Biliary leak after laparoscopic cholecystectomy: incidence and management

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Background
Biliary leak represents an unusual complication of laparoscopic cholecystectomy (LC). The origin of biliary leak is multifactorial, that may arise from gallbladder bed, cystic duct, or injuries of a major bile duct. Even with standardization and growing experience, LC still involves threat of damage of the biliary tree. The reported incidence of iatrogenic bile duct injuries was 0.3–0.9%. As the occurrence of iatrogenic bile duct injury remains high, it is still a determining factor for morbidity related to LC.
Patients and methods
This study was a case series of 1000 cases who underwent LC. Twenty cases complaining from biliary leakage following LC had been reported consecutively. The age of patients was 22–57 years and sex was dispensed as 780 females and 220 males. There were five (25%) males and 15 (75%) females in the studied patients. The statistics had been acquired from the cases getting admitted with bile leak following LC or developed bile leak post-LC, had been managed properly, and the follow-up period was 3 months.
Results
In the current study, there were 20 cases; out of the 1000 patients that underwent LC complaining from biliary leakage, 14 of the 20 patients were presented with bile leakage following LC, which was attributed to gallbladder bed, duct of Luschka, and minor accessory duct, two cases due to unsecure or slipped ligature of the cystic duct, and a slipped clip. Two cases due to injury to common hepatic duct and the other two cases due to direct injury to common bile duct. The definitive treatment of biliary leakage was done. All cases were treated therefore with the use of endoscopy in four cases (plus percutaneous techniques in two patients) and surgical intervention in one patient and one patient died. The endoscopic management proved very effective in cases with simple biliary leakage than patients with complex bile leak.
Conclusion
Biliary leakage post-LC is an unusual problem. The incidence in most reported studies is much less than 2% and, in the current study, it was precisely 2%. The management of that leakage varies from conservative management, endoscopic retrograde cholangiopancreatography, and insertion of stent and surgical intervention. The long-term prognosis will rely on early diagnosis and successful treatment.

Keywords:
bile duct, bile leak, laparoscopic cholecystectomy, percutaneous

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Introduction

Laparoscopic cholecystectomy (LC) comes to be the favored technique for management of cholelithiasis and an increasingly more approach performed for acute cholecystitis [1]. Inspite of the brilliant effect of LC for treatment of cholelithiasis, however, surgeons retain to stand challenges for the utility of LC in surgery [2]. Nowadays, LC may be a straightforward surgical procedure, however, it can also be a surgical procedure fraught with underlying difficulties. The anatomical variations and the severity of the underlying pathology make LC difficult in different situations. Many surgeons continue to be tremendously inexperienced in laparoscopy in regard to the technical nuances that permit for a success and secure completion of a difficult LC [3].

LC remains a really secure approach with a mortality rate of 0.22–0.4% [4]. Major morbidity takes place in about 5% of cases [5]. The most dreaded complication of LC is biliary injury and leakage.

Biliary leakage is an infrequent disorder but critical. The causes of biliary leakage may be due to traumatic causes or most commonly iatrogenic [6]. The tremendous causes occur following hepatobiliary surgical procedures and the remarkable causes always follow LC or open cholecystectomy [7]. Bile duct injuries take place in about 0.1–0.2% in open cholecystectomy and 0.3–0.8% at LC [8]. Biliary leak is commonly the end result of direct injuries to the bile duct, unsecure or slipped ligature or clip of the stump of the cystic duct, or bile leak from the liver bed and commonly induced with blockage of the distal part of the duct from residual stone or stricture [9]. Minor biliary leak can disappear spontaneously, while major leak can result in drastic effects to the patient [10]. The cases presented with internal or external bile leak, leading to localized or generalized biliary peritonitis [11]. About 10–24% of bile duct injuries are identified during surgery, while the remaining injuries are recognized after surgery or discharge [12]. Proper treatment is the cornerstone for pleasant outcomes. Improper treatment commonly leads to critical comorbidities and repair becomes more difficult [13]. Surgical intervention is associated with high satisfactory results, however, it is related to severe comorbidities and associated with a higher mortality rate [14,15]. Endoscopy with evidenced outcomes identical to surgical results has become the management of choice [16]. In comparison with surgical procedure, endoscopy can also additionally need multiple sessions, and its efficacy is not satisfactory in all patients [17]. The quality of surgical treatment versus endoscopy of biliary leakage remains one of the essential difficulties facing surgeons.

