unconditional support and sincere piloting.

I do honestly wish to extend my deepest appreciation and sincere gratitude to **Prof. Dr. Ali Ahmed Shafik**, assistant professor of general surgery, Cairo University who inspired me the spirit of research and granted me close supervision, precious aid and extreme help.

CONTENTS

	Page
Introduction	i
Aim of work	iv
Review of Literature	
Chapter (1): Embryology and Anatomy of Biliary Tract	
- Embryology	1
- Biliary Tract Anatomy	4
- Accessory Biliary Apparatus	18
- Calot's Triangle	22
- Embryological Anomalies	33
Chapter (2): Gallstone Disease	
- History	44
- Prevalence and Incidence	46
- Open Cholecystectomy	48
- Laparoscopic Cholecystectomy	72
Chapter (3): Biliary Injury	
- Incidence	109
- Aetiology and Pathogenesis	110
- Classification	119
- Presentation	124
- Management	126

	Page
Chapter (4): Patients and Methods	146
Chapter (5): Case Presentation	158
Chapter (6): Results	184
Chapter (7): Discussion	194
Summary	198
References	200
Bibliography	205

LIST OF FIGURES

	Page
Figure 1: Progressive stages in the development of the duodenum, liver, pancreas, and extra hepatic biliary apparatus (Moore & Persaud, 2003).	3
Figure 2: Overall arrangement of the intrahepatic and extrahepatic biliary tree (Standring et al, 2005).	5
Figure 3: Intrahepatic bile duct anatomy (Blumgart, 2007).	8
Figure 4: Sketch of the anatomy of the plate system. (Blumgart, 2007)	9
Figure 5: Extrahepatic bile duct anatomy (Blumgart, 2007).	10
Figure 6: Relationship between the posterior aspects of the quadrate lobe and the biliary confluence (Blumgart, 2007).	11
Figure 7: Schematic representation of the sphincter of Oddi (Blumgart, 2007).	14
Figure 8: Diagram of the human sphincter of Oddi (Blumgart, 2007)	17
Figure 9: Interior of the gallbladder (Standring et al, 2005).	20
Figure 10: The bile duct blood supply (Blumgart, 2007).	27
Figure 11: Lymphatic drainage of the liver and gallbladder (Blumgart, 2007).	28
Figure 12: Low power micrograph showing the gallbladder wall (Standring et al, 2005).	32
Figure 13: Main variations in gallbladder and cystic duct anatomy. (Blumgart, 2007)	35
Figure 14: Main variations of the hepatic duct confluence. (Blumgart, 2007)	37
Figure 15: The main variations of ectopic drainage of the intrahepatic ducts into the gallbladder and cystic duct. (Blumgart, 2007)	38
Figure 16: Classification of choledochal cysts. (Brunnicardi et al, 2005)	41
Figure 17: The main variations of the cystic artery (Blumgart, 2007)	43

	Page
Figure 18: Triangle of Cholecystectomy (Blumgart, 2007).	54
Figure 19: Exposure of the gallbladder during open cholecystectomy. (Fischer et al, 2007)	60
Figure 20: The cystic artery is ligated close to the gallbladder wall. (Blumgart, 2007)	62
Figure 21: Intraoperative cholangiography (Blumgart, 2007).	63
Figure 22: Anterograde or fundus down cholecystectomy. (Blumgart, 2007)	67
Figure 23: Blind placement of clamps for hemostasis. (Blumgart, 2007)	70
Figure 24: Hemorrhage should be controlled first by manual clamping (Blumgart, 2007).	71
Figure 25: Room setup for laparoscopic cholecystectomy “English/American setup” (Zollinger, 2003).	86
Figure 26: The French/European Room Setup (Zinner & Ashley, 2007).	86
Figure 27: Diagram of the abdomen and port positions. (Zinner & Ashley, 2007)	94
Figure 28: Proper gallbladder retraction for exposure of Calot's triangle (Blumgart, 2007).	98
Figure 29: Pedunculation of the gallbladder (Fischer et al, 2007).	99
Figure 30: Vulnerable area of CBD (Blumgart, 2007).	108
Figure 31: Junction of the cystic duct with the main extrahepatic biliary channel (Blumgart, 2007).	112
Figure 32: Proper exposure of Calot’s triangle (Blumgart, 2007).	117
Figure 33: Bismuth Classification of biliary strictures (Blumgart, 2007).	120
Figure 34: Strasberg Classification of biliary injuries (Blumgart, 2007).	121
Figure 35: Primary end-to-end repair of biliary tree on a T-tube (Zinner & Ashley, 2007).	138

