



# International Journal of Hepatology & Gastroenterology

Research Article

## Evaluation of Management Protocols for Post- Cholecystectomy Iatrogenic Biliary Injuries -

**Ahmed M. Abdel Modaber<sup>1\*</sup>, Ahmed Hammad<sup>1</sup> and Vusal Aliyev<sup>2</sup>**

<sup>1</sup>*General Surgery Department, Faculty of Medicine, Mansoura University Hospitals, Egypt*

<sup>2</sup>*General Surgery Department, Emsey Hospital, Istanbul, Turkey*

**\*Address for Correspondence:** Ahmed A. Modaber, Department of General Surgery, Mansoura University, Egypt, Tel: +20-102-334-567; E-mail: ahmedhammad2005@yahoo.com

**Submitted:** 02 December 2017 **Approved:** 18 December 2017 **Published:** 20 December 2017

**Cite this article:** Abdel Modaber AM, Hammad A, Aliyev V. Evaluation of Management Protocols for Post-Cholecystectomy Iatrogenic Biliary Injuries. *Int J Hepatol Gastroenterol.* 2017;3(4): 091-098.

**Copyright:** © 2017 Abdel Modaber AM, et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

## ABSTRACT

In this study, 33 patients with post cholecystectomy bile duct injuries were assessed, of which 22 were females and 11 males. The ages of the patients ranged between 30 and 65 years. 4 patients were diagnosed intra - operatively while 23 patients were diagnosed in the post-operative period. The time of presentation of patients diagnosed postoperatively varied significantly among the patients ranging from few days to 3 months. Twenty one patients were presented clinically with obstructive jaundice with or without cholangitis. Two patients were presented with biliary peritonitis while 4 patients were presented with external biliary fistulae and 2 patients with an intra-abdominal collection. All patients were assessed through a thorough history taking and physical examination, in addition to complete laboratory work-up. Abdominal ultrasound was done as a routine primary investigation for all patients. It was very accurate in the detection of intrahepatic biliary dilatation and intraperitoneal collections and their aspiration. ERCP was successfully performed as a preoperative investigation with accurate results documenting the level of bile duct injuries, failure in one case; also it was successful in management of 9 cases. MRCP was done as a preoperative diagnostic tool for 8 patients. It showed excellent results in accurately specifying the level of the injury, and the degree of dilatation of the proximal biliary tree. PTC was a successful preoperative diagnostic tool in two patients, clearly delineating the proximal biliary tree and identifying the level of injury. PTC with external drainage of the biliary tree (PTD) was avoided to keep the advantage of finding dilated bile ducts in subsequent planned surgery shortly afterwards. Management depended largely on time of diagnosis. Patients were managed immediately. 12 patients were, managed by non - surgical treatment through ERCP or US guided drainage. 17 patients were managed by surgery by bilioenteric anastomosis. The four patients diagnosed intraoperatively were managed immediately, one patient with partial injury of the CBD at the level of the cystic duct was repaired primarily over a T - tube, another patient had completely transected CBD were repaired by end - to - end anastomosis of the CBD on a T-tube and two patients had an immediate hepaticojejunostomy. Twelve patients were managed non - surgically. Three of them had US guided drainage of an intra-abdominal collection of bile, three patient with bile leaks had ERCP Sphincterotomy and stent insertion alone and six patients with partially occluded CHD with bile leak had an ERCP performed with Sphincterotomy, balloon dilatation of the stricture followed by stent insertion. Seventeen patients underwent elective surgical repair of their bile duct injuries, in this group patients had Roux - en Y hepaticojejunostomy performed to 16 cases. One case was managed by choledochoduodenostomy. Short term results were generally satisfactory. The short term morbidity of the patients who underwent the operative procedures included. One patient developed a transient attack of cholangitis, which was controlled by antibiotics. One patient developed jejunal fistula and two patients developed re-stricture. There was one mortality case due to hepatorenal failure. The short - term morbidity of the patients who underwent the endoscopic procedures included one patient developed pancreatitis and another case developed cholangitis. They are treated conservatively. This study revealed the following findings and recommendations: ERCP has the advantage of being diagnostic and therapeutic modality as it can be used in detection of level of injury, stenting and dilatation of strictures. MRCP has excellent standard in determining the exact site of injury and in demonstrating of the exact anatomy of the proximal biliary tree. PTC is helpful in identifying the proximal extent of complete segmental and major bile duct injuries and obstruction. A Roux - en Y choledoco - or hepaticojejunostomy is the procedure of choice if the defect is more than 1 cm long or is detected a long time after the injury. Safe surgery during cholecystectomy should be the rule in practice.

**Keywords:** Post-cholecystectomy; Iatrogenic biliary injury

## INTRODUCTION

Iatrogenic biliary trauma has increased many folds ever since laparoscopic cholecystectomy came into practice. Associated morbidity, mortality and the long term sequel of such injuries have made them the most dreaded complications of laparoscopic cholecystectomy. This has been ascribed to the lack of experience in this new technique. A decline in the rate of iatrogenic biliary trauma expected with passage of time [1].

A number of mechanisms were 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, a casual attitude during surgery and human error [2].