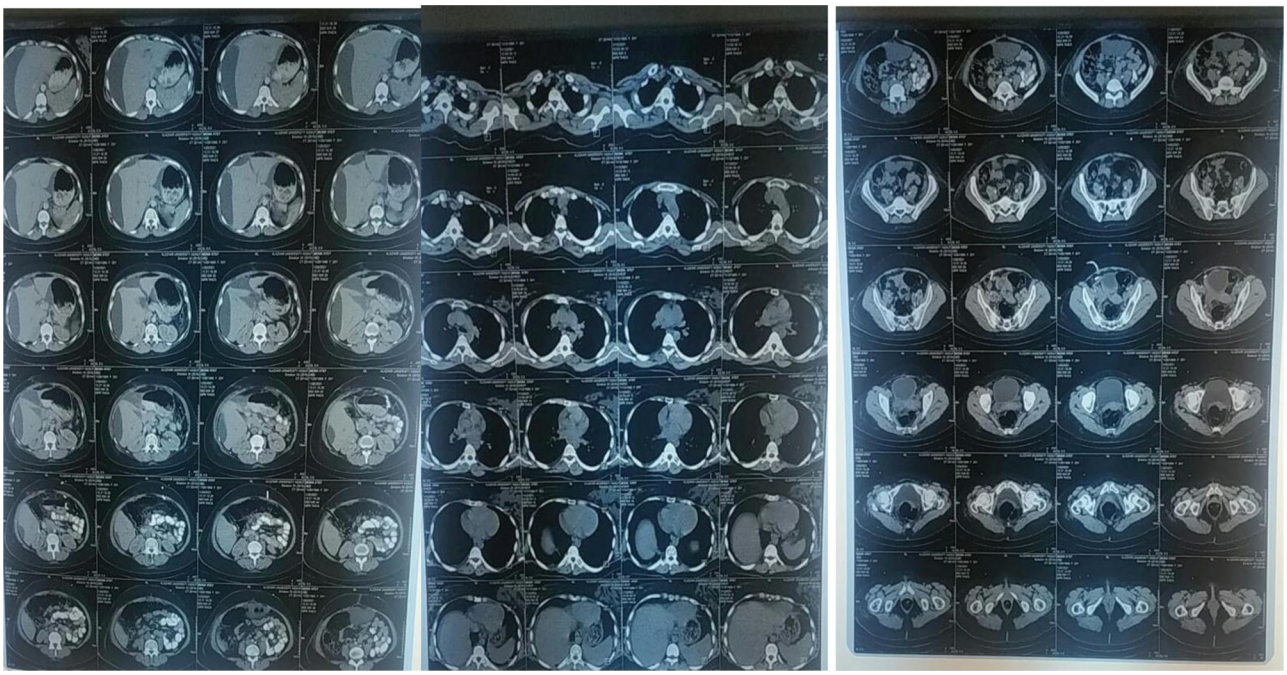
Data recommended that the incidence of bile duct injuries throughout open cholecystectomy is one in 500–1000 patients, but their occurrence is clearly higher throughout LC. Although a wide variety in their appearance may occur in recorded series, the highly correct statistics was most probably reported from surveys encompassing thousands of cases. These reviews reflect the outcomes from many surgeons in each community and teaching hospitals. The outcomes of those series advocate an incidence of bile duct injuries [18].

Furthermore, the prevalence of bile duct injuries related to LC does not appear to have diminished in more recent surveys, suggesting that the previously observed elevation is not always definitely the end result of a learning curve related to the laparoscopic approach. Finally, because of the increasing frequency of LC, it is expected that one in every two or three surgeons will create a bile duct injury throughout his or her career [19].

Patients and methods

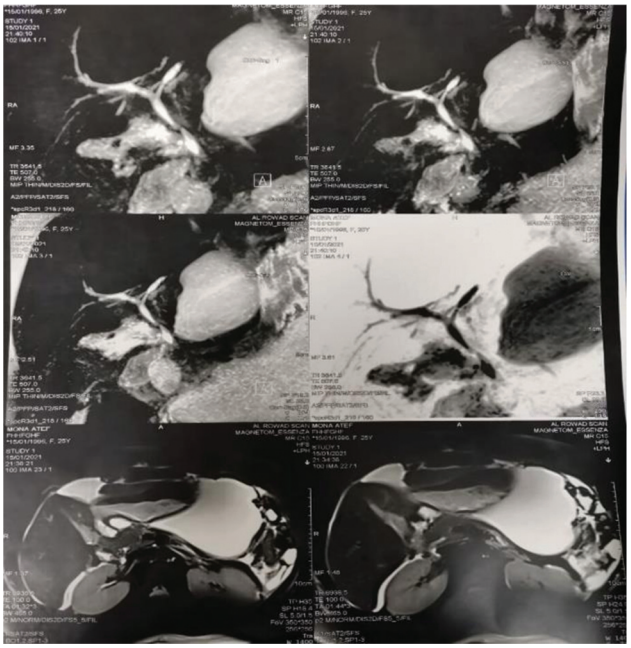
This retrospective study was performed at the Department of General Surgery, Al-Azhar University Hospital, Assiut, between October 2015 and September 2020. This paper was a case series of 1000 cases that underwent LC. Twenty cases with a biliary leakage following LC had been reported consecutively. After approval from the local ethical committee, an informed written consent was taken from all cases who accepted to participate in this research article. The age of the cases varied from 22 to 57 years and sex was dispensed as 780 females and 220 males. There were five (25%) males and 15 (75%) females in the studied patients. Full history was taken, physical examination, laboratory investigations (complete blood count, liver function tests, and coagulation profiles), and radiological investigations as ultrasonography had been reported. Computed tomography (CT) (Fig. 1) or MRI (Fig. 2) was achieved in certain patients. In this study, the period for follow-up was 3 months. Twenty cases with cholecystitis (acute and chronic) who undergo LC and suffering from postoperative bile leak, were included in this study. This paper did not include cases that had bile leakage following LC converted to open procedure, bile leakage due to other procedures, and bile leak discovered and definitively treated intraoperatively. Also, the cases associated with biliary leakage due to traumatic causes, rupture, associated biliary malignancy, or vascular injuries were excluded. There were five (25%) males and 15 (75%) females in the studied patients. Biliary leakage was recognized clinically (abdominal pain, fever, distension, nausea, tenderness, and jaundice) and radiological diagnosis as ultrasonography and/or CT and confirmed throughout cholangiogram. Cases had been categorized actually in line with cholangiographic and operative findings into two groups: simple biliary leakage that consists of leakage at liver bed, unsecure or slipped ligature, or clip of the stump of the cystic duct (Fig. 3), accessory duct leakage, and complex biliary leakage that consists of complete duct transaction. The treatment of these cases started with endoscopic retrograde cholangiopancreatography (ERCP) alone (Fig. 4) or with percutaneous technique (Fig. 5) to the more invasive surgery. When a significant localized collection had been determined, a radiologically guided drainage was achieved, but when the collection had been massive and diffuse, drainage was carried out either laparoscopically or via open approach, either

