

# Experience of Sultan Qaboos University Hospital, Oman, in the Management of Common Bile Duct Injuries

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## ***Abstract***

Iatrogenic bile duct injuries (IBDI) are not so common but are one of the important surgical problems to deal with in gastrointestinal surgeries. Common Bile Duct injuries is one of the most devastating complications of both open and laparoscopic cholecystectomy. Laparoscopic cholecystectomy carries two to three times more risk associated with bile duct injury as compared to open cholecystectomy. Management of these injuries needs multidisciplinary approach and an experienced center to deal with the injuries so as to provide better outcome in these patients. We share our experience of management of Bile Duct injuries at Sultan Qaboos University Hospital, Oman, referred to our center from outside institution.

## **Introduction**

The majority of bile duct injuries (BDI) are iatrogenic and occur during abdominal surgeries or other endoscopic interventions. Laparoscopic cholecystectomy (LC) was first performed in 1985.<sup>1</sup> Nowadays, LC is considered the gold standard surgical approach in the management of the different gallbladder diseases.<sup>2</sup> Although LC has advantages of faster recovery and better cosmetic outcomes compared to open cholecystectomy (OC), it carries higher risk of iatrogenic injury to the common bile duct (CBD) and the right hepatic artery.<sup>2</sup> The rate of iatrogenic injuries was found to be around 3% in LC compared to 0.5-1% in the open cholecystectomy (OC).<sup>3,4</sup> These injuries can be due to difficult anatomy of Callot's triangle, inadvertent use of cautery, failure to elicit proper anatomy at Callot's triangle and bleeding. The injuries can range from simple cystic stump leak to a complete transection of the common bile duct and hepatic artery. These injuries are associated with high morbidity and mortality. There are different classification systems used to classify CBD injuries, the most commonly used are Strasberg and ATOMs classification systems.<sup>5</sup> Clinically, the CBD injuries are classified into minor and major damage. Minor injuries include superficial thermal injury or partial cut which can be repaired simply by a suture, leaving a drain in the abdomen or by a CBD stent placement. On the other hand, Major injuries like completed occlusion or transection of the CBD require a major reconstructive surgery.<sup>6</sup> Dahl performed Roux-en-Y hepaticojejunostomy for surgical treatment of bile duct injury.<sup>5</sup>

In SQUH, which is a tertiary care hospital, Laparoscopic cholecystectomy is a routine surgery to be performed both electively and in emergency for gall stones. Since 2014 till now, around 1200 cases of laparoscopic cholecystectomy done by hepatobiliary team and there is no CBD injury reported yet. However, we have managed 5 patients with CBD injuries referred from secondary care hospitals or private hospitals. Three of these patients were critically sick and required major reconstructive surgery, the other 2 patients were managed with CBD stent placement. In this article, we aim to present our hospital experience in the management of the major CBD injuries.

## Case Reports

### Case one

An otherwise healthy 35 years old female patient, underwent laparoscopic cholecystectomy for symptomatic gallstones at a private hospital. Intra-operatively, the cystic artery clip slipped and the bleeding could not be managed laparoscopically, thus the surgery was converted to open and the surgeon fired a clip to control the bleeding and left a drain in the gallbladder bed which was removed later on. The patient was discharged home but returned within 2 days with right upper quadrant abdominal pain and bloody output from the drain site. For that, a new drain was re-inserted and she was referred to our hospital on the 6th day postoperatively for further management. Upon arrival, to our hospital, the patient was dehydrated, jaundiced, tachycardiac and her temperature was 38-degree Celsius. She had tenderness at the abdominal wound site. Initial laboratory investigations showed high inflammatory markers, low hemoglobin and deranged liver function tests [table 1]

