

# Iatrogenic Bile Duct Injury Following Cholecystectomy, Surgical Management and Outcome: A Single Center Experience

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## Abstract

**Background and objectives:** Iatrogenic bile duct injury (IBDI) is a serious complication during cholecystectomy caused by a surgeon in apparently healthy patients and is associated with a significant rate of morbidity and a low rate of mortality. Our aim was to review the surgical repair of IBDI and post-operative outcome regarding morbidity and mortality. **Methods:** We retrospectively analyzed the surgical management and outcome of biliary injuries during cholecystectomy in 52 patients diagnosed intraoperatively during cholecystectomy or referred post operatively to Sulaymaniyah digestive and liver surgery center between May 2014 and May 2017. **Results:** During these three years; we managed 52 patients of which 41 patients (78.8%) was females. Forty-seven bile duct injuries happened during laparoscopic cholecystectomy and in 5 patients during open type surgery. Eight patients diagnosed intraoperatively the remaining 44 were diagnosed post-operatively. The most common type of injury was Strasbourg type E2 (33 patients, 63.5%). The mean age of patients was 32 years in females and 36 years in males. Roux-en- Y hepaticojejunostomy was the surgical treatment in 47 patients (90.4%). Post-operative morbidity within three years was 34.6% and mortality was 3.8%. Patient followed for one month on their regular visit to our center or private clinic post operatively then followed by their irregular visits once they had complains within the period of our study. **Conclusions:** Hepaticojejunostomy was the best surgical procedure for repair of IBDI with less post-operative morbidity and mortality in our study, IBDI type E4 according to Strasberg classification associated with more morbidity and mortality than other types.

**Keywords:** .Paroscopic; Open Cholecystectomy; Bile duct injury; Complications

## Introduction

Cholecystectomy is one of the most common surgical procedures in the world, especially laparoscopic type<sup>1</sup>. Although the incidence of iatrogenic bile duct injury (IBDI) is decreasing due to improvement in the learning curve and standardization of the procedure, it remains one of major issues that are facing us as surgeons<sup>1</sup>. The incidence of IBDI according to the literature varies from 0.2- 0.3% in open type surgery and 0.4-0.7 in laparoscopic cholecystectomy (LC)<sup>2,3</sup>. The incidence of recognition of IBDI intraoperatively is approximately 17-20%<sup>4</sup>. There are many risk factors for IBDI which includes factors related to patient's biliary anatomy like abnormal anatomy, surgeons' experience, an error of visual perception, whether it was performed as emergency or elective surgery, adhesions, poor visibility of surgical field and many others factors<sup>5-7</sup>. Diagnosis of IBDI as early as possible accurately is the best way to have a good result after management and to avoid devastated complications like biliary stricture, biliary cirrhosis, liver failure and or death<sup>8,9</sup>. Surgery was previously the only and preferred modality of treatment of IBDI but now Endoscopic and radiological intervention have been introduced as less invasive way for treating those patients if possible according to type of injury with less morbidity to the patients<sup>10,11</sup>. The best result of management of IBDI was observed when it had been done in specialized hepato-biliary center with multidisciplinary team with more experience in dealing with complex biliary injuries<sup>12,13</sup>. The

