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Original Research Article

Incidence of major biliary injuries associated with laparoscopic cholecystectomy at Al-Karama teaching hospital, Baghdad, Iraq

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ABSTRACT

Background: Laparoscopic cholecystectomy (LC), is a new modality of surgery late surfaced late 1980s. Compared with open cholecystectomy, LC is associated with less local pain, shorter hospitalization resulting in an early return to work, and a favourable cosmetic outcome. The aim of this study was to determine the incidence of major biliary injuries associated with LC.
Methods: The patients have been admitted before operation and classical LC was done. Monopolar electrocautery was used. The insertion of postoperative intraperitoneal drain or nasogastric tube depended on the surgeons' preference and opinion. The data was evaluated according to outcome measures, such as bile duct injury, morbidity, mortality and numbers of patients whose operations had to be converted from laparoscopic to open.
Results: One hundred and eighty-three (183) patients were initially included in this study. LC was accomplished successfully in one hundred and sixty-two patients (162), twenty-one have been converted to the conventional open method due to sever adhesions or unclear anatomy and they were excluded from this study. Among those who underwent LC, 5(2.73%) had major biliary injuries, another 6 (3.28) had minor injuries and 7 (3.82%) Spillage of Gallstones to the Peritoneal cavity.
Conclusions: Biliary injury is the Achilles' heel of laparoscopic Cholecystectomy. It can have devastating effects, turning the individual into a "biliary cripple". They mainly result from anatomical anomalies and errors of human judgment and are thus preventable to some extent.

Keywords: Biliary, Injuries, Laparoscopic cholecystectomy

INTRODUCTION

Laparoscopic cholecystectomy (LC), first introducedin the United States by Dr. Eddie Joe Reddick in 1989, has been rapidly embraced worldwide as the procedure of choice for cholecystectomy.[1,2]

Compared with open cholecystectomy, LC is associated with less local pain, shorter hospitalization resulting inan early return to work, and a favorable cosmetic outcome.[3,4]

During the surgical learning curve for this technique there was an initial rise in the reports of bile duct injuries, resulting mainly from the surgeons' inexperience and misinterpretation of the anatomy.[5] The incidence of biliary injury during laparoscopic cholecystectomy, estimates the rate of major injury to be about 0.55%, and the incidence of minor injuries and bile leaks to be about 0.3%, a total of 0.85%. Limited view, difficult orientation and assessment of depth on a two-dimensional image, and the lack of tactile sensation and unusual manual skills

that are needed have led to the rise in bile duct injury during LC.

A number of different factors are associated with bile duct injury during laparoscopic cholecystectomy, these include acute or chronic inflammation, obesity, anatomic variations, bleeding, surgical technique with inadequate exposure and failure to identify structures before ligating or dividing them are the most common causes of significant biliary injury, the bile duct may be narrow and can be mistaken for the cystic duct, the cystic duct may run alongside the common bile duct before joining it, leading the surgeon to the wrong place, additionally, the cystic duct may enter the right hepatic duct, and the right hepatic duct may run aberrantly, coursing through the triangle of Calot and entering the common hepatic duct, also a number of intraoperative technical factors have been implicated in biliary injuries; excessive cephalad retraction of the gallbladder may align the cystic duct with the common bile duct, and the latter is then mistaken for the cystic duct and clipped and divided, the use of an angled laparoscope instead of an end-viewing one will help visualize the anatomic structures (in particular those around the triangle of Calot, an angled scope also will aid in the proper placement of clips), careless use of electrocautery may lead to thermal injury, dissection deep into the liver parenchyma may cause injury to intrahepatic ducts, and poor clip placement close to the hilar area or to structures not well visualized can result in a clip across bile duct.[6-8]

The routine uses of intraoperative cholangiography to prevent bile duct injury is controversial, it may limit the extent of injury, but does not seem to prevent it. However, if a bile duct injury is suspected during cholecystectomy, a cholangiogram must be obtained to identify the anatomic features. It is important to check that the whole biliary system fills with contrast and to be sure there are no leaks.

Among the factors that cited as predisposing factor for the biliary injuries are anatomical malformation, difficulties due to related pathologies and difficult techniques.