The diagnostic evaluation of the patient with biliary injuries should include accurate determination of the biliary anatomy. Many studies proposed investigations like intra-operative cholangiography and magnetic resonance cholangiogram to reduce the rate [3].

Malik, et al. [4] concluded that iatrogenic biliary injuries continue to occur despite tremendous overall improvement in technique and expertise.

Early recognition of iatrogenic biliary injury is essential in any patient who has an atypical course following cholecystectomy to prevent major morbidity. Accordingly, Imaging techniques, such

as ultrasound and CT, are extremely valuable during the initial evaluation of a patient of having a biliary injury. ERCP can confirm the presence of biliary injury and provides a means for definitively managing many injuries with temporary internal stents. If complete disruption or occlusion of the proximal bile duct is present, prompt evaluation with Percutaneous Transhepatic Cholangiography (PTC) is necessary to define the biliary anatomy and decompress the biliary system [5].

Noninvasive imaging techniques, such as Magnetic Resonance Cholangiopancreatography (MRCP) and CT cholangiography can be used to evaluate bile duct injuries. CT cholangiography has also been shown to be an effective means of imaging the biliary tree [6].

Too much debate about the treatment of iatrogenic biliary injury is still present. Endoscopic intervention can be safe and effective method of treatment in some cases and surgery can be the treatment of choice in some cases. However, management should be individualized based on factors such as outpatients or inpatients, presence of stone, stricture, ligature, or coagulopathy [6].

The surgical treatment of elective IBDI is made using different methods of biliary reconstructions. The main aim of surgical treatment is the reconstruction of proper flow of bile to the alimentary tract. The following operations are performed in biliary injuries surgical treatment: Roux-Y hepaticojejunostomy, end-to-end ductal biliary anastomosis with tube drainage choledochoduodenostomy,

hepaticojejunostomy, jejunal interposition hepaticoduodenostomy [6].

In this paper, we are going to evaluate the best protocol in management of iatrogenic biliary injuries sustained during either laparoscopic or open cholecystectomy.

**PATIENTS AND METHODS**

This study was conducted on thirty three patients, suffering from biliary injuries complicating cholecystectomy (21 patients were operated by open method and 12 patients by laparoscopic method) were included in this study. Twenty two patients were females (66.6%) and 11 patients were males (33.4%). Their ages ranged between 30 and 65 years old with a mean age 40 ± 12.5.

Twenty-nine patients were referred after doing their original cholecystectomy procedure in another center, while the remaining four patients did their original cholecystectomy in an affiliated center.

**Time of diagnosis**

Four cases of biliary injuries were detected intraoperatively. Three cases were at open procedures. While the remaining case was at laparoscopic cholecystectomy.

Eight patients were diagnosed at early postoperative period (during the first week postoperatively). They were presented with signs of biliary leakage; biliary peritonitis, external biliary fistula or biloma.

Two of them were in a bad general condition with hypotension, tachycardia, right hypochondrial tenderness on palpation, and shifting dullness on percussion denoting presence of free intraperitoneal fluid i.e., biliary peritonitis.

Four cases presented with external biliary fistula through continuous discharge of bile through drains postoperatively with normal general condition.

Two cases presented with a distended abdomen with fixed dullness on the right hypochondrium i.e., a biloma.

Twenty one patients presented at variable intervals post operatively (2 weeks-3 months). They presented with one of the following: Fifteen patients presented with jaundice alone. Six patients presented with jaundice associated with recurrent attacks of pain, fever and chill denoting cholangitis.

**Patient assessment:** Thorough history taking. Complete physical examination including general examination of vital signs, presence of jaundice, lower limb edema and scratch marks.

Laboratory investigations including Complete Blood Picture (CBC), liver function tests including total and direct bilirubin, ALT, AST, and ALK, phosphatase, prothrombin time and concentration, serum electrolytes, Fasting Blood Sugar (FBS), urea and creatinine.

**Radiological investigations:** Establishment of proper diagnosis rested on four main investigations which are abdominal ultrasonography, Endoscopic Retrograde Cholangiopancreatography (ERCP), Magnetic Resonance Cholangiopancreatography (MRCP) and Percutaneous Transhepatic Cholangiography (PTC).

**Management of postoperative diagnosed patients:** Management was either surgical or non-surgical; twelve cases had avoided surgical intervention and seventeen cases had surgical intervention.

**Non-surgical management: US guided drainage:** Three cases with suspected biliary leakage were treated by US guided drainage using 20 Fr. Nelaton tube under local infiltration anesthesia.

**ERCP:** Nine cases with biliary leaks (fistula) were subjected to therapeutic ERCP.

**Surgical management**

**Preoperative evaluation:** Preoperative antibiotic coverage. IV fluids. Parenteral vitamin K. Plasma or human albumin, when needed so as to correct any coagulopathy or hypoalbuminemia.

**Operative methods:** Roux-en Y Hepaticojejunostomy was performed in 16 cases. Choledochoduodenostomy was performed in one case with dilated CBD more than 2 cm.