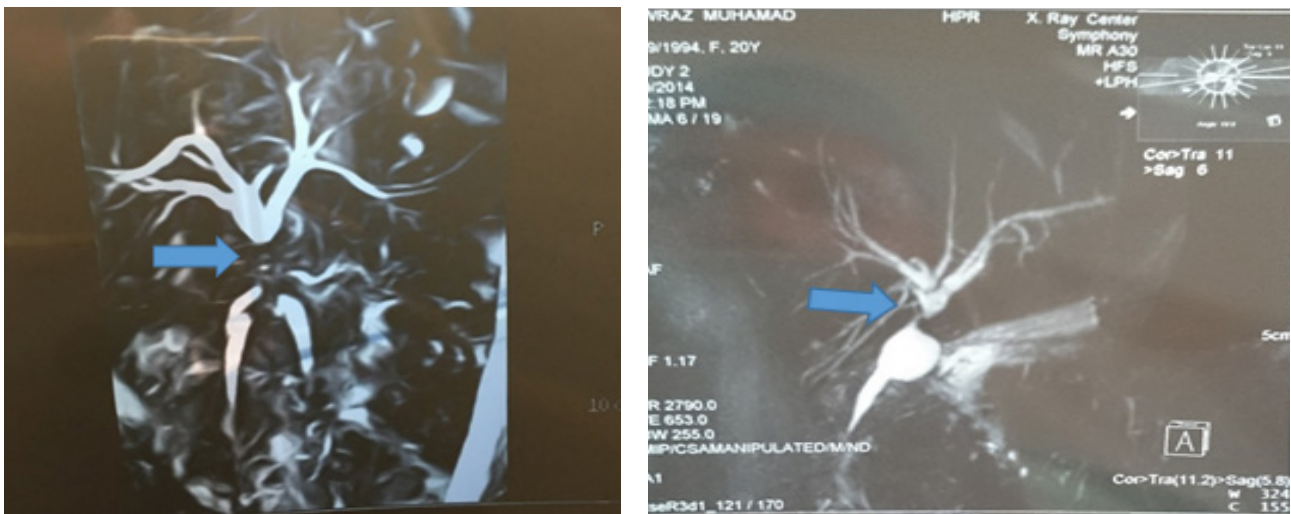
aim of our study was to review the surgical management of IBDI according to pattern of injury done by our surgical team of Sulaymaniyah digestive and liver surgery center.

## Patients and Methods

This is a retrospective descriptive analytical study of 52 patients who had IBDI after open or LC. They were treated by our surgical team whether it was done in other hospital after intraoperative diagnosis of IBDI or referred post operatively to our digestive surgery unit in Sulaymaniyah Governorate-Kurdistan –Iraq over a period of three years from May 2014 to May 2017. We had patients referred from Duhok, Erbil, Kirkuk and Sulaymaniyah Governorates. Data were collected regarding patient's age, gender, type of injury (according to Strasberg classification<sup>14</sup>) time between injury till referral, investigations, surgical management, and the outcome. All patients with bile duct injury who had been treated surgically were included. We excluded patients who had been treated conservatively. All repair procedures were performed by our surgical team either when the injury diagnosed intraoperatively or post-cholecystectomy. In patients who diagnosed post operatively; clinical assessment, biochemical and imaging study (abdominal ultrasound, magnetic resonance cholangio-pancreatography (MRCP), as seen in Figures 1.

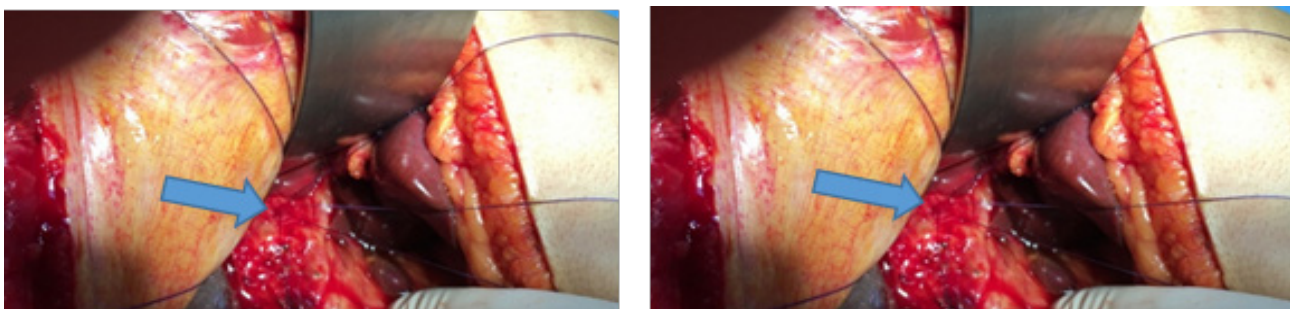
Endoscopic retrograde cholangiopancreatography (ERCP) in selected patient) done before the surgical repair. Surgery