There is scare information about the extent of biliary injuries associated with use of laparoscopic cholecystectomy. The aim is to assess the outcome of LC at Al-Karama teaching hospital by determining the incidence of bile duct injuries focusing on the major biliary injuries.

METHODS

This is a prospective study of patients undergoing laparoscopic cholecystectomy between November 2009 to November 2012 at Al-Karama Teaching Hospital. Most of the patients underwent elective cholecystectomy for symptomatic cholelithiasis. All patients had symptoms consistent with biliary colic and other symptoms of chronic cholecystitis.

Data have been taken from the history like age, gender, presentation, history of previous surgery. Clinical examination and investigations like liver function test, hematocrit, and abdominal ultrasound were done to all patients preoperatively, the latter to assess the GB size, thickness of the wall, presence of stones, location and number of the stones, and diameter of the CBD. For some patients authors needed to do upper oesophago-gastroduodenoscopy, prothrombin time (PT) and partial thromboplastin time (PTT).

The patients have been admitted before operation and classical LC was done. Monopolar electrocautery was used. The insertion of postoperative intraperitoneal drain or nasogastric tube depended on the surgeons' preference and opinion.

The data was evaluated according to outcome measures, such as bile duct injury, morbidity, mortality and numbers of patients whose operations had to be converted from laparoscopic to open.

RESULTS

One hundred and eighty-three patients were initially included in this study. LC was accomplished successfully in one hundred and sixty-two patients, twenty-one have been converted to the conventional open method due to sever adhesions or unclear anatomy and they were excluded from this study. Conversion rate is 11.47%.

Table 1: Sex distribution and conversion rates in 183 planned LC.

Sex	Type of surgery		Total
	LC	Open cholecystectomy	
Male	47 (25.68%)	4 (2.18%)	51 (27.86%)
Female	115(62.84%)	17 (9.28%)	132 (72.13)
Total	162 (88.52%)	21 (11.47%)	

Table 2: The baseline characteristics of patients undergoing LC.

Characteristic		LC (n=183)
Age (year)	Mean	40
	Range	15-65
Previous lower abdominal surgery		32 (17.48%)
Acalculous cholecystitis		6 (3.27%)

The base line characteristics of the patients with mean age of 40 years (15-65 y) (Table 2). Age distribution is shown in table 3. Patients of the laparoscopic group who got previous lower abdominal surgery were 32 (17.48%).

Patients who were diagnosed as acalculous cholecystitis in the patients were 6 (3.27%).

Table 3: Age distribution.

Sex	Age (years)					Total
	15-25	26-35	36-45	46-55	56-65	
Male	0	1	31	16	3	51
Female	3	41	60	23	5	132
Total	3	42	91	39	8	

Nasogastric tube was left after the operations in 48 (29.62%)of patients with a mean insertion time of 15 h. A tube drain was left in the sub-hepatic space at the end of the procedure in 114 (70.73%) patients with a mean insertion time of 35 h.

The postoperative complication rate was 17.48% (32 patients) as shown in table 4.

Table 4: Type and rate of complications in sex group in 32 of 183 laparoscopic cholecystectomies.

Sex complication	Male	Female	Total
Wound infections	6 (3.27%)	4 (2.19%)	10 (5.46%
Pulmonary infection	1 (0.54%)	3 (1.64%)	4 (2.18%)
Ischemic chest pain	0	0	0
Major biliary injury	1 (0.54%)	4 (2.19%)	5(2.73%)
Minor biliary injury	2 (1.09%)	4 (2.19%)	6 (3.28)
Spillage of gallstones to the peritoneal cavity	2 (1.09%)	5 (2.73%)	7 (3.82%)
Mortality	0	0	0
Total	12 (6.53%)	20 (10.94)	

These complications don't carry the same degree of importance and some of them are specific and some are general. Biliary injury and biliary leak reported in 11 cases of laparoscopic group (6.01%). Five of them managed by re-exploration while the remaining was managed conservatively.

The five cases with re-exploration were managed in different ways. In two of them (both female pt.), CBD was seen to be injured, T-tube was inserted, and a drain was put, and patient discharged in a stable condition. The other one (male pt.) underwent re-exploration and choledocho-jejunostomy. The remaining two cases (both female pt.) underwent re-exploration and drainage.