LIST OF PHOTOS

	Page
Photo 1: ERCP showing CBD stricture in patient no.1	174
Photo 2: PTC showing strictured anastomosis & dilated IHBR in patient no.2	174
Photo 3: CT scan abdomen of patient no.3 showing huge biloma	175
Photo 4: ERCP showing CBD stricture in patient no.3	175
Photo 5: ERCP showing completely ligated CBD in patient no.4	176
Photo 6: CT scan abdomen showing dilated IHBR and aerobilia in patient no.4	176
Photo 7: ERCP showing CBD stricture in patient no.5	177
Photo 8: ERCP showing complete ligation of CBD in patient no.6	177
Photo 9: PTC showing markedly dilated IHBR indicating completely ligated CBD in patient no.6	178
Photo 10: ERCP showing CBD ligation and leakage in patient no.7	178
Photo 11: delineating the whole biliary tree but leakage still persisted in patient no.7	179
Photo 12: ERCP showing leakage from CBD in patient no.8	179
Photo 13: MRCP showing leakage from the CHD in patient no.8	180
Photo 14: ERCP showing leakage from cystic duct following laparoscopic cholecystectomy in patient no.9	180
Photo 15: ERCP after 5 days showing stoppage of leakage in patient no.9	181
Photo 16: T-tube cholangiography showing leakage from CBD in patient no.10	181
Photo 17: ERCP showing clipping of CBD in patient no.11	182
Photo 18: ERCP showing complete transection of CBD in patient no.12	182
Photo 19: Intra operative cholangiography in patient no.12	183

LIST OF TABLES

	Page
Table 1: Techniques of minilaparotomy cholecystectomy (Blumgart, 2007)	49
Table 2: Indications for laparoscopic cholecystectomy (Zinner & Ashley, 2007)	77
Table 3: Causes of Laparoscopic Biliary Injuries (Blumgart, 2007)	111
Table 4: Bismuth Classification of Biliary Strictures (Blumgart, 2007)	119
Table 5: Strasberg Classification of biliary injuries (Zinner & Ashley, 2007)	121
Table 6: Clinical data of included patients	149
Table 7: Summary of cases	173
Table 8: Main clinical presentation of patients	184
Table 9: Duration of time till presentation	185
Table 10: Results of ERCP studies	188
Table 11: Results of surgical repair	190
Table 12: Analysis of different methods of repair	191

Introduction

The management of the patients with gall stone diseases has been revolutionized during the last decade with the introduction and evolution of laparoscopic cholecystectomy (**Koran and Roslyn, 1997**). The laparoscopic technique for cholecystectomy was first performed by Philippe Mouret in Lyon, France, in 1987 and was developed and spread among general surgeons all over the world (**Dubois, 1991**).

Laparoscopic cholecystectomy, after rapidly substituting traditional cholecystectomy, represents the gold standard for surgical treatment of cholelithiasis (**Nuzzo et al, 2005**). Although the laparoscopic surgery has many advantages; it is still having many hazards. The majority of operative major complications of laparoscopic surgery result from puncture injuries following incorrect insertion of Veress needle or trocars (**Mintz, 1994**). Bleeding and bile duct injuries are common hazards of both open and laparoscopic cholecystectomy (**Alexander, 1996**). Injury of the biliary tree is reported in approximately 0.2% of patients undergoing open cholecystectomy (**Roslyn et al, 1993**). It is widely recognized that the incidence of bile duct injuries has increased with the spread of laparoscopic cholecystectomy raising the percentage to 0.5% to 2% in some studies (**Meyers et al, 1991**). Despite the

progress achieved, bile duct injuries represent an important complication, and have become more frequent than in the past (**Nuzzo et al, 2005**).

It may not always be possible to determine the precise nature of the bile duct injury but a number of possible mechanisms may be responsible, such as excessive traction on the gall bladder or the excessive use of the diathermy around the common bile duct area leading to bile duct necrosis or ischemic stricture (**Terblanche et al, 1990**). The commonest cause of major bile duct injury is failure to identify correctly the anatomy of Calot's triangle and the bile duct is mistaken for the cystic duct and is then divided (**Davidoff, 1996**).