Figure 1



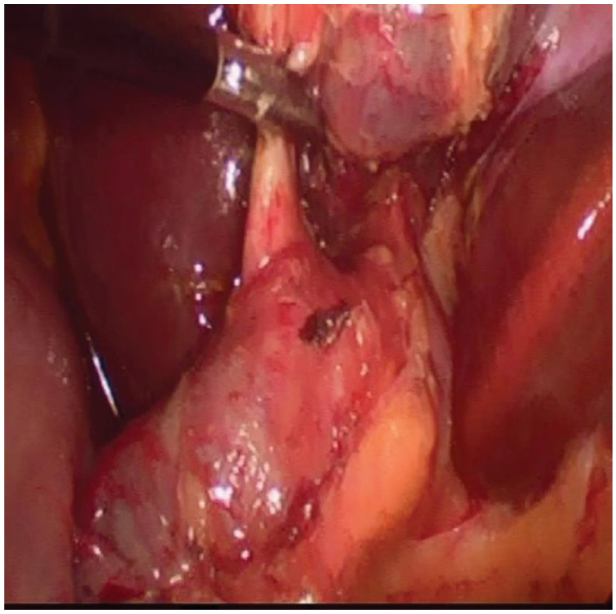
MSCT abdomen and pelvis with contrast showing RT sub-phrenic, porta hepatis, and umbilical region peritoneal localized collections and multiple inserted drains. MSCT, multislice computed tomography; RT, right.

Figure 2



MRCP showing biliary leak and stricture of CBD. CBD, common bile duct; MRCP, magnetic resonance cholangiopancreatography.