**Postoperative management:** Parenteral fluid and stopped when the patients started oral fluid. Antibiotic for 5-7 days covering mainly gram-ve and anaerobic bacteria. Care of drains and they were extracted after the cessation of discharge.

**Follow up of all patients:** Clinical assessment with special stress on symptoms of jaundice, cholangitis, pruritis, dark urine, pale stools, symptoms suggestive of biliary leakage and hepatic cell failure. Laboratory investigations including Complete Blood Picture (CBC), total and direct bilirubin, ALT, AST, ALK Phosphatase, Prothrombin, urea and creatinine. Visualizing investigations including T-tube cholangiography, ultrasound and ERCP. So, the study evaluated the following parameters. Time of diagnosis, Patients’ presentation. Diagnostic procedures either laboratory, radiological or endoscopic. Therapeutic intervention either surgical or endoscopic. Follow up for 6-12 months.

**RESULTS**

Variable patients’ presentations were detected. They were intraoperative detected injury, biliary peritonitis, and biliary fistula, and abdominal collection, obstructive jaundice with or without cholangitis (Table 1).

The time of diagnosis from the cholecystectomy procedure till patient’s presentation was variable. In 4 cases injury was discovered and managed at initial operation (immediate repair). The remaining 29 cases presented after different periods (Table 2).

Abdominal ultrasonography was performed to all patients who presented postoperatively, and it revealed the findings shown in table 3.

**Table 1:** Types of presentations of the patients.

Types of Presentation	Number	Percentage %
Intra - operatively detected injury	4	12.1 %
Biliary peritonitis	2	6 %
External biliary fistula	4	12.1 %
Biloma	2	6 %
Obstructive Jaundice	15	54.4 %
Obstructive Jaundice + cholangitis	6	16.1 %
Total	33	100 %

**Table 2:** Time of diagnosis from the original cholecystectomy till the patients’ presentation.

Time of presentation	Number of patients	Percentage %
Intra - operative	4	12.1%
Less than 1 week	8	24.2%
1 week - 1 month	18	54.5%
1 month - 3 months	3	9%
Total	33	100%



Endoscopic Retrograde Cholangiopancreatography was done in 15 cases presenting postoperatively. It was diagnostic in 14 cases (93.3%). In 3 cases it showed the exact site of biliary leakage. In 11 cases it demonstrated ductal stricture or obstruction and the site of the distal stump. It was failed in one case where cannulation of the duodenal papilla could not be performed. The above results summarized in table 4.

This was done to 8 cases .It was 100% accurate in detection of the type and the level of injury and gave a detailed anatomy of the proximal biliary tree that was confirmed by operative findings afterwards (Table 5).

It was used as a therapeutic modality in 9 patients out of the 29 cases (31%) that was presented with postoperative injury. Sphincterotomy and stent insertion was used with adequate drainage in three cases (34% of total cases) presented with bile leakage. Mild attack of pancreatitis post ERCP occurred and was diagnosed clinically by abdominal pain referred to the back and relieved in sitting position with raised level of amylase and lipase and was treated conservatively by stoppage of oral fluids with adding of intravenous fluid, Cefotaxime 1 gm Q12 h and metronidazole 500 mg Q 8 h for five days. In 6 cases (66% of total cases) the presentation was obstructive jaundice. ERCP showed partial occlusion of the CHD denoting partial clipping or ligation. Balloon dilatation was done followed by Sphincterotomy and a 10fr. Stent insertion was done to this patient (Table 6).

Ascending cholangitis in one patient as a result of stent occlusion was occurred after 8 days and relieved after exchange of stent associated with medical treatment. Another patient developed mild pancreatitis after two days of ERCP that was treated conservatively (Table 7). Roux-en Y Hepaticojejunostomy was performed for 16 (55.1%) patients. The Lt. Duct approach was adopted in one case, where there was extensive adhesion and fibrosis at the area of the confluence (Table 8).

The commonest early complication was wound seroma and infection, which occurred in 5 patients and was treated along the usual lines (proper drainage of the wound by removal of three stitches with daily dressing and antibiotic according to culture and sensitivity). Two patients developed a sub phrenic collection in one of them the collection responded to the conservative management. In the second catheter drainage under U/S guidance was needed. One patient developed a pelvic collection and had catheter drainage under CT guidance. One patient developed deep vein thrombosis, despite early ambulation. Patient was obese with past history of DVT 2 years

**Table 3:** Results of abdominal ultrasonography.

Finding	No	%
Dilated intrahepatic biliary radicles	16	56.5%
Intraabdominal collection	5	17 %
Negative	8	26.5%

**Table 4:** Results of ERCP modality.

Results	Numbers	%
Diagnostic	14	93.3%
Failed procedure	1	6.7%
Total	15	100%

**Table 5:** Results of MRCP.

Numbers of cases	Diagnostic accuracy	Percentage %
8	8	100

**Table 6:** Therapeutic treatment of ERCP.

Technique	Number	Percentage %
Sphincterotomy and Stenting	3	34
Sphincterotomy, Dilatation and Stenting	6	66

**Table 7:** Complications of ERCP.

Complications	Numbers	Percentage %
Ascending Cholangitis	1	6.6%
Mild Pancreatitis	1	6.6%