began with careful assessment of the surgical field and visualization of injured bile ducts which was not easy to be visualized according to extent of injury. After detection of the site of injury; the injury was classified according to Strasberg bile duct injury classification, appropriate intraoperative decisions were taken. The following surgical procedures were done in our study: Direct repair of IBDI over T tube, Choledocho-duodenostomy and Bilo-enteric anastomosis depending of type and extent of bile duct injury.



**Figure (1):** MRCP of two different patients shows common hepatic duct injury.

Roux en y portoenterostomy was done in patients where anastomosis to proximal viable bile duct was not possible. Hepaticojejunostomy (HJ) was done when the injury was above cystic duct confluence with the common hepatic duct using jejunal Roux loop as seen in Figures 2.



**Figure (2):** Operative photograph shows complete cut of common hepatic duct prepared for hepaticojejunostomy of two different patients

End to side Roux en y HJ or choledochojejunostomy using roux jejunal loop. Internal biliary stent at side of biliary anastomosis used in most of patient especially when the duct diameter was small. The statistical analysis mean and median) and tables were done by Microsoft office Excel 2016. Ethics committee approval was obtained from Kurdish Board for Medical Specialty to conduct this study. Follow up of patients was during the period of admission in the hospital then for one month during their regular visit post operatively to our center or private clinic, then information obtained from patient during their irregular visit for checkup if they had any complain within three years of our study.

## Results

In our study total number of the patients was 52. Forty-one females (78.8%) and 11 males (21.2%) with their ages ranging from 8 years to 65 years, mean

age of patients was 32 years in female and 36 years in males. IBDI during LC was 47(90.4%) patients and open cholecystectomy done in 5(9.6%) patients. Intraoperative IBDI was diagnosed in 8(15.4%) patients. In all other patients the diagnosis was established within two weeks after surgery. The presentation of patients diagnosed with IBDI postoperatively was in form of jaundice in 26 (50%), biliary peritonitis in 10 (19.2%) and biliary leakage through a drain or a wound in 8 (15.4%). We could not calculate the incidence of post. Cholecystectomy bile duct injury in our study because we had referral post-operative patient from other governorates as mention previously.

Based on Strasberg classification, there was no patient with type A injury, type B found in one patient (1.9%), type C in 3 (5.8%) patients, type D in one patient (1.9%), type E1 in 2 patients (3.8%), E2 in 33 patients (63.5%), E3 in 8 patients (15.4%) and E4 in 4 patients (7.7%), Table 1.

**Table (1):** Types of bile duct injury according to Strasberg classification with type of surgical repair

Type of injury	No.	%	Type of surgical repair
A	0		
B	1	1.9	Roux en y HJ
C	3	5.8	Roux en y HJ
D	1	1.9	Direct repair over T tube
E1	2	3.8	Roux en y choledochoduodenostomy
E2	33	63.5	Roux en y HJ
E3	8	15.4	Roux en y HJ
E4	4	7.7	2 Roux en y portoenterostomy and 2 Roux en y HJ
E5	0	0	
Total	52	100	

Concomitant right hepatic artery injury was found in 5 patients (9.6%). Operative repair was done during same anesthesia session in 8 patients (15.4%). Most of bile duct reconstruction procedures were performed by anastomosis of the common hepatic duct to a loop of small bowel through Roux-Y loop in 47 patients (90.4%), Roux- en- Y portoenterostomy were done in 2(3.85%) patients both of them bile duct injury were Strasberg type E4, Choledocho-duodenostomy in 2 patients (3.85%) both of the IBDI were Strasberg type E1 and direct repair over T tube were done in one patient (1.9%) with bile duct injury was Strasberg type D. the rest of injuries were repair by HJ, Table 2. Total hospitalization days ranged from 7 days to 26 days with median was 13 days.