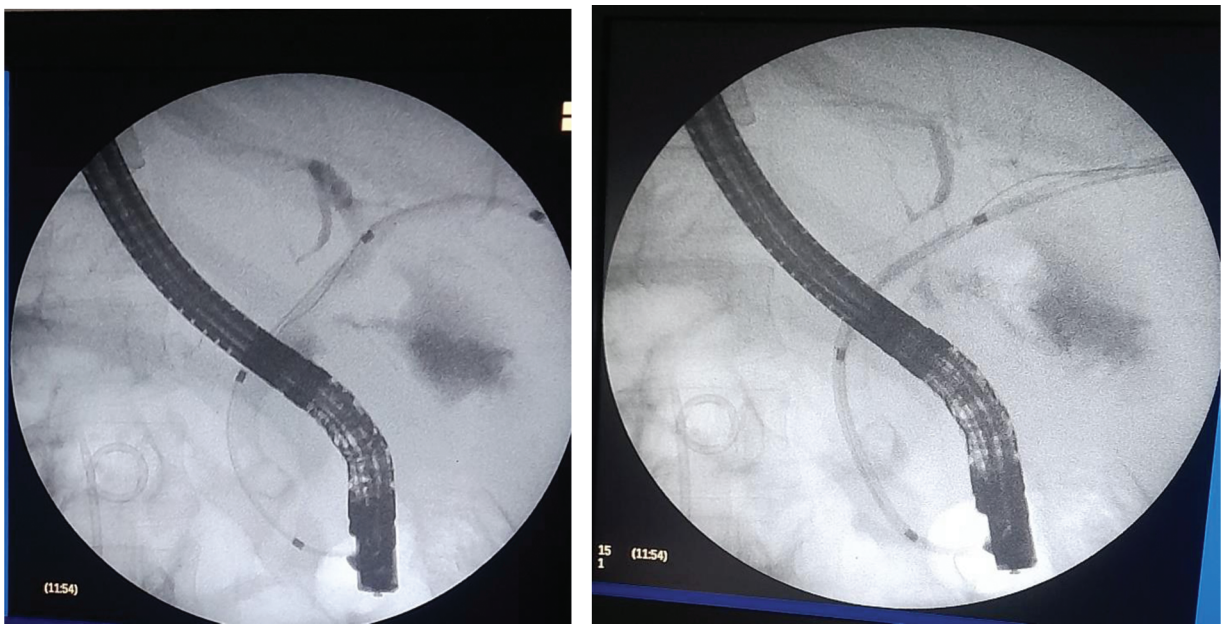
Figure 3



Dissection showed a wide cystic duct and dilated CBD. CBD, common bile duct.

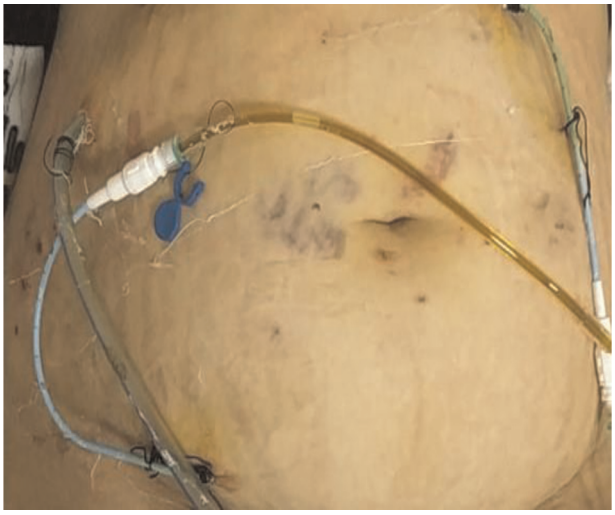
before or after the required approach. For simple biliary leakage, the cases underwent combined endoscopic sphincterotomy plus plastic stent (10 F, 9–12 cm), straddling the site of the leakage (Fig. 4). For cases with biliary leakage and retained stones, an endoscopic sphincterotomy, removal of stone, and insertion of stent was performed (Figs 4 and 5). For further evaluation and removal of stent, ERCP was repeated 2–3 months post the performed procedure. Cholangiography was carried out for confirmation of healing and lack of stricture or residual stone, and as a result, they had been treated. When ERCP failed, the percutaneous intervention was achieved either in the form of percutaneous transhepatic drainage [percutaneous transhepatic cholangiography (PTC)]

Figure 4



ERCP showing biliary leak that was managed with stenting. ERCP, endoscopic retrograde cholangiopancreatography.

Figure 5



Percutaneous drainage.

before surgical intervention or a part of combined approaches (Rendezvous procedure). Urgent surgical interventions were achieved with massive and diffuse collection not appropriate for percutaneous drainage, but elective surgery following failure or unsuitable nonsurgical management.

Follow-up

Third-generation cephalosporin antibiotics (cefoperazone), or quinolone and metronidazole infusion was prescribed for most cases. The parameters of hospital discharge were achieved through improvement clinically and radiologically, and close follow-up in the outpatient clinic. Main outcome measurements: successful treatment was obtained by improvement of both clinical, laboratory, and radiological parameters and normal ERCP with removal of stent with no additional drastic effects.

The method of collection of data, operative, and postoperative reports had been scrutinized and data collected. In this paper, clinical presentations after bile leakage, the time of detection of postoperative biliary leakage either less than 24 h or more than 24 h, acute or chronic cholecystitis at the time of the procedure, amount of bile leakage, duration of biliary leakage, postoperative investigations [magnetic resonance cholangiopancreatography (MRCP), CT abdomen, and ultrasonography] for biliary leakage, different modalities of treatment and their end results, and site of biliary leakage were noted.

Statistical analysis

Statistical analysis was achieved throughout using the Statistical Package for Social Sciences (SPSS), version 16 (SPSS Inc., Chicago, Illinois, USA). Descriptive data were expressed as mean and SD or medians and ranges for continuous variables and as number and percent for categorical variables.

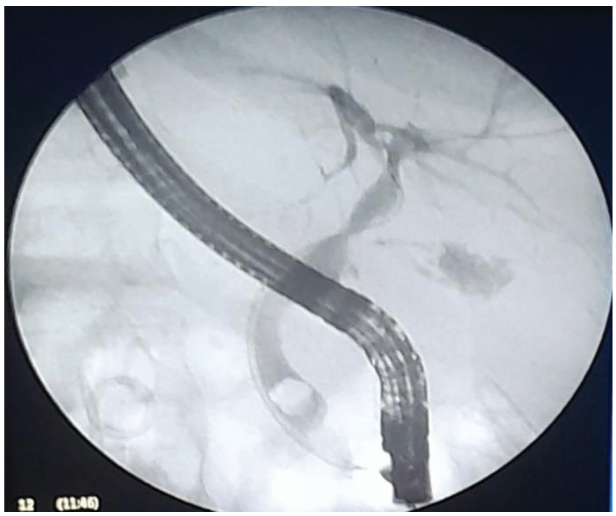
Results

Percutaneous drainage of a collection under ultrasound/CT guidance had been performed before ERCP in two cases (Fig. 6) and laparoscopic lavage in

