

# **RECENT TRENDS IN THE MANAGEMENT OF IATROGENIC BILIARY INJURIES DURING LAPAROSCOPIC CHOLECYSTECTOMY**

Essay

Submitted for Partial Fulfillment of  
Master Degree in **General Surgery**

By

**Mohammed Salah Hassan**

M.B.B.ch

Supervised By

**Prof. Dr. Mohammed Emad Saleh**

Professor of General Surgery  
Faculty of Medicine  
Ain Shams University

**Dr. Ali Mohammed Ali Al Anwar**

Assistant Professor of General Surgery  
Faculty of Medicine  
Ain Shams University

**Dr. Mohammed Abdel Monem**

Lecturer of General Surgery  
Faculty of Medicine  
Ain Shams University

Faculty of Medicine  
Ain Shams University

2011

الإتجاهات الحديثة فى  
تشخيص وعلاج إصابات القناة  
المرارية أثناء إستئصال المرارة  
بالمنظار

رسالة

توطئة للحصول على درجة الماجستير  
فى الجراحة العامة

مقدمة من

طبيب/ محمد صلاح حسن  
بكالوريوس الطب والجراحة

تحت إشراف

الأستاذ الدكتور/ محمد عماد صالح

أستاذ الجراحة العامة  
كلية الطب-جامعة عين شمس

الدكتور/ على محمد على الأنور

أستاذ مساعد الجراحة العامة  
كلية الطب-جامعة عين شمس

الدكتور/ محمد عبد المنعم مرزوق

مدرس الجراحة العامة  
كلية الطب-جامعة عين شمس

## SUMMARY

Cholecystectomy is the most frequently performed operation in abdominal surgery. Laparoscopic cholecystectomy replacing open cholecystectomy is now performed in more than 80% of surgically treated patients for symptomatic gall stones.

Bile duct injuries during laparoscopic cholecystectomy are a serious problem that is better being prevented than treated.

Strasberg et al., 2002: have classified laparoscopic bile duct injury into 5 types:

*Type A:* Bile leakage from minor ducts.

*Type B:* Occlusion of aberrant right duct

*Type C:* Transaction of aberrant right hepatic duct.

*Type D:* Lateral injury to major bile ducts.

*Type E:* Circumferential injury to major bile ducts.

The mechanisms involved in bile duct injuries during laparoscopic cholecystectomy identify the basic error groups:

A) Misinterpretation of the anatomy.

B) Technical errors.

Except for type D and type E injuries, intraoperative identification is uncommon. Even in

كلية الطب  
جامعة عين شمس  
٢٠١١



Thanks to **ALLAH** the most merciful for guiding me through and giving me the strength to complete this work the way it is.

It is a pleasure to express my deepest thanks and profound respect to my honored professor, **Doctor / Mohammed Emad Saleh**, Professor of General surgery, Faculty of medicine, Ain Shams University, for his continuous encouragement and valuable supervision and guidance throughout this work. It has been an honour and a privilege to work under his generous supervision.

Also, I wish to express my deep gratitude to **Doctor /Ali Mohammed Ali Alanwar**, Assistant Professor of General Surgery, Faculty of medicine, Ain Shams University, for his valuable suggestions, excellent support and unlimited help during this work.

I would like also to express my sincere thanks and gratitude to **Dr/ Mohamed Abd El Monem**, Lecturer of General Surgery, Ain Shams University, for his great help and his continuous guidance, correction and explanation which helped me to finish this work. I wish to be able to return a part of what he offered to me.

Mohamed Salah Hassan

# LIST OF CONTENTS

| Title   | Page No. |
|---|----------|
| Introduction.....   | 1        |
| Aim Of The Work .....   | 4        |
| Review of Literature  |          |
| • Anatomy of The Biliary System.....  | 5        |
| • Pathology of Biliary Injury.....  | 32       |
| • Diagnosis of Bile Duct Injuries .....   | 48       |
| • Prevention of Bile Duct Injury (BDI)<br>During Laparoscopic Cholecystectomy ..... | 60       |
| • Management Of Bile Duct Injuries .....  | 72       |
| Summary .....   | 112      |
| References .....  | 116      |
| Arabic Summary .....  | —        |

## LIST OF TABLES

| Tab. No.    | Title   | Page No. |
|-------------|---|----------|
| Table (1):  | Bismuth's classification (1982): .....  | 34       |
| Table (2):  | Proposed definition of major and<br>minor bile duct injuries.....                 | 35       |
| Table (3):  | Strasberg's classification (1995) .....   | 35       |
| Table (4):  | Amsterdam Academic Medical Center<br>classification (1996) .....                  | 37       |
| Table (5):  | Neuhaus' classification (2000).....   | 37       |
| Table (6):  | Csendes' classification (2001) .....  | 38       |
| Table (7):  | Stewart-Way's classification of<br>laparoscopic bile duct injuries (2004) .....   | 39       |
| Table (8):  | Lau and Lai classification.....   | 40       |
| Table (9):  | Lau and Lai classification mechanisms<br>of injury, prevention and treatment..... | 41       |
| Table (10): | Prevention of BDI.....  | 64       |
| Table (11): | Tenets of a successful surgical repair.....                                       | 73       |