Early diagnosis in patients with suspected bile duct injury is important because the clinical condition may rapidly deteriorate after three to five days when ileus, peritonitis, and sepsis develop. Several authors have, therefore, emphasized the importance of early aggressive investigations in patients with diffuse abdominal pain, fever, malaise or liver function abnormalities (**Rossi et al, 1992**). The diagnosis of postoperative biliary injury is first made or suspected on clinical basis, then a number of laboratory tests and imaging techniques are used to confirm and define precisely the nature of the injury. The gold standard for patients with bile duct injuries is cholangiography (ERCP, PTC and MRCP) (**Martin et al, 1994**).

The ideal surgical treatment for complete transection of the bile duct recognized intra operatively is primary end to end anastomosis with a T-tube (**Browder et al, 1987**). However, a Roux-en Y, choledocho- , or hepaticojejunostomy remains the procedure of choice for late discovered injuries (**Collins and Gorey, 1984**). Trials for primary suture repair was described by **Woods et al(1994)** with the additional postoperative endoscopic stenting while **Frattaroli et al (1996)** reported high success rate of bilioenteric anastomosis in mid level bile duct injuries. Retrospective studies comparing endoscopic and open treatment regimens suggested that both are equally successful (**Dauids et al, 1992**).

Aim of work

This study is conducted to review the problem of iatrogenic bile duct injury following open and laparoscopic cholecystectomy as regards the aetiology, type of injury, clinical presentation, investigations and different modalities of management of this condition.

Through this study, it is sought that a better understanding of the causes of this condition will be reached and the different methods of their prevention and repair will be identified.

Embryology

Development of Liver, Gallbladder, and Biliary Apparatus:

The liver, gallbladder, and biliary duct system arise as a ventral outgrowth from the caudal part of the foregut early in the fourth week (see Fig. 1A). Based on recent research findings, it has been suggested that both the hepatic diverticulum and the ventral bud of the pancreas develop from two cell populations in the embryonic endoderm. At sufficient levels, fibroblast growth factors (*FGFs*), secreted by the developing heart, interacts with the bipotential cells and induce formation of the hepatic diverticulum. The hepatic diverticulum extends into the septum transversum, a mass of splanchnic mesoderm between the developing heart and midgut. The septum transversum forms the ventral mesentery in this region.

The hepatic diverticulum enlarges rapidly and divides into two parts as it grows between the layers of the ventral mesentery (Fig. 1A). The larger cranial part of the hepatic diverticulum is the primordium of the liver. The proliferating endodermal cells give rise to interlacing cords of hepatic cells and to the epithelial lining of the intrahepatic part of the biliary apparatus. The hepatic cords anastomose around endothelium lined spaces, the primordia of the *hepatic sinusoids*. The fibrous and *hematopoietic tissue* and *Kupffer cells* of the liver are

derived from mesenchyme in the septum transversum.

The liver grows rapidly and from the fifth to tenth weeks, fills a large part of the upper abdominal cavity. The quantity of oxygenated blood flowing from the umbilical vein into the liver determines the development and functional segmentation of the liver. Initially, the right and left lobes are about the same size, but the right lobe soon becomes larger. *Hematopoiesis begins during the sixth week*, giving the liver a bright reddish appearance. By the ninth week, the liver accounts for about 10% of the total weight of the fetus. *Bile formation* by the hepatic cells begins during the twelfth week.

The small caudal part of the hepatic diverticulum becomes the gallbladder, and the stalk of the diverticulum forms the cystic duct (see Fig. 1C). Initially, the extrahepatic biliary apparatus is occluded with epithelial cells, but it is later canalized because of vacuolation resulting from degeneration of these cells. The stalk connecting the hepatic and cystic ducts to the duodenum becomes the bile duct. Initially, this duct attaches to the ventral aspect of the duodenal loop; however, as the duodenum grows and rotates, the entrance of the bile duct is carried to the dorsal aspect of the duodenum (see Fig. 1C and D). The bile entering the duodenum through the bile duct after the thirteenth week gives the meconium (intestinal contents) a dark green color (Moore & Persaud, 2003).