one patient before ERCP; in another case, laparoscopic lavage had been done immediately post-ERCP period. Common bile duct (CBD) cannulation and cholangiography at ERCP was a success in most patients. In a single case, the cholangiographic finding showed complete transection of the right-hepatic duct, and this case finally underwent Roux-en-Y hepaticojejunostomy. Leakage at the stump of the cystic duct was reported in two patients. In one patient, CBD stone was documented (Fig. 6); in this patient, choledocholithiasis was detected at intraoperative cholangiogram, and postoperative ERCP and sphincterotomy were made for its management. In this patient, the biliary leakage was unexpected and only reported at the time of ERCP. Common hepatic duct (CHD) leakage was documented in two patients. Endoscopy was tried in four (66.6%) of the six cases; the case with complete division of the RHD (Strasberg type-C injury) underwent open reconstruction. Endoscopic sphincterotomy was performed in three patients, from the four patients that underwent ERCP with stent placement (Fig. 4), while in a single case, a stent was placed without sphincterotomy. As regards to complications associated with endoscopy, only two cases were reported. In the first one, the affected persons developed a mild form of acute pancreatitis, who underwent conservative treatment after staying for 7 days in the hospital. The second case presented with deep-venous thrombosis throughout hospitalization without further complications.

Table 1 shows the description of age in all studied patients. The mean age of all studied cases was 41.1 ±9.5 years with minimum age of 22 years and maximum age of 57 years.

Figure 6



ERCP showing stricture, leak, and missed stone. ERCP, endoscopic retrograde cholangiopancreatography.

Table 2 shows the description of sex in all studied patients. There were five (25%) males and 15 (75%) females in the studied patients.

Table 3 shows the description of indications in all studied patients. It was due to acute cholecystitis in 13 (65%) patients and chronic calcular cholecystitis in seven (35%) cases.

Table 4 shows the description of time presented postoperative in all studied patients. It was at the first day in 17 (85%) patients, third day in two (10%) patients, and fifth day in one (5%) patient.

Table 5 shows the description of the mode of presentations in all studied patients (Fig. 7). It was presented by abdominal distension in 13 (65%) cases, abdominal pain in cases (30%), tachycardia in 17 (85%) cases, fever in five (25%) cases, and bile drain in 19 (95%) cases.

Table 1 Description of age in all studied patients

Ages (years)	Studied patients (*N*=20)
Mean±SD	41.1±9.5
Minimum–maximum	22–57

Table 2 Description of sex in all studied patients

Sex	Studied patients (*N*=20)	
Male	5	25%
Female	15	75%

Table 3 Description of indications in all studied patients

Indication	Studied patients (*N*=20)	
Acute cholecystitis	13	65%
Chronic calcular cholecystitis	7	35%

Table 4 Description of time presentation of postoperative biliary leak in all studied patients

Time presented postoperative	Studied patients (*N*=20)	
1st day	17	85%
3rd day	2	10%
5th day	1	5%

Table 5 Description of the mode of presentations in all studied patients

Mode of presentation	Studied patients (*N*=20)	
Abdominal distention	13	65%
Abdominal pain	6	30%
Tachycardia	17	85%
Fever	5	25%
Bile in drain	19	95%

Table 6 shows the description of investigations in all studied patients. Ultrasound was done in 18 (90%) patients, CT was done in five (25%) patients, and MRCP was done in six (30%) patients (Fig. 8).

Table 7 shows the description of liver enzymes in all studied patients. The mean alanine transaminase (ALT) in all studied patients was 40.45±14.3 U/l with minimum ALT of 21 U/l and maximum ALT of 67 U/l. The mean aspartate transaminase (AST) in all studied patients was 52.6±15.09 U/l with minimum AST of 34 U/l and maximum AST of 95 U/l.

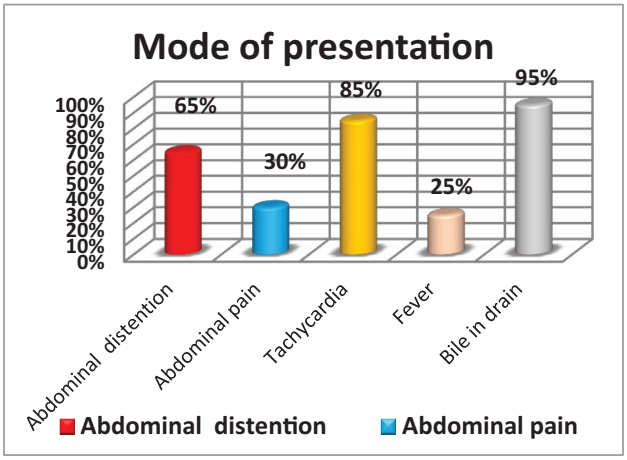
Table 8 shows the description of grade in all studied patients. It was CBD injury in two (10%) patients, CHD injury in one (5%) patient, CHD transection in one (5%) patient, cystic duct leak in two (10%) patients, gallbladder fossa, duct of Luschka accessory duct, and minor accessory duct in 14 (70%) patients.