**Table 8:** Analysis of the different surgical procedures done for the patients.

Procedure	n	% of Operative pts. [17]	% of Total pts. [29]
Roux-en Y HJ	16	94%	55.1%
Choledechooduodenostomy	1	6%	3.4%
Total	7	100%	58.6%

**Table 9:** postoperative complications observed.

Postoperative complications	Number of patients [17] (%)
Wound infection	5(29.4%)
Subphrenic collection	2(11.7%)
Pelvic collection	1(5.8%)
DVT	1(5.8%)
Total	9(52.9%)

ago. This was managed along the usual ways without sequels. (Bed rest with raise his leg 45 degrees and 7 days of enoxaparin sodium (clexane) 60 mg twice daily by subcutaneous route and patient was discharged on warfarin 5 mg for 6 months) (Table 9).

## DISCUSSION

Injuries to the bile ducts during cholecystectomy represent a dreaded problem, which is easier to prevent rather than cure. The management of these injuries is difficult, and satisfactory results are not always obtained. The management of these problems provides an enormous challenge, even to experienced biliary surgeons [7].

Major bile duct injury may require biliary enteric reconstruction. Many patients, their consultants and their lawyers believe that treatment results in life time of disability [8].

In this study, 33 patients with post cholecystectomy bile duct injuries were studied. There was a predominance of female, middle aged patients, as they are classically the population group most susceptible to calculus gallbladder disease which is, by far, the most common indication for elective cholecystectomy procedures performed for the patients presented in this study.

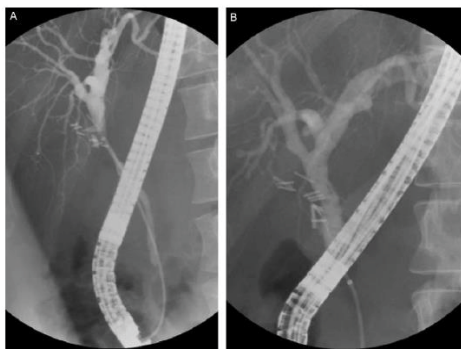
The risk of bile duct injury after open cholecystectomy varies between 0.2 and 0.5%. Recent large collective reviews have shown that there is approximately twice the risk (0.6 versus 0.3%) of bile duct

injury following laparoscopic cholecystectomy compared with open cholecystectomy [9].

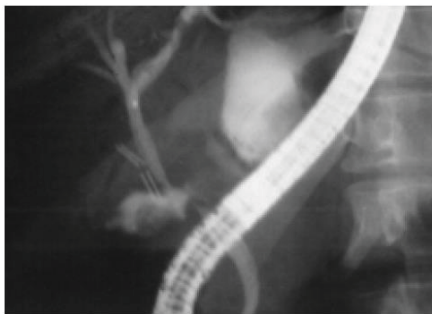
Laparoscopic cholecystectomy has been generally accepted as the conventional cholecystectomy to the degree that an international study by Barkun, et al. [10] concluded that 75% of all cholecystectomies performed are laparoscopic. Therefore it is a fact that the introduction of laparoscopic cholecystectomy increased the incidence of iatrogenic bile duct injuries.

Detection of the injury intraoperatively during the cholecystectomy procedure is not easy and can easily be missed especially with partial duct injuries as the affected duct will cause leak later on or stricture even later.

In our study 4 patients (12.1%) were diagnosed intra-operatively,



**Figure 1A,B:** Many clips at the level of a stenosis in the common hepatic duct, prior to stenting. After 3 months stenting (B), no stenosis in the common hepatic duct.



**Figure 2:** ERCP showing biliary leak from common bile duct after laparoscopic cholecystectomy in the region of several surgical clips.



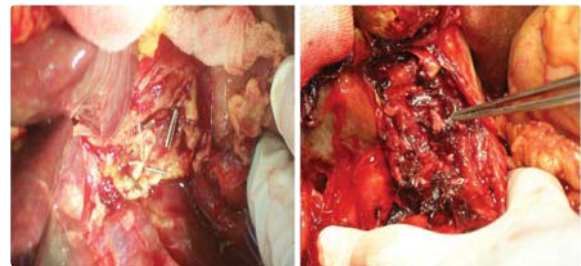
**Figure 3:** Cholangiography by ERCP shows continuity of the biliary tree, but many clips after laparoscopic cholecystectomy in the area of the common hepatic duct with contrast leakage.



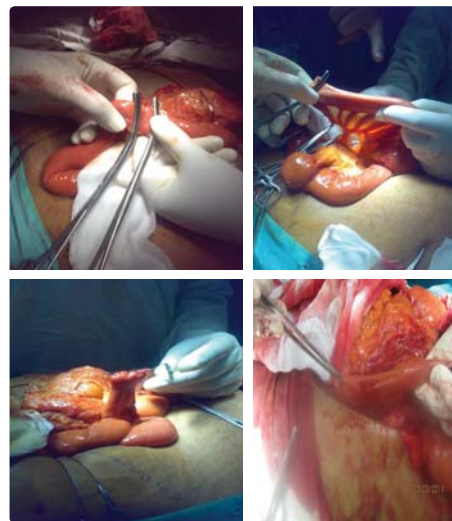
**Figure 4:** Stenting of the jejunal loop.