Spillage of stones occurred in 7 (3.8%) of patients with laparoscopic cholecystectomy to the peritoneal cavity especially during extrusion of the gallbladder through the port opening. None of the patients in this study died as a result of laparoscopic cholecystectomy.

DISCUSSION

The major complications in present study were due to anatomical anomalies of the biliary tree. The first case was male who had LC for symptomatic cholelithiasis had a long and large-caliber cystic duct which was mistaken for the common bile duct, complete transection of the CBD (with stump length more than 3cm) was done operation was converted to open cholecystectomy and choledocho-jejunostomy was done, drain was inserted, and pt. was kept on *i.v.* fluid and antibiotics for 6 days and discharged well.

The second case which was female pt. who had LC for gallstones had a short cystic duct but her operation was otherwise apparently classical with no complications, on day 1 postoperatively the intra-abdominal drain showed >350ml of bile, and the pt. was investigated, U/S, MRCP, and ERCP was done which showed contrast extravasation into the abdominal cavity, the pt. was re-explored and was found to have CBD injury about 1.5cm from the CHD with collection of bile in the subhepatic region, T-tube was inserted and repair of CBD with T-tube for external drainage was done. Pt. was kept in the ward for 2 weeks and discharged well.

The third female pt. who had LC was found to have a short cystic duct and discharged on day 1 postoperatively with the intra-abdominal drain, presented 2 days later with mild abdominal pain, loss of appetite, and bilious fluid >1 liter from her drain, pt. was re-admitted and investigated by U/S, MRCP, and ERCP which revealed mild subhepatic collection and CBD injury. The pt. was prepared for re-exploration, during operation, CBD was found to be injured 2cm from the CHD with collection of bile in the subhepatic region, T-tube was inserted and repair of CBD with T-tube for external drainage was done. Pt. was kept in the ward for 15 and discharged well.

The fourth and fifth cases were females who had similar illness course. One of them had intrahepatic gall bladder while the other pt. had chronic cholecystitis during her LC sever adhesions and thick omentum was discovered, but the operation was apparently uneventful and both pt. was discharged well on the next day, 3 days later pt. presented with abdominal pain, mild fever, and tachycardia so the pt. was re-admitted. U/S, MRCP, and ERCP was done, the investigations showed subhepatic fluid collection, with normal biliary tract, pt. were re-explored and bile leak from gall bladder bed was found in one patient, closure of liver bed, drainage and wash was done, drain was inserted, pt. was kept for 7 days and discharged well. The other pt. was re-explored and subhepatic collection was found that was managed by drainage and wash with insertion of subhepatic drain, pt. was kept for 6 days in the ward and discharged well.

Among the minor complications in present study, wound infection was the most common, followed minor biliary leak. The six cases with biliary leak presented between the third and the fifth postoperative day with leak of bile in the drain. The pt. was investigated by U/S, MRCP, ERCP which revealed normal biliary tree anatomy with subhepatic collection, all pt. was vitally stable with normal abdominal examination apart from mild tenderness at the right subhepatic region. The pt. was managed conservatively by keeping them nill by mouth, I.V. fluid and antibiotic. Those pt. were kept in the hospital for around 8-14 days and the amount of bile leakage started to decline within a week.

The reported figures of operative bile duct injuries are much lower than the actual incidence, a recent audit of 1522 LCs performed in Thailand revealed a bile duct injury rate of 0.59%, i.e., about four times the incidence reported for open cholecystectomy; this injury rate is similar to that found in present study (0.6%).[9] In Jordan in 2001, of 791 patients with chronic cholecystitis (CC) and 207 with acute cholecystitis (AC) who underwent LC, extrahepatic bile duct injuries were reported in only three cases.[10] After 1995, a median incidence rate of 0.3% was documented in data from both retrospective and prospective series.[11] The single most important factor responsible for bile duct injuries is misinterpretation of the patient's anatomy. Compared to the open operation, injuries sustained during LC are more often severe (e.g., excision of a segment of the CBD) and generally extend to higher levels. The majority (70-85%) of these injuries are not recognized during the operation; which is similar to present study (20%) as only one major extrahepatic CBD injury in the series was recognized intra-operatively (the one with complete transection of the CBD). Combined bile duct and hepatic arterial (right hepatic artery or common hepatic artery) injuries carry a particularly bad prognosis, with higher postoperative morbidity and mortality and poorer outcomes after remedial surgery.