Table 9 shows the description of intervention in all studied patients. Conservative with controlled external fistula was done in 14 (70%) patients, ERCP alone was done in one (5%) patient, ERCP and stone extraction was done in one (5%) patient, hepaticojejunostomy was done in one (5%) patient, and percutaneous drainage and ERCP was done in two (10%) patients, while there was one (5%) patient who died before any intervention.

Table 10 shows the description of discharge days in all studied patients. There were four (20%) patients discharged after 5 days, three (15%) patients discharged after 6 days, six (30%) patients discharged after 7 days, one (5%) patient discharged after 8 days, two (10%) patients discharged after 10 days, two (10%) patients discharged after 12 days, and one (5%) patient discharged after 20 days.

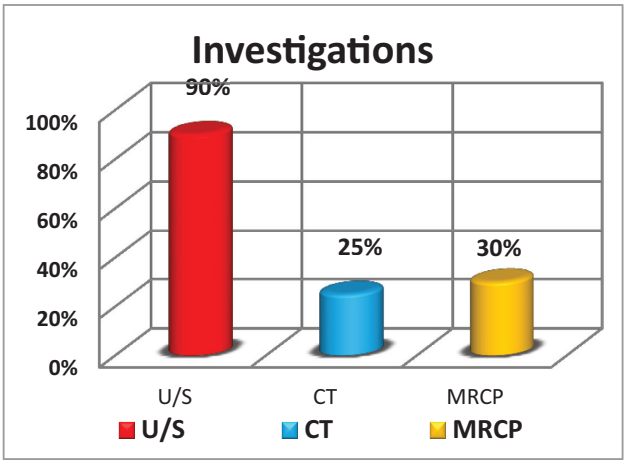
A total of 1000 cholecystectomies had been performed in the current study, out of which 10 cases that underwent or had been converted to open

Figure 7



Description of the mode of presentation in all studied patients.

Figure 8



Description of investigations in all studied patients.

Table 6 Description of investigations in all studied patients

Investigations	Studied patients (*N*=20)	
U/S	18	90%
CT	5	25%
MRCP	6	30%

CT, computed tomography; MRCP, magnetic resonance cholangiopancreatography; U/S, ultrasound.

Table 7 Description of liver enzymes in all studied patients

	Studied patients (*N*=20)
ALT (U/l)	
Mean±SD	40.45±14.3
Minimum–maximum	21–67
AST (U/l)	
Mean±SD	52.6±15.09
Minimum–maximum	34–95

ALT, alanine transaminase; AST, aspartate transaminase.

Table 8 Description of the site of injury in all studied patients

Grades	Studied patients (*N*=20)	
CBD injury	2	10%
CHD injury	1	5%
CHD transection	1	5%
Cystic duct leak	2	10%
GB bed, Duct of Luschka, and minor accessory duct	14	70%

CBD, common bile duct; CHD, common hepatic duct; GB, gallbladder.

Table 9 Description of intervention in all studied patients

Intervention	Studied patients (*N*=20)	
Conservative with controlled external fistula	14	70%
ERCP	1	5%
ERCP and stone extraction	1	5%
Hepaticojejunostomy	1	5%
Percutaneous drainage+ERCP	2	10%
Died before any intervention	1	5%

ERCP, endoscopic retrograde cholangiopancreatography.

Table 10 Description of intervention in all studied patients

Discharge time	Studied patients (*N*=20)	
5 days	4	20%
6 days	3	15%
7 days	6	30%
8 days	1	5%
10 days	2	10%
12 days	2	10%
20 days	1	5%

cholecystectomy were excluded from our study. In the present study, 20 patients of biliary leakage were reported, out of which six patients had been recognized as major bile duct injuries and the last 14 patients of biliary leakage had been identified as originated from gallbladder fossa, duct of Luschka, or minor accessory duct injuries thhhat were resolved spontaneously after conservative treatment (Table 9). Out of the 20 (0.20%) patients of bile leak, four patients had been recognized as major bile duct injuries, and out of four cases, two patients with major bile duct injuries were managed endoscopically via ERCP and stenting and percutaneous drainage were done, and one patient had undergone hepaticojejunostomy later and the last one died in the hospital without any surgical interference due to generalized biliary peritonitis and sepsis due to delayed intervention.