# LIST OF FIGURES

| Fig. No.     | Title  | Page No.                     |
|--------------|--|------------------------------|
| Figure (1):  | Typical pattern of intrahepatic biliary branching.....   | 6                            |
| Figure (2):  | Hepatic segmentation .....   | 7                            |
| Figure (3):  | The anatomy of the extrahepatic biliary system.....  | 9                            |
| Figure (4):  | Configuration of the lower end of the common bile duct and the pancreatic duct .....                                       | 13                           |
| Figure (5):  | Dissection of Calot's triangle allows exposure of the cystic artery and cystic duct junction with the main bile duct ..... | 14                           |
| Figure (6):  | Rouviere's sulcus.....   | 16                           |
| Figure (7):  | Anatomy of the GB, cystic duct and CBD .....   | 19                           |
| Figure (8):  | The main variation in gall bladder and cystic duct anatomy: .....  | 22                           |
| Figure (9):  | The main variations of the cystic artery   | Error! Bookmark not defined. |
| Figure (10): | Strasberg classification of biliary injuries following laparoscopic cholecystectomy .....                                  | 36                           |
| Figure (11): | Stewart-Way's classification of laparoscopic bile duct injuries .....  | 40                           |
| Figure (12): | Ultrasound and CT scan of a patient with extensive fluid collection after laparoscopic cholecystectomy (biloma).....       | 55                           |
| Figure (13): | Operative cholangiogram demonstrating narrowing of the common bile duct.....   | 57                           |
| Figure (14): | 41-year-old woman with Bismuth type III injury 8 days after laparoscopic cholecystectomy.....                              | 59                           |
| Figure (15): | 63-year-old man with Bismuth type IV injury 10 days after laparoscopic cholecystectomy.....                                | 59                           |
| Figure (16): | The cystic duct emerges in acute angle from the CBD .....  | 70                           |



## LIST OF FIGURES (Cont...)

| Fig. No.     | Title   | Page No. |
|--------------|---|----------|
| Figure (17): | The cystic duct is brought to a right angle with the CBD by lateral retraction of the infundibulum.....   | 71       |
| Figure (18): | Operative picture depicts the correct retraction of the infundibulum stretching the cystic duct. Note the cystic artery parallel to the cystic duct.....    | 71       |
| Figure (19): | End to end anastomosis over a T-tube .....  | 80       |
| Figure (20): | Method of repair of lateral biliary ductal injury.....  | 81       |
| Figure (21): | Construction of an end-to-end biliary enteric anastomosis in a very dilated biliary system. ....  | 89       |
| Figure (22): | The distal end of the duct is doubly ligated and the proximal part is trimmed to achieve maximum diameter, good blood supply and viable duct tissue.....    | 91       |
| Figure (23): | Anastomosis to a small bile duct .....  | 94       |
| Figure (24): | The approximation of separated right and left hepatic duct at the hilus before hepaticojejunostomy. Several ducts may be so approximated as necessary ..... | 95       |
| Figure (25): | Roux en Y choledocho-Jejunostomy .....  | 96       |
| Figure (26): | Construction of end-to-side choledochojejunostomy. ....   | 96       |
| Figure (27): | Cholangiograms of a 45-year-old patient with a peripheral leakage.....  | 105      |
| Figure (28): | Cholangiograms of a 47-year-old patient with central leakage.....   | 106      |
| Figure (29): | Cholangiograms of a 57-year-old patient with a biliary stricture.....   | 106      |

## LIST OF ABBREVIATIONS

| Abbrev.   | Full term   |
|-----------|---|
| AC        | : Acute cholecystitis                               |
| BDI       | : Bile duct injury                                  |
| BPP       | : Biliary percutaneous procedure                    |
| CBD       | : Common bile duct                                  |
| CD        | : Cystic duct                                       |
| CHD       | : Common hepatic duct                               |
| CT        | : Computerized tomography                           |
| ES        | : Endoscopic sphincterotomy                         |
| ERCP      | : Endoscopic retrograde cholangio-pancreaticography |
| GB        | : Gallbladder                                       |
| HJ        | : Hepatico-jejunostomy                              |
| HP        | : Hartmann pouch                                    |
| IBDs      | : Intra-hepatic biliary ducts                       |
| IOC       | : Intra-operative cholangiography                   |
| LC        | : Laparoscopic cholecystectomy                      |
| LHD       | : Left hepatic duct                                 |
| MRCP      | : Magnetic resonance cholangio-pancreaticography    |
| MRI       | : Magnetic resonance imaging                        |
| PTC       | : Percutaneous trans-hepatic cholangiography        |
| RHA       | : Right hepatic artery                              |
| RHD       | : Right hepatic duct                                |
| RPSD      | : Right posterior sectorial duct                    |
| RASD      | : Right anterior sectorial duct                     |
| HIDA scan | : Hepatobiliary IminoDiacetic Acid Scan             |