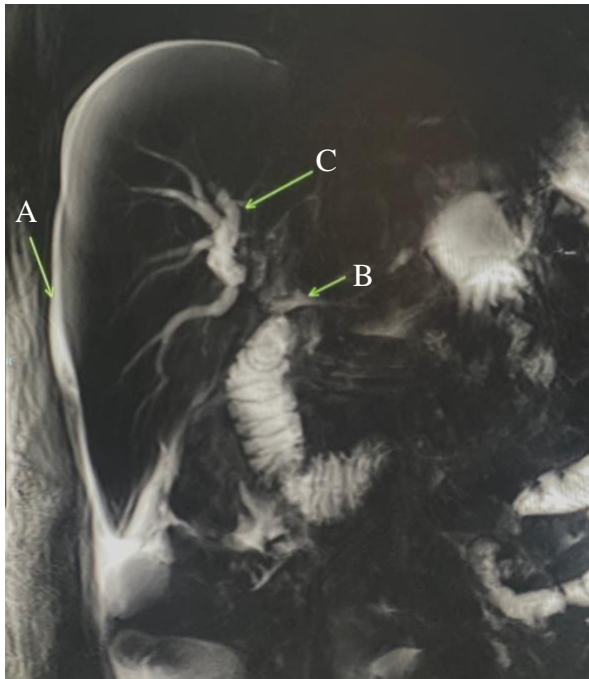
**Table 1:** Initial laboratory investigation for patient in case one.

Full blood count	Hemoglobin level 7.9	White cell count 15.4	Neutrophils count 11.7	Platelets count 379	
C-reactive protein	221				
Coagulation profile	PT 12.1	INR 1.15	APTT 32.7	TT 14.9	
Liver function test	ALT 101	ALP 131	AST 31	Albumin 26 – Protien 51	Bilirubin 118
Urea and electrolytes	Creatinine 35	eGFR >90	Potassium 3	Sodium 134	Urea 1.4

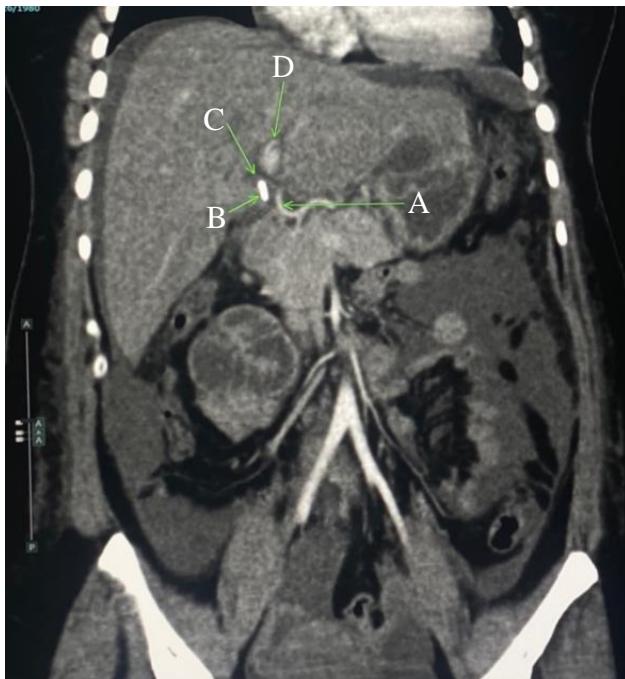
The patient received the required resuscitation together with broad-spectrum antibiotics. Further imaging investigations followed. Initially an ultrasound abdomen showed mild fullness of the intrahepatic bile ducts with free fluid in the abdomen and pelvis. This was followed by MRCP which showed dilated right sided biliary ducts, normal left sided biliary ducts, distal CBD was seen but the proximal CBD could not be visualized [Figure 1]. Then an ERCP showed complete block of the distal CBD about 2 cm from the ampulla of vatar (Strasberg type E). For further confirmation of the diagnosis a HIDA scan (Hepatobiliary Scintigraphy HS) done and showed loculated biliary leak in the left lower abdomen but no radioactive tracer was seen in the small or large bowel. For the assessment of vascular injury, a CT angiography showed no visualized right hepatic duct and the left hepatic artery was vaguely seen [Figure 2]. At this point, it was clear that there is a distal CBD injury with injury of the right hepatic artery, but there was a doubt whether there are any further proximal injuries. Surgical exploration was performed and around one liter of bile was found in the abdomen, bile-stained omentum, stomach, small and large bowel and liver were densely adhered to each other, complete transection of the CBD, right hepatic duct and right hepatic artery, normal arterial blood flow in left lobe but absent arterial flow in the right lobe of the liver which was confirmed by intra-op doppler US. There was also a clear demarcation of the ischemic right hepatic lobe. So, a right hepatectomy was done (segment V, VI, VII & VIII RESECTION). Despite careful dissection and good exposure, the left hepatic vein and the site of bile leak could not be identified for reconstruction so an abdominal drain kept inside to consider a re-look surgery later.