Out of the 20 patients of bile leak, two cases causing leak were due to cystic duct causes: one from slipped clip and another one from inappropriate ligation of the cystic duct; both patients were managed via minimally invasive (endoscopic treatment) alone in one patient and with percutaneous drainage in the second one. About 85% (17 patients) of bile leakage was identified within 24 h, and in the last three patients, it was detected late (Table 4). The amount of biliary leakage in most of the patients (15 out of 20) is more than 500 ml and the mean duration of biliary leakage in major bile duct injuries is 7.33 days and the duration of minor biliary leakage is 7.14 days. Almost all cases of post-LC bile leakage manifested with abdominal distension (65%) and tachycardia (85%) due to bilomas. There were manifestations of abdominal distension in 13 (65%) patients, abdominal pain in six (30%) cases, tachycardia in 17 (85%) cases, fever in cases (25%), and bile in drain in 19 (95%) patients (Table 5).

Radiological assessment of the 20 patients with biliary leak consists of ultrasonography abdomen (90%) (18 cases), MRCP (30%) (six cases), and CT abdomen (25%) (five cases) (Table 6, Fig. 8). As regards to the condition of cases, six cases out of 20 cases were assessed for the site of bile duct injuries. The origin of bile duct injuries was identified to be CHD in 10% (two cases), CBD in 10% (two cases), and cystic duct in 10% (two cases). In about 70% (14 patients), bile leakage was discovered to be from the fossa of the gallbladder, duct of Luschka, or injury of minor accessory ducts. Biliary leakage that was recognized to be from the bed of gallbladder, duct of Luschka, or accessory duct injury was spontaneously resolved after controlled external biliary fistula. Conservative management consists of controlled external biliary fistula that was taken into consideration in 70% (14 cases) that underwent spontaneous resolution in more than 1 day. Surgical intervention was reported in the form of hepaticojejunostomy in one (5%) case, the other patient (5%) died from bad sequels after bile leakage because of not in-time referral to the hospital. Out of 20 patients, 19 (95%) cases recovered without major drastic effects and follow-up for 3 months without any complaint. The other patient (5%) died due to biliary peritonitis who had been presented late.

Discussion

Generally, cholecystectomies are the most achieved abdominal operations everywhere in the world. Bile leakage following either LC or open cholecystectomy due to bile duct injuries is a probably devastating problem of this otherwise-secure surgical approach [20]. The drastic outcomes of bile duct injuries can vary from minor clinically inconsiderable biliary leakage, bilomas, and biliary ascites to biliary peritonitis, marked sepsis, or even loss of life of the patient in the acute condition, and stricture of the bile duct, secondary biliary cirrhosis, portal hypertension, and end-stage liver disease that required liver transplantation in the long term. Adequate and early interventions can commonly salvage the condition and saving the affected person from major morbidity and mortality. Many researches have proven that the incidence of biliary injury has decreased over time [21,22] and in line with a few authors, the patients

referred with iatrogenic bile duct injury have also declined [23,24]. However, numerous modern studies have recommended no big difference in the occurrence of bile duct injury over time [22], and the variety and complexity of patients referred for repair have remained fixed at few specialized centers [24]. However, continuity of appearance bile duct injury by an inexpert surgeon has been maintained [25]. LC has replaced the open procedure, as the LC accompanied with much less discomfort, rapid recovery and short hospitalization, and better cosmesis. However, LC has been related to a higher occurrence of bile duct injury than open procedure, varying from 0.5 to 2.0% [8]. As regards the study of Adamsen *et al*. [25], bile duct injury is more reported after LC, which includes fistula, which was recorded in 1.3–5.5% of patients [10]. Ali *et al*. [26] and Karvonen *et al*. [8], additionally reported that bile duct injury is often recoded more in the LC (0.2–0.7%) than in open cholecystectomy (0.1–0.4%).

Minor bile duct injuries were a frequently reported problem of LC and were recorded at an incidence of ~1.2% [6,8,27]. If the management were unsuitable, those injuries constitute an iatrogenic catastrophe that decreases the quality of life of the patients and leads to critical morbidity and mortality [28]. Currently, using of endoscopy in treatment of minor biliary tree injury has been associated with a high success rate with marked reduction in morbidity. ERCP can be used for diagnosis of the anatomical site of leakage and overcoming the pressure gradient at the ampulla of Vater, which will permit for flowing of bile to the duodenum and away from the leakage site. This facilitates rapid healing of the injured site [29]. In the current study, we have discovered that the mean duration of biliary leakage was 7.33 days that agreed to the study performed by Chen *et al*. [29] (9 days). It the present study, ultrasound and CT scan of the abdomen and pelvis were the commonly performed investigations in postoperative bile leakage [9]. In our study, the MRCP was performed for delineation of the anatomy of biliary tree and detection of the site of injury, which agreed to the study performed by Mungai *et al*. [30], which records that MRCP combined with hepatobiliary contrast-enhanced MRI is a beneficial method that offers comprehensive data about the biliary tree and can locate the site of bile leakage and differentiate it from different postoperative complications. In our study, the commonest sites of biliary leak were documented to be originated from the bed of the gallbladder, duct of Luschka, and from minor accessory bile duct. Type A (leak from the cystic or bile duct of Luschka) was the most frequently reported biliary injury in this study, which agreed with the study performed by Strasberg *et al*. [31]. When the continuity of biliary-enteric is reported, and bile flow is not obstructed distal to the fistulous origin, a prolonged period of conservative management is recommended due to the fact that the fistula closed spontaneously. Recently, conservative management in the form of external drainage of bile has proven tremendous outcomes in the treatment of biliary leakage. However, in the presence of major bile duct injury, surgical intervention must be taken into consideration [32,33]. Conservative management in the form of controlled external biliary fistula had been performed in up to 70% of cases in this research article, out of which 70% of the patients presented with leakage spontaneously closed in 2 days with controlled external biliary fistula. That agrees with the study of Chen *et al*. [30], in which the nonsurgical management of biliary leak was effective in 82.5% of cases. In the current study, only one (5%) patient underwent surgical intervention in the form of hepaticojejunostomy, cases associated with biliary leakage but without considerable major duct injuries usually not in need to intervention, but percutaneous external drainage of the bilomas, ERCP with ES, or placement of the temporary stent may be mandatory. Major bile duct injury with or without considerable biliary leakage needs more invasive treatment, such as biliary reconstruction [29]. The other 5% (one case) died from complications after bile leakage because of marked sepsis.