## INTRODUCTION

**C**holecystectomy is a surgical procedure in which the gall bladder is removed. This procedure is performed in cases when patients suffer from chronic gallstones which cannot be resolved, or severe gallbladder inflammation which does not clear or which threatens other organs and Gallbladder carcinoma (*Simon, 2007*).

Laparoscopic cholecystectomy is considered the gold standard surgical intervention for the treatment of symptomatic gallstones (*Zehetner, 2007*).

Laparoscopic cholecystectomy has now replaced open cholecystectomy as the first-choice of treatment for gallstones and inflammation of the gallbladder unless there are contraindications to the laparoscopic approach (*Kapoor, 2007*).

The laparoscopy became the main surgical technique for cholecystectomy with a rate of laparoscopic performances of about 99% for some teams. The development of recent innovative and experimental surgical techniques (N.O.T.E.S.) reduces the abdominal wall trauma and complications by using ports and removal of the gall bladder or any other abdominal organs (*Baron, 2007*).

Laparoscopic cholecystectomy has many advantages but still it has many hazards, the complications include intra operative and post operative complications. The majority of intra operative complications of laparoscopic surgery result from puncture injuries following insertion of Veress needles or trocars (*Mintz, 1999*).

Serious complications that occur with laparoscopic cholecystectomy, including bile duct injury and bile leak, result from patient selection, surgical inexperience, and the technical constraints that are inherent to the minimally invasive approach. (*Khan, 2007*).

Biliary leakages and bile duct strictures are the most severe complications after cholecystectomy. Biliary leakages are an early complication, whereas biliary strictures are considered a late complication. The rate of clinically-relevant bile leaks after conventional open cholecystectomy ranges from 0.1% to 0.5% (*Gouma and Go, 1994*).

A number of mechanisms causing biliary injury are postulated including an undue dissection in a distorted Calot's triangle, use of diathermy close to bile ducts, local pathology such as acute and chronic inflammation with fibrosed gallbladder, excessive traction on gallbladder (*Bhattacharjee, 2005*).

Many authors proposed investigations like intra-operative cholangiography and magnetic resonance cholangiogram to reduce the rate of such injuries (*Slater et al., 2002*).

The incidence of CBD injury is strongly related to experience and a decrease in CBD injury has been reported (*Nair et al., 1997*).

ERCP is shown to be highly effective in both diagnosis and treatment of biliary complication after laparoscopic cholecystectomy. The rate of the therapeutic effect about 84% but the morbidity rate is less than 4% (*Kianika et al., 2007*). As it is important in drainage in case of biliary leakage, removal of retained common bile duct stone and insertion of stent in biliary stricture (*Quinn et al., 1992*).

MRCP is the imaging modality of choice for the work-up of suspected BDI as it outlines both the intra and extra-hepatic biliary tree, and thus can provide a better map of the biliary anatomy for planning the reconstructive surgery than ERCP (*Khalid et al., 2001*).

In the majority of major BDIs, a Roux-en-Y hepaticojejunostomy (HJ) is the preferred method of repair (*Connor, 2006*).

## **AIM OF THE WORK**

**T**he aim of this work is to clarify the problem of bile duct injuries during laparoscopic cholecystectomy and to increase awareness about the aetiology, clinical presentation, the most recent investigations and different methods of management.

## **ANATOMY OF THE BILIARY SYSTEM**

### **Normal anatomy of the biliary system**

**T**he biliary system consists of the intra-hepatic and extra-hepatic biliary tracts. The ducts located in the hepatic parenchyma, those proximal to the right hepatic "RHD" and the left hepatic "LHD" ducts, represent the intra-hepatic system. (*Reau & Jensen, 2008*).

### **Intra-Hepatic Biliary Tract**

There are more than 2 kms of bile ductules and ducts in the adult human liver. The intra-hepatic system is further divided by size into small and large ducts. Intra-hepatic large bile ducts roughly correspond to ducts from the first to the fourth branches of the right and left hepatic ducts. Intra-hepatic small bile ducts are further classified as septal bile ducts, interlobular bile ducts, or bile ductules according to their size and location (*Cha et al., 2007*).