The patient stayed in the ICU post operatively and was extubated on the 3rd day. Then she remained in the ward as her drain output was high and she was often spiking fever. She grew candida albican in her blood thus started on anti-fungal medication. 20 days post-operatively, the patient complained of severe abdominal pain and diarrhea. A CT abdomen showed multiple intra-abdominal collections, a thrombus in the distal IVC extending to the left iliac vein and a large right pleural effusion. So, an IVC filter placed and therapeutic anti-coagulation started, then the patient was taken for exploratory laparotomy. Intra-operatively she underwent abdominal wash and resection of around 8 cm of the small bowel which was looking unhealthy. The small bowel continuity was re-established by

primary anastomosis. Then the patient was managed with antibiotics and her abdominal drains were monitored daily. Once she became stable enough, patient was sent to a other referral center where she underwent Roux-en-Y hepaticojejunostomy. Patient is being followed on OPD basis and doing fine.



**Figure 1:** A. Perihepatic free fluid B. Contrast leakage and non-visualization of proximal CBD C. Intrahepatic biliary dilatation.



**Figure 2:** A. Hepatic artery proper B. Surgical clip C. Right Hepatic Artery (faint) D. Left Hepatic Artery.

### ***Case two***

A 49 years old female patient who is known to have hypertension on medications. She underwent laparoscopic cholecystectomy in a private hospital for symptomatic gallstones. On the fourth day post operatively, she reported back to the hospital with abdominal pain, vomiting and her abdomen was distended. There, she had MRCP which showed multiple fluid collections at the gallbladder bed, in the lesser sac and in the subcutaneous plane of the anterior abdominal wall. For this reason, the patient was referred to our hospital which is a tertiary care hospital. She had an US guided drainage of the fluid collections. An ERCP was done which revealed a blind ended CBD with the surgical clip at its end. There was no contrast going to the intrahepatic ducts. An MRCP was repeated again and showed that the continuity of the intrahepatic duct and the extrahepatic ducts seems to be lost. The team decided to manage the intra-abdominal sepsis initially then to take care of the CBD injury. After stabilization, Roux-en-Y hepaticojejunostomy was done without complications. The patient was discharged home on the 6th day post operatively. Patient is being followed up regularly in the OPD till 6 months back and is doing well.

### ***Case three***

A young male aged 20 years patient known to have achondroplasia was seen in our hospital. He was involved in MVC and sustained multiple injuries required laparotomy which was done in regional hospital. Upon initial assessment, the patient was hemodynamically normal apart from tachycardia, however a FAST scan showed intra-peritoneal fluid collection and a CT scan showed evidence of multiple hepatic laceration with active extravasation, multiple laceration in the spleen and features suggestive of pancreatic injury. The patient was taken for exploratory laparotomy and liver and splenic lacerations were sutured. A perforation developed in the second portion of the duodenum, with active bleeding from the pancreaticoduodenal artery and that was ligated. Multiple packs were kept in place and the patient was managed in an intensive care unit. He was then transferred to our tertiary care hospital for further management. He underwent re-look laparotomy and packs were removed, hematoma noted in the second part of the duodenum and head of the pancreas but no bile leak, other structures were normal. The abdomen was irrigated and closed.