**Table (2):** Types of surgical repair of IBDI

Type of surgical repair	No	%
Roux en Y HJ	47	90.4
Roux en Y Portoenterostomy	2	3.85
Choledocho-duodenostomy	2	3.85
Direct repair over T tube	1	1.9
Total	52	100

Morbidity in our study was 34.6% (18patients) in a form of re-operation in 5 patients (9.6%) due to biliary collections, bleeding and strictures; wound infection in 5 patients (9.6%); biloma aspirated under radiological guidance in 4 patients (7.7%); localized abscess in 3 patients (5.8%) and secondary biliary cirrhosis in one patient (1.9%) which is caused by complex bile duct injury with concomitant right hepatic artery injury , the patient developed biliary cirrhosis two years after her operation . In HJ the morbidity was 29.7% (14 out of 47) redo surgery done in 4 patients (one due to bleeding nearby the anastomosis, two patients due to stricture of the HJ anastomosis and one for abdominal lavage due to pus collection). Four patients developed biloma, three patients developed abscess collection and 3 patients developed wound infection. In portoenterostomy morbidity was100% (one patient developed biliary leakage with redo surgery and the other one developed secondary biliary cirrhosis). In choledocho-duodenostomy, it was 50% because one patient developed wound infec-

tion. In direct duct to duct repair it was 100% because the patient developed wound infection. If we compare the morbidity with each type of bile duct injury according to Strasberg classification, it is found that in type B, one out of one (100%) developed wound infection, in type C, one out of 3(33.3%) developed biloma, in type D one out of one (100%) developed wound infection, in type E1, one out of 3 developed wound infection, in type E2, eight out of 33(24.2%) developed post-operative complications in the form of redo surgery in 3 patients biloma in 2 patients abscess collection in two patients and wound infection in one patient. In type E3, three out of 8(37.5%) with one patient developed abscess other one redo surgery done and the last one developed wound infection, in type E4, it was 3 out of 4(75%) with one patient developed secondary biliary cirrhosis one developed biloma and the last one redo surgery done for him. Mortality rate in our study was 3.8% 2 patients in both of them bile duct injury was Strasberg type 4 and the cause of death was sepsis and subsequent multiorgan failure, Table 3.

**Table (3):** Morbidity and Mortality Discussion.

Type of morbidity	No	%
Redo surgery	5	9.6
Wound infection	5	9.6
Biloma	4	7.7
Abscess	3	5.8
Secondary biliary cirrhosis	1	1.9
<b>Total</b>	18	34.6
<b>Mortality</b>	2	3.8

### Discussion

Iatrogenic bile duct injury is a major and serious issue in surgical practice everywhere since it has a major consequence if not dealt with in a proper way<sup>12</sup>. There is deficient data regarding the incidence of IBDI in our country because of improper case documentation. There are numerous factors that may be attributed to IBDI which includes variation in patients' biliary anatomy, poor visualization, local adhesion or hemorrhage, porta hepatis loaded with fat, poor surgical experience or visual perception error and many other factors<sup>5-7</sup>. IBDI usually involve thermal injury, bile duct laceration, division, occlusion, or resection of the bile duct<sup>15</sup>. In our study; 91.4% of IBDI occurred after LC while 9.6% occurred after open cholecystectomy, this is because in our locality most of cholecystectomies performed by laparoscopy. The average time between diagnosis and referral ranged from 1 to 23 days with a mean of 7 days which appear to be less than in many other studies which ranged from 12 to 21 days<sup>16-19</sup>. Early recognition of IBDI and referral to specialized center is associated with best post-operative results as the delay in referral is associated with more inflammation making definitive surgery so difficult to conduct<sup>1</sup>. In our study, the median age of patients was 34 years which is less than a study done by Mohammed and Masaad<sup>12</sup> (41 years) and Aziz A et al<sup>20</sup> (45.4 years).