The injuries of the bile duct may include partial tear, laceration, transection and even excision of a portion of the duct. These injuries are seen irrespective of the type of cholecystectomy and result in biliary stricture, which is undoubtedly the most serious complication following cholecystectomy. The severity of the complication depends on the type of injury, the delay in presentation, and on whether the patient requires a revision of an initial attempt at repair. Injuries identified and repaired at the time of the first operation afford good results.[9]

In present study, 21 patients' (11.47%) operations were converted due to difficulties encountered intra-operatively which is higher than the conversion rate of patients found in other reports which is 5.9%, 12 due to difficult anatomy (6.55%) 8 due to the discovery of adhesions (4.37%) and one patient's operations were converted due to common bile duct injuries (0.54%).[12] Acute inflammation around Calot's triangle makes the tissue friable and difficult to grasp. Dissection in such conditions leads to excessive bleeding. This, together with the distorted anatomy, increases the risk of bile duct injuries during laparoscopic cholecystectomy. On the other hand, extensive fibrosis around Calot's triangle in cases of chronically inflamed and fibrosed gallbladders may make them extremely difficult to dissect. The probability of complications in the patients who underwent laparoscopic cholecystectomy was significantly higher in those patients diagnosed with complicated gallstone disease.[13] Some authors have described the mechanism of "classic" laparoscopic injury in the presence of "normal" anatomy of the biliary tree; this pattern, occurs when the gallbladder is retracted superiorly. Surgeons believe they can see where the cystic duct is and dissect directly on to it, rather than dissecting on to the gallbladder. It is possible to follow what is believed to be the cystic duct down and then the CBD can be dissected out, clipped and then divided as the cystic duct. Dissection proceeds upwards along the medial aspect of the CBD and the common hepatic duct until damage to the right hepatic artery results.

Other authors have described a variation of this sequence of events, where faulty anterior and medial traction on the Hartmann pouch fails to open up Calot's triangle causing the cystic duct and the common hepatic duct to be mistaken. The common hepatic duct junction is pulled up into the cystic duct and then clipped and divided. This can result in distal obstruction of the CBD and a fistula through the open cystic duct remnant. Clearly if the surgeon is aware of the existence of a short cystic duct then particular care needs to be taken when clipping it.

The factor responsible for the occurrence of such complications (as in present study) is the difficulty interpreting the two-dimensional images seen in laparoscopic surgery.

A review of 74 patients referred with bile duct injuries sustained during laparoscopic cholecystectomy done at the Vanderbilt University Medical Center, Nashville, suggested that these injuries are frequently severe and are related to cautery and high clip ligation.[14]

According to the literature, the leak may be minor, arising from a small, accessory bile duct and clinically insignificant.[15] Such cases should be treated conservatively. Injuries to the accessory bile duct are the most common cause of postoperative complications.

On the other hand, a major leak due to injury to a main duct or a retained stone in the CBD may result in biliary fistula, peritonitis, or biloma.[16] Biliary fistula following LC is a common outcome in many studies; however, author hadn't faced any case in the series. Mostly, this complication results from improper application of clips or the clips slipping. ERCP helps in diagnosis and removes any doubts regarding possible major ductal injuries. The condition resolves spontaneously provided there is no

distal obstruction; the process may be hastened by the placement of a stent endoscopically.

In bile duct excision, a portion of the bile duct is lost and simple repair, as may be done in transection and laceration, is notpossible.[17] The chances of late stricture are greater in bile duct transection than in bile duct laceration, as the axial vascular supply of the CBD is damaged in transection. Biliary reconstruction in the presence of peritonitis, combined vascular and bile duct injuries or injuries at or above the level of the biliary bifurcation were significant independent predictors of poor outcome.[17]

In present study, all patients had excellent recovery and were discharged in a good condition; however, long-term follow-up was not available.