During his admission, the patient started to become septic, in terms of high-grade fever, jaundice, increased inflammatory markers and deranged liver function tests. He had a CT scan which showed multiple fluid collections in the abdomen. Those collections were successfully drained with US guidance. Liver function tests showed improvement after the drain insertion. The output from the drain was sent for culture and grew Multi- drug resistant organism so kept on multiple antibiotics as per the hospital policy. The fluid in the drain was bilious, and laboratory investigations showed high levels of bilirubin in the fluid, so CBD injury was highly suspected. A HIDA scan was done which showed normal uptake in the liver but no flow in the CBD. The patient was managed with a drain and antibiotics initially and after being stable, he underwent hepaticojejunostomy. The surgery was prolonged and complicated due to multiple adhesions that made mobilization difficult. Post operatively the patient was doing well and discharged home.

Six months post operatively, he came with abdominal pain and his liver function tests noted to be deranged. An MRCP showed stricture in the hepaticojejunostomy site. An attempt of Percutaneous transhepatic cholangiogram to cross the stricture was tried but it was not successful, so the drain was kept in the CHD. After a month the PTC got blocked and there was no dilatation of the peripheral hepatic ducts to insert another PTC. For that, the patient underwent revision hepaticojejunostomy which was successful. Currently, the patient is being monitored in the OPD and doing well.

The other two cases were managed with a CBD stent placement and are doing fine with no major reconstruction required.

## **Discussion**

Laparoscopic cholecystectomy nowadays is considered the gold standard modality for the management of different gallbladder diseases and it is the most commonly performed laparoscopic surgery in the world.<sup>1</sup> The risk of iatrogenic injury depends on multiple factors including patient's body habitus, previous abdominal surgery,

cirrhosis, presence of large gallstone and also depends on the surgeon's experience. However, the risk of iatrogenic injury in LC still remains higher than the conventional open cholecystectomy. Some surgeons consider converting a laparoscopic surgery to an open when they find it difficult, but there is no evidence proved that conversion will reduce the risk of iatrogenic injury.<sup>2</sup>

There have been multiple approach techniques to help reduce the risk of iatrogenic CBD injury. The most commonly used one is the critical view of safety (CVS). This view includes identifying the CBD, cystic duct and the liver bed. When this view is achieved, the surgeon can clip the cystic duct and artery confidently without risking the CBD and other structures.<sup>2</sup> There are other techniques used in case the CVS cannot be achieved like fundus-first approach and subtotal cholecystectomy. Troidl have proposed several techniques to prevent injuries: a 30-degree telescope, to avoid diathermy use near common bile duct, dissection near gall bladder and whenever uncertain convert to an open approach.<sup>5</sup>

Biliary ducts injury has been classified based on different systems. Strasberg and Bismuth are commonly used. They are described in [Table 2]. Clinically, bile duct injuries can be divided into minor injuries that can be managed and repaired easily, and major injuries which require major reconstructive surgery. Examples of minor injuries includes, burn and partial cut. Complete dissection of the CBD is an example of a major injury.<sup>2</sup>

**Table 2:** Strasberg classification of Bile Duct Injury.

<p><b>Strasberg classification:</b></p> <ul style="list-style-type: none"> <li>▪ Type A - Injury to the cystic duct or from minor hepatic ducts draining the liver bed.</li> <li>▪ Type B - Occlusion of biliary tree, commonly aberrant right hepatic duct(s).</li> <li>▪ Type C - Transection without ligation of aberrant right hepatic duct(s).</li> <li>▪ Type D - Lateral injury to a major bile duct.</li> <li>▪ Type E (1-5) - Injury to the main hepatic duct; classified according to level of injury (ie, below). <ul style="list-style-type: none"> <li>• E1 (Bismuth type 1) - Injury more than 2 cm from confluence</li> <li>• E2 (Bismuth type 2) - Injury less than 2 cm from confluence</li> <li>• E3 (Bismuth type 3) - Injury at the confluence; confluence intact</li> <li>• E4 (Bismuth type 4) - Destruction of the biliary confluence</li> <li>• E5 (Bismuth type 5) - Injury to aberrant right hepatic duct</li> </ul> </li> </ul>
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In our series of patients, two of them had minor CBD injuries which were managed by a CBD stent placement and they improved well. The three patients presented in this article had major CBD injuries and required major reconstructive surgeries.