**Figure 5:** View of diaphragmatic liver with the transhepatic stent in situ.



**Figure 6:** Operative photograph of ligated common bile duct with ligature (open) and clip (Laparoscopic).



**Figure 7:** A case of post cholecystectomy ligated CBD while preparing the jejunal loop for performing Roux-en-Y hepaticojejunostomy.

while 29 patients (87.9%) were diagnosed in the post-operative period.

In a recent study by Agabiti, et al. [9] where 200 cases of biliary injuries following open or laparoscopic cholecystectomy were studied, they showed that one third of the lesions were discovered intraoperatively.

In another study done by Ibrahim, et al. [11] where 472 cases of biliary injuries following open or laparoscopic cholecystectomy were studied, they showed that only 5% of the lesions were discovered intraoperatively (24 out of 472).

Advantages of immediate on-table repair of biliary injuries include single anesthesia, single surgical procedure for the patient, and shorter hospital stay. When a hepatobiliary surgeon provides the service of on-table repair as an outreach service, in addition to the added advantage of better surgical outcome, the need to transfer the patient to a tertiary center is also abolished.

As opposed to a delayed repair, an immediate on-table repair nullifies the need for prolonged external biliary drainage and

associated increases risk of sepsis. The disadvantages of such an outreach on-table repair of bile duct injuries are that these injuries are often complex, requiring high hepaticojejunostomy reconstruction for non-dilated, normal diameter ducts with thin wall.

Obstructive jaundice with or without cholangitis was the cardinal presentation of patients in this study (70.5%). A variety of other presentations were present including biliary fistula (12.1%), biliary peritonitis (6%) and biloma (6%). In a study done by Cameron and Gadacz [12], 50% of the patients in their study also presented with jaundice, with occasional cholangitis.

The time of presentation of patients following their original cholecystectomies in our study ranged from a few days to 3 months postoperatively. Eighty nine percent of our post-operative diagnosed cases were presented within one month post operatively while eleven percent were presented after one month. This wide variation was due to the different clinical presentations depending on the type of injuries. Most of the patients who were presented at less than one month duration had biliary peritonitis due to major bile leak injuries, while those who were presented after one month had delayed bile duct strictures and external biliary fistulae.

In the study done by Ibrahim, et al. [11], cases presented within one month after operation were considered as early referrals and they were 250 cases out of 472 (58%), but the cases presented postoperatively after one month were considered late referrals and they were 208 cases (42%).

Abdominal ultrasound was done as a routine primary investigation in our study. It detected dilatation of intrahepatic biliary radicles in 56% of patients (those who were presented with jaundice) while it confirmed the presence of intraperitoneal collections in 17% of patients (those who presented with a biloma or biliary peritonitis) but it cannot reliably distinguish bile leak from other postoperative fluid collection such as blood, pus, or serous fluid because of similar densities and it was negative in 27% of cases. So in our study sensitivity of ultrasound was 74%.

In the study done by Chapman, et al. [13], US showed biliary dilatation in 35% of patients while abdominal collections were detected in 30% with 62% sensitivity.

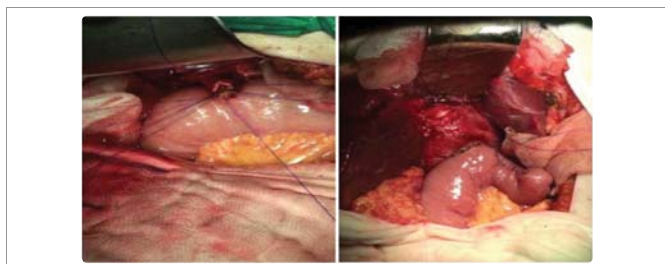
Another study done by Fleming et al. [14], the sensitivity of U/S was 88.89% and in another study done by Donatelli et al. [15], US showed biliary dilatation in 50% of patients while abdominal collection in 40% of patients and it was negative in 10% of cases with 65% sensitivity.

In our study, 3 patients were underwent US guided aspiration of bile collection successfully. Also in study done by Show, et al. [16], 1 patient out of 50 was underwent US guided aspiration.

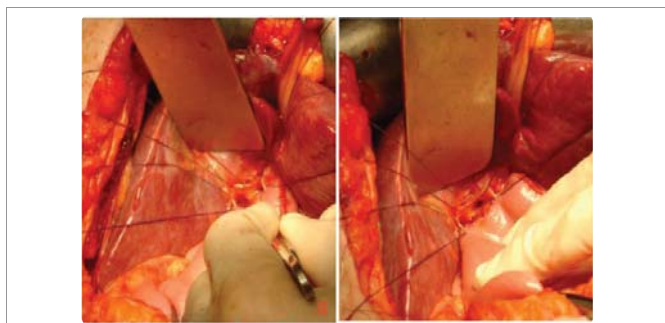
In our study PTC was used in limited numbers (2 cases = 6.8%) as a preoperative diagnostic investigation, clearly delineating the proximal biliary tree and identifying the level of injury with 100% sensitivity. In the study done by Misra, et al. [17], 32% of their patients successfully underwent PTC as the preoperative diagnostic and in the study done by Ibrahim, et al. [11], 2% only of their patients did PTC.