Strictures may develop early (within days or weeks) or may take years to develop and vary in both diameter and length. Early strictures may develop due to intra-operative procedures such as clamping, ligation or clipping of the duct or thermal injury. Local infection may also result in both early and delayed stricture formation. Thermal injury and occult malignancy are important causes of delayed stricture formation.

Fundus-first cholecystectomy is well recognized as a safe technique during open cholecystectomy as well as during laparoscopic cholecystectomy, because it minimizes the risk of injuries to the biliary structures at the Calot's triangle.[18]

Further specialized training to heighten awareness of the possible problems relating to the anatomy of the Calot's triangle is essential.

Since injuries occurring at laparoscopic cholecystectomy are frequently more severe and extend to a higher level than those that occur during open cholecystectomy, prevention should always be the aim.[19]

Prevention

Bile duct injury should be regarded as preventable, but over 70 per cent of surgeons regard it as unavoidable.[20]

It has been suggested that the commonest cause of common bile duct injury is misidentification of biliary anatomy (70-80 per cent of injuries). Several techniques were proposed to prevent injury: a 30◦ telescope, avoidance of diathermy close to the common hepatic duct, dissection close to the gallbladder cystic duct junction, avoidance of unnecessary dissection close to the cystic duct common hepatic duct junction, and conversion to an open approach when uncertain.[21] However, to apply these techniques, correct interpretation of the anatomy is required. Most cases of bile duct injuries are not recognized at the time of injury, suggesting that anatomical orientation is a major problem. To overcome this and to facilitate orientation before starting dissection, it is recommended to identify Rouviere's sulcus as a fixed extra-biliary point ventral to the right portal pedicle, dissection ventral to this allows a triangle of safe dissection when the gallbladder has been reflected cephalad, extending this dissection as far as possible up the gallbladder fossa both posteriorly and anteriorly allows the hepatobiliary triangle to open out. This ensures no unexpected anatomy and confirms the correct anatomical position before any significant structure is divided. No dissection should occur in the hepatoduodenal ligament at the base of segment IV in figure 6 as the left hepatic duct lies extrahepatically within this tissue. Although controversial, there is no randomized controlled trial on the relationship of intraoperative cholangiography and the incidence of bile duct injury, and it is unlikely that one will be conducted given the number of patients required to address this issue. Three population-based studies have shown a reduction in risk if surgeons perform routine intraoperative cholangiography, although all are subject to bias.[22]

It was reported that the risk of injury is reduced eightfold in the presence of complicated gallstone disease.[23,24] other reports show a twofold reduction in risk of bile duct injury with routine use of intraoperative cholangiography for inexperienced surgeons. Key components in minimizing ductal injury include surgeon experience, adherence to well-defined dissection principals, and cholangiography.[25,26] Routine use of cholangiography is cost-effective with maximum efficiency achieved when used by inexperienced surgeons or when complex disease is encountered. Others have argued that bile duct injury is not prevented by cholangiography, and that only meticulous dissection and correct interpretation of anatomy will avoid this complication.[27] Despite this controversy there is good evidence to show that intraoperative cholangiography is likely to identify the injury at the time of surgery. Some authors report that 81 percent of bile duct injuries were detected at the time of initial surgery when a cholangiogram was obtained in comparison to only 45 per cent when it was not employed.

This has significant implications for the patient given the improved outcome associated with early appropriate repair.[28]

CONCLUSION

Biliary injury is the Achilles' heel of laparoscopic Cholecystectomy. It can have devastating effects, turning the individual into a "biliary cripple". They mainly result from anatomical anomalies and errors of human judgment and are thus preventable to some extent.

The costs are reduced, and outcome improved if these injuries are diagnosed early (during operation or the early postoperative period). Adding the experience gained from

open cholecystectomy on the one hand and the advantages of laparoscopic cholecystectomy, in terms of visualization and magnification on the other will help in reducing the incidence of such complications.

Recommendations

Careful selection of patients for LC. with prompt conversion on requirement is crucial for safe LC. Cholecystectomy related biliary injury once happened should be managed, by expert team to provide stepwise management according to circumstances with referral to specialized center if needed is a corner stone for proper management to lessen the tragedy of its morbidity and mortality.

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