In the first case, although the surgery was converted to open, the surgeon still injured the CBD and the right hepatic artery. This proves the above statement that converting the laparoscopic surgery to an open surgery does not usually help identify and solve the problem. The injury was not identified intra-operatively, yet it was a wise decision to keep a drain in place. In the literature, BDI can only be identified intra-operatively in 25% of cases.<sup>3</sup> It has been advised by the World Society of Emergency Surgery guideline (WSES) that in case a surgeon face a difficulty during the surgery, he should consult another surgeon before proceeding to a critical step and also to clearly report any anatomical difficulty or unusual findings.<sup>2</sup> It has been mentioned also in the literature using intra-operative cholangiogram (IOC) can help identify CBD injury, but this takes longer time and needs higher expertise.<sup>4</sup> In case the surgeon identified the injury intra-operatively, management options depend on the type of injury. In the case of minor injury, e.g. Strasburg A, options include T-tube placement, direct repair, keeping a drain and using endoscopic stent decompression if available on time. However, in case of major injury, like Strasberg E, Roux-en-Y hepaticojejunostomy is the advised method of repair,<sup>6</sup> together with placement of T-tube to the healthy part of the CBD to help reduce the incidence of future stricture. If the surgeon is not confident enough, it is advised to keep a

drain in place and send the patient to a more experienced surgeon. In a single center study of 200 patients who had CBD injuries, it was noticed that CBD injury repair by a non-hepatobiliary surgeon, increase the risk of biliary strictures, recurrent cholangitis, revision surgery and morbidity.<sup>7</sup> On the other hand, transferring the patient early to an experienced HPB surgeon significantly reduce the risk of post-operative complications compared to a late transfer.<sup>8</sup> It is not advised to convert the surgery to an open just only to diagnose the injury.

The CT scan is more sensitive than US in detecting such complications as well as detecting vascular injuries and hepatic ischemic changes. However, neither US nor CT can identify whether the fluid collection is biliary, pus or blood and also it cannot identify the location of biliary leak if present. Hepatobiliary scintigraphy (HS) is a more sensitive and specific modality in identifying the biliary collection and the location of the leak, yet the disadvantage of this study is that it cannot show other structures and so information about them cannot be obtained.<sup>9</sup> MRCP is considered the gold standard modality to identify the biliary tree injury. It can show the precise location of the injury, it can show the anatomy proximal and distal to the injury and identify the site of leak with accuracy around 100%.<sup>10</sup> Other invasive methods like ERCP and PTC are useful to diagnose the injury and can be used for treatment like decompression sphincterotomy and stent placement. CBD stent placement using ERCP is more likely to succeed when the injury is extrahepatic and is < 5 mm in size, and when there is no biloma or abscess.<sup>11</sup>

Management of minor CBD injury includes draining the abdominal collection and observation. If there is no clinical improvement then a surgeon should proceed to endoscopic decompression and CBD stent placement.<sup>12</sup> Major CBD injuries should be managed by a hepatobiliary surgeon. Roux-en-Y is the gold standard modality of treatment.<sup>7</sup> Success rates increase when the surgery is done within 72 hours of the injury. However, beyond those times, a surgeon should wait until the inflammation settles then a repair can be done. When the surgery cannot be done early, the "drain now, fix later" approach should be implemented.<sup>13</sup>

## Conclusion

Iatrogenic Common Bile Duct injuries represent one of the most serious complication in the abdominal surgeries either emergency like trauma or elective surgeries when operating near the porta-hepatis. In the elective surgeries, most common surgical procedures in which CBD injury can occur is open and laparoscopic cholecystectomy. The factors leading to laparoscopic bile duct injury mainly is due to anatomical abnormality of the biliary anatomy. Avoidance of injury can be achieved or at least decreased by good exposure of Calot's triangle, proper demonstration of critical view of safety, appropriate use of electrocautery and safe clip application. The key points for successful treatment are characterized by early recognition of injury preferably intraoperative or early post-operative period, control of any intra-abdominal fluid collection and infection on the emergency basis, multidisciplinary approach, and refer the patient to higher tertiary center where expertise is there for surgical repair by an experienced surgeon in biliary reconstruction.

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