In the study done by Cozzi, et al. [18] and Ibrahim, et al. [11], sensitivity and specificity of PTC for identifying the cause and site of biliary tract obstruction were 100 percent, being more accurate in this regard than ultrasonography or CT scan

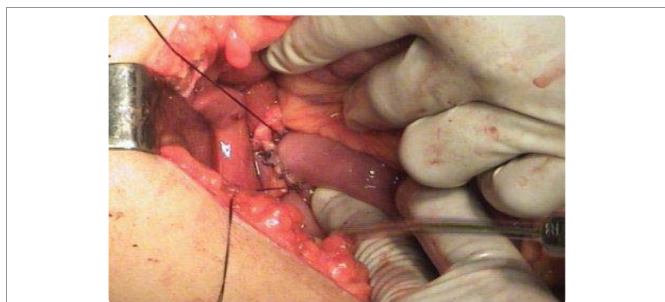
ERCP was successfully preformed as a preoperative diagnostic



**Figure 8:** Operative dissections of hepatic ducts with Roux-en-Y hepaticojejunostomy.



**Figure 9:** Operative hepaticojejunostomy and anastomosis of jejunum with single ostomy of both right and left hepatic ducts after operative stomaplasty.



**Figure 10:** Roux-en Y Hepaticojejunostomy.

investigation in 51.7% of the patients in our study. In study done by Martin, et al. [7], 88% of their patients successfully underwent preoperative diagnostic ERCP. It was noticed in this study that ERCP failed in 1 patient to assess the biliary tree, most probably due to extensive stricture of bile ducts with severe fibrosis which pulls the proximal stump to a much higher level and pulling the distal stump. Also in our study ERCP failed in one case where cannulation of the duodenal papilla could not be performed.

MRCP was done to eight patients. In our study it had a diagnostic accuracy of 100% with sensitivity and specificity of 100%. In a study performed by Waleed, et al. [19], the overall sensitivity, specificity and accuracy of MRCP in the detection of bile duct lesions in post-cholecystectomy injuries were: 93%, 99% and 97%, respectively. Another study done by Ibrahim, et al. [11] showed sensitivity and specificity of 87% and 80% respectively.

Three of our patients with diagnosed postoperative biliary injuries underwent ERCP and Sphincterotomy with stenting of the common bile duct, six cases had Sphincterotomy, dilatation and stenting. ERCP offered a definite therapeutic measure for these patients as an alternative to surgical repair. These results are also comparable with those of Martin, et al. [7] who had a success rate of 89%.

The endoscopic treatment succeeded in all nine patients to give the desired therapy with closure of the fistula and Complete relieve of jaundice in all three patients within two weeks. During the period of follow up (mean 9 months) there was no recurrence of fistula or jaundice. The stent was removed after complete closure of fistula.

Martin, et al. [7] commented that it is unknown whether the results of stent therapy are improved by the use of large diameter stents and the optimal duration of stent therapy has not yet been established.

In our study, 58.6% of the patients underwent surgical corrective procedures for their bile duct injuries. While in the study by Li, et al. [20], 96% of their patients underwent various surgical procedures of repair including Roux en Y hepaticojejunostomy in 72%, Roux en Y Choledochoduodenostomy in 18% and Choledochoduodenostomy in 6%.

On the other hand in another study done by Martin, et al. [7], all 22 patients presented in their study underwent Roux- en Y hepaticojejunostomy.

In our study, primary repair over T tube and primary end to end repair was done in two patients, whose injury was discovered intraoperatively during cholecystectomy procedure.

On the other hand, Pujahari [21] reported a 78% rate of stricture following attempts at end to end repair in accidental operative section of the common bile duct after 7 years of follow up. No strictures occur in our patients within our period of follow up (1 year) which was proved to be not enough for follow up. However, a Roux - en Y choledoco- or hepaticojejunostomy is the procedure of choice if the defect is more than 1 cm long or is detected a long time after the injury.

Choledochoduodenostomy was performed for 1 patient in our study. Its disadvantage is that it may cause ascending cholangitis. Ascending cholangitis occurred in our study after 3 weeks that treated by conservative measures. Choledochoduodenostomy is more physiological resulting in better digestion and avoid peptic ulcer formation. It is easier and faster technique [22].

The majority of cases underwent hepaticojejunostomy, as most of injuries presented were proximal. This may be due to proximal traction on the upper stump by the formed fibrosis together with extending ischemia of the affected duct. The high approach was adopted in all cases so as to perform the anastomosis with the optimum healthy proximal duct stumps as far as possible from any fibrosis or adhesions.

Proper dissections of the hilar plate together with a sound mucosa to mucosa anastomosis are the key for a successful repair. Stenting after Roux - en Y hepaticojejunostomy was performed in three cases in our study due to small caliber ducts. The role of stenting remains controversial. There has been an increasing trend away from stenting if an adequate wide anastomosis is done. The use of Trans anastomotic stenting has to be individual to each patient, the experience of surgeon and the healthy and diameter of the ducts [15].