There was a female predominance, which represents the most common population presenting with symptomatic cholelithiasis. The percentage of females were higher than males (78.85% versus 12.15%); these are similar to the results by Amr M. Aziz et al and by most other literatures<sup>14,20,21</sup>. There was high incidence of Strasberg E2 types of injuries. If we compare these results with other studies it shows that most of IBDI was of Strasberg E type but with difference percentages. In our study; it was mostly Strasberg E2 (63.5%); in Mohammed and Masaad<sup>12</sup> and Hajjar et al<sup>22</sup> studies, Strasberg E2 was also most common type of IBDI but with significant lower percentage (37.5%, 25.6% respectively). Comparing with Slater et al<sup>23</sup> and Aziz A et al<sup>20</sup> papers which showed higher Strasberg (E1) IBDI type (34.4%, 19% respectively) than other types of injuries. Regarding management of IBDI; when the continuity of bile duct is still present, it can be treated by endoscopic and/or percutaneous stent with good results. However, when this continuity is lost, it definitely needs surgical treatment<sup>24</sup>. A Roux-en-Y HJ had been the treatment of choice with the best results in experienced hands<sup>24,25</sup>. If there is no tissue lost; direct duct to duct anastomosis is possible but with success rate of approximately 50%<sup>26</sup>. Roux-en-Y HJ is preferable than choledocho-duodenostomy because of the risk of recurrent cholangitis and if leakage occurs; it will lead to duodenal fistula following surgery<sup>27,28</sup>. Roux-en-Y HJ was the most common type of operation 90.4%. Our results were close to the results of Mohammed AM et al<sup>12</sup> and Sicklick et al<sup>16</sup> which was 87.5% and 86% respectively. It is the most appropriate repair for type (E) IBDI because wide anastomosis can be done, more proximal anastomosis avoiding distal query bile duct regarding viability with subsequent leakage and stricture in the future which reflect our good result because we follow this strategy. Compared with Ibnouf et al<sup>13</sup>; only 50% underwent Roux en Y HJ, because of lack of MCRP as first diagnostic modality and substituted by ERCP and trial for stenting was done even if the injury was complete injury, stent was inserted even in completely transected bile duct. In our study, concomitant right hepatic artery injury was 9.6% whereas other authors reported incidence between 12% and 32%, the importance of concomitant vascular and bile duct injury is that those patients are at higher risk of recurrent bile strictures<sup>29-32</sup>. No attempt was done for vascular repair in those patients in our series. The complication rate in our cases was 34.6%, It is more than that in Salama A et al series<sup>21</sup> which was 11% but it was less than in Mohammed AM et al<sup>12</sup> and Sicklick et al<sup>16</sup> 40.1% and 42.9% respectively. Redo operation were done in 5 patients; two of them for anastomotic site stricture which was associated with concomitant right hepatic artery injury, two for lavage due to biliary collections and one for bleeding near the anastomotic site. If we compare each surgical procedure with the post-operative morbidity, HJ was the operation of choice with good post-operative outcome and less morbidity 14 out of 47(29.7%) while it was 100% in portoenterostomy patients, 50% in choledocho-duodenostomy patients, and 100% in direct duct to duct repaired patient.

The mortality rate in our study was 3.8%, it was similar to Salama A et al<sup>21</sup> 4% but it was higher than Siclick et al<sup>16</sup>

(1.7%) and significantly less than Mohammed AM et al<sup>12</sup> 12.5%. Two of our patients died due to sepsis caused by late presentation (10-14) days post IBDI and their injury was Strasberg E4 with hepatic artery injury in both of them. Total hospitalization days in our study ranged from 7 days to 26 days with median of 13 days which is less than in Mohammed AM et al<sup>12</sup> 18 days and Ibnouf et al<sup>13</sup> 16 days.

## Conclusions

The best surgical treatment with less post-operative morbidity and mortality was HJ in our study as compare with other surgical procedures. Iatrogenic bile duct injury type E4 according to Strasberg classification associated with more morbidity and mortality than other types.

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