Short - term postoperative morbidity of patients in our study had an overall rate of 19% (4 cases out of 21) in surgically treated patients in the form of ascending cholangitis, intestinal fistula and two cases developed stricture at the anastomosis after 3 months and re-surgery was done in the form of hepaticojejunostomy. In non-surgical treatment there were 16.6% morbidity (2 out of 12), one case of ascending cholangitis and one case of mild pancreatitis. Postoperative complications were 26.3% wound infection, 10.5% sub phrenic collection and 5.3% DVT.

Fischer, et al. [23] had a postoperative complications rate of 39% including postoperative wound and chest infections, sub phrenic collections as well as other long- term complications such as incisional hernia and bile leaks.

We had one postoperative mortality due to hepatorenal failure (3%). In a study done by Ibrahim, et al. [11], the average mortality rate for patients undergoing biliary reconstruction was 4.5%.

Another study done by Ardiles, et al. [24] showed 12.5% mortality rate. The results of surgery were considered excellent if the patient remained symptoms free and required no further surgery. Patients were considered to have a good result if they had only mild symptoms including rare episode of cholangitis and did not require further surgery. Patients were considered to have a poor result if obstructive jaundice or severe cholangitis developed requiring reoperation, died within 30 days postoperative or died from biliary cirrhosis or liver failure.

According to that, the results in our study were as follow; the results of surgery were excellent in (76.5%) compared with 75% in reports of Bittner [25], 75% in reports of Ardiles, et al. [24] and 80% in reports of Ibrahim et al.(11). Those patients showed excellent final results as symptoms were relieved and liver function tests showed normal results. (11.7%) of patients had good results compared with 10% in reports of Bittner [25], 9% in reports of Ardiles, et al. [24] and 7% in reports of Ibrahim, et al. [11].

Poor results were 8% compared with 10% in reports of Bittner [25], 16% in reports of Ardiles, et al. [24] and 13% in reports of Ibrahim, et al. [11].

## CONCLUSION

The diagnosis and management of bile duct injuries should be multidisciplinary targeting on the prevention rather than cure. Early detection of complications is mandatory, especially for laparoscopic cholecystectomy patients, because they are discharged earlier, often

before the clinical manifestation of biliary injury are apparent. Ultrasound detects free or localized collection in biliary leakage while MRCP delineates the biliary passages. ERCP can be used in detection of injury level, stenting or dilatation of strictures. PTC is helpful in identifying the proximal extent of complete segmental and major bile duct injuries and obstruction. However, it comes with complications such as cholangitis, bile leakage and even hemorrhage. Endoscopic treatment is considered the least invasive technique and carries low morbidity and mortality. There is no gold standard protocol and the decision must be tailored according to individual patient's condition. A Roux - en Y choledoco- or hepaticojejunostomy are of choice if the defect is more than 1 cm long or was detected long time after the injury. Good result is attributed to wide mucosa to mucosa anastomosis and easy mobilization of jejunum rather than the duodenum with a tension-free anastomosis. Choledochoduodenostomy allows for later endoscopic access by ERCP to assess the efficiency of the anastomosis or dilate any stricture that might develop. A proper dissection of the hilar plate is the key for successful repair. Delayed end - to - end repair of bile duct injuries is generally not advisable as the major portion of the duct will be affected by fibrosis secondary to injury and ischemia. Injury sustained during a cholecystectomy in a small medical center should be transferred to a tertiary care center with no attempts at unplanned repair.

## REFERENCES

- Thomson BN, Nardino B, Gumm K, Robertson AJ, Knowles BP, Collier NA, et al. Management of blunt and penetrating biliary tract trauma. *J Trauma Acute Care Surg.* 2012; 72: 1620-1625. <https://goo.gl/UKRP59>
- Bhattacharjee PK. Bile duct injuries: Mechanism and prevention. *Indian J Surge.* 2005; 67: 73-77.
- Giger U, Ouaiissi M, Schmitz SF, Krahenbuhl S, Krahenbuhl L. Bile duct injury and use of cholangiography during laparoscopic cholecystectomy. *Br J Surg.* 2011; 98: 391-396. <https://goo.gl/BSJCPQ>
- Talpur KA, Laghari AA, Yousfani SA, Malik AM, Memon AI, Khan SA. Anatomical variations and congenital anomalies of extra hepatic biliary system encountered during laparoscopic cholecystectomy. *J Pak Med Assoc.* 2010; 60: 89-93. <https://goo.gl/ubrt41>
- Perini RF, Uflacker R, Cunningham JT, Selby JB, Adams D. Isolated right segmental hepatic duct injury following laparoscopic cholecystectomy. *Cardiovasc Intervent Radiol.* 2005; 28: 185-195. <https://goo.gl/N8wxxP>
- Hirano Y, Tatsuzawa Y, Shimizu J, Kinoshita S, Kawaura Y, Takahashi S. Efficacy of multi-slice computed tomography cholangiography before laparoscopic cholecystectomy. *ANZ J Surg.* 2006; 76: 693-695. <https://goo.gl/mbsst>
- Martin IG, Holdsworth PJ, Asker J, Baltas B, Glinatsis MT, Sue Ling H, et al. Laparoscopic cholecystectomy as a routine procedure for gallstones: results of an "all-comers" policy. *Br J Surg.* 1992; 79: 807-810. <https://goo.gl/TejYK>
- Attwood SE, Hill AD, Mealy K, Stephens RB. A prospective comparison of laparoscopic versus open cholecystectomy. *Ann R Coll surg Engl.* 1992; 74: 397-400. <https://goo.gl/RUVkwa>
- Agabiti N, Stafoggia M, Davoli M, Fusco D, Barone AP, Perucci CA. Thirty-day complications after laparoscopic or open cholecystectomy: A population-based cohort study in Italy. *BMJ Open.* 2013; 3: 19-43. <https://goo.gl/NiovFa>
- Barkun J, Barkun A, Sampalis J, Wexler MJ, Meakins JL, Taylor B, et al. Randomised controlled trial of laparoscopic versus mini cholecystectomy. *Lancet.* 1992; 340: 1116-1119. <https://goo.gl/sHzdLe>
- Ibrahim AS, Hany AS, Sherif MS, Osama H, Mohamed H, Abbasy M, et al. Iatrogenic Biliary Injuries: Multidisciplinary Management in a Major Tertiary Referral Center. *HPB Surgery.* 2014; 30: 30-41.
- Cameron J, Gadacz T. Laparoscopic cholecystectomy. *Ann Surg.* 2011; 213: 1-2.
- Chapman WC, Halevy A, Blumgart LH, Benjamin IS. Post cholecystectomy bile duct strictures, Management and outcome in 130 patients. *Arch Surg.* 1995; 130: 597-602. <https://goo.gl/keBmH2>
- Fleming KW, Lucey BC, Soto JA, Oates ME. Posttraumatic bile leaks: role of diagnostic imaging and impact on patient outcome. *Emerg Radiol.* 2006; 12: 103-107. <https://goo.gl/92a6GK>
- Donatelli G, Vergeau BM, Derhy S, Dumont JL, Tuszyński T, Dhumane P, et al. Combined endoscopic and radiologic approach for complex bile duct injuries. *Gastrointest Endosc.* 2014; 79: 855-864. <https://goo.gl/TJz4zf>
- Schmidt SC, Settmacher U, Langrehr JM, Neuhaus P. Management and outcome of patients with combined bile duct and hepatic arterial injuries after laparoscopic cholecystectomy. *Surgery.* 2004; 135: 613-618. <https://goo.gl/jNwch4>
- Misra S, Melton GB, Geschwind JF, Venbrux AC, Cameron JL, Lillemoie KD. Percutaneous management of bile duct strictures and injuries associated with laparoscopic cholecystectomy: a decade of experience. *J Am Coll Surg.* 2010; 198: 218-226. <https://goo.gl/3CWQGS>
- Cozzi G, Severini A, Civelli E, Milella M, Pulvirenti A, Salvetti M, et al. Percutaneous transhepatic biliary drainage in the management of post surgical biliary leaks in patients with non dilated intrahepatic bile ducts. *Cardiovasc Intervent Radiol.* 2006; 29: 380-8. <https://goo.gl/ndQ63u>
- Waleed S, Mahafza MD, Azmi M, Azmi A. Magnetic Resonance Cholangiopancreatography in Post Laparoscopic Cholecystectomy Patients. *JMJ.* 2005; 39: 23- 29.
- Li J, Frilling A, Nadalin S, Radunz S, Treckmann J, Lang H, et al. Surgical management of segmental and sectoral bile duct injury after laparoscopic cholecystectomy: a challenging situation. *J Gastrointest Surg.* 2010; 14: 344-351. <https://goo.gl/iBeKmr>
- Pujahari A. Prevention of bile leak after liver surgery: a fool-proof method. *Saudi J Gastroenterol.* 2009; 15: 128-130. <https://goo.gl/3RHWWQ>
- Yaghoubian A, Saltmarsh G, Rosing DK, Lewis RJ, Stabile BE, de Virgilio C. Decreased bile duct injury rate during laparoscopic cholecystectomy in the era of the 80-hour resident work week. *Arch Surg.* 2008;143: 847-851. <https://goo.gl/oUw6PZ>
- Fischer CP, Fahy BN, Aloia TA, Bass BL, Gaber AO, Ghobrial RM. Timing of referral impacts surgical outcomes in patients undergoing repair of bile duct injuries. *HPB (Oxford).* 2009; 11: 32-37. <https://goo.gl/bF4Wbh>
- de Santibanes E, Airdiles V, Pekolj J. Complex bile duct injuries: management. *HPB (Oxford).* 2008; 10: 4-12. <https://goo.gl/jm7rML>
- Bittner, R. Laparoscopic surgery--15 years after clinical introduction. *World J Surg.* 2006; 30: 1190-203. <https://goo.gl/oGsy6e>