ERCP and PTC can determine the continuity of biliary tree, find the actual site of biliary leak, and, consequently, permit for correct management of injury by appropriate decompression or dilation of the biliary system. However, those procedures are invasive, use significant quantity of radiograph, and related to drastic effects such as pancreatitis particularly following ERCP, bleeding, and cholangitis following PTC [34]. The other negative aspects encompass the inability to detect the extrabiliary anomalies and no visualization of ducts upstream or downstream from an obstructing lesion (stricture and stone). Moreover, occasionally the technique of PTC may be difficult as intrahepatic bile ducts are commonly not dilated [29]. ERCP does not usually display the actual site of leak in minor biliary injury, but the most reported sites are the cystic duct stump and bed of gallbladder. This is shown through both the modern study and formerly posted data. If a major biliary injury is recognized at ERCP, the affected person needs to refer for attention of biliary reconstruction. If the actual site of leak cannot be identified after ERCP, the affected person has to refer for further investigations. An excluded biliary

segment following transection during LC will not be visible in ERCP and these cases can be identified with MRCP or CT-IVC [29].

Most reported studies focus on the value of ERCP in the treatment of bile leakage following LC, but in many patients, the use of endoscopy can manage the original cause of the leak, because it stops the leakage. For dealing with the localized or diffuse biliary collections secondary to the leakage, supplementary measures may be required. In those studies, a successful combination of endoscopy and radiology or laparoscopy was used, making all efforts to avoid the requirement for open intervention in all patients. These studies are complementary to preceding evaluations that verify the safety and efficacy of minimally invasive techniques in the treatment of symptomatic biliary leakage after minor bile duct injury-related LC. Endoscopic management by using of ERCP is the cornerstone of treatment, with the aid of using either radiological intervention or laparoscopic approach [35].

In our study, the biliary leak was more reported in acute cholecystitis in 13 (65%) patients and chronic calcular cholecystitis in seven (35%) patients due to massive adhesions and the inability to achieve the 'critical view of safety' in all patients with unclear anatomy of the Calot's triangle, due to delayed LC [36].

Conclusion

Bile leak following LC due to major bile duct injuries is infrequent though not usual. Biliary leakage takes place from accessory bile duct, duct of Luschka, and fossa of the gallbladder that underwent conservative treatment and cautious observation. Only biliary leakage from major bile duct injury needs to be treated promptly and required a well-trained and skilled surgeon.

Endoscopic management has been an alternative to surgical intervention in all simple cases presented with postoperative biliary leakage as an equal definitive management. Surgical intervention has been the definitive management of complicated postoperative biliary leak, but endoscopic treatment was an obligatory complementary tool in the preliminary treatment.

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Nil.

Conflicts of interest
There are no conflicts of interest.

References

1 Morgenstern L. Carl Langenbuch and the first cholecystectomy. Surg Endosc 1992; 6:113–114.
2 Tompkins RK. Laparoscopic cholecystectomy. Threat or opportunity?. Arch Surg 1990; 125:1245.
3 Gallstones and laparoscopic cholecystectomy. NIH Consens Statement 1992; 10:1–28. No authors listed. PMID: 1301217.
4 Zhou PH, Liu FL, Yao LQ, Qin XY. Endoscopi; treatment of posto]p-cholecystectorny syndrome. Pancreat Dis Int 2003; 2:117–120.
5 Moore K, Dailey A. Clinically oriented anatomy. Philadelphia, PA: Lippincott Williams & Wilkjns; 2008.
6 Pioche M, Ponchon T. Management of bile duct leaks. J Visc Surg 2013; 150:S33–S38.
7 Chinnery GE, Krige JEJ, Bornman PC, Bernon MM, Al-Harethi S, Hofmeyr S, *et al.* Endoscopic management of bile leaks after laparoscopic cholecystectomy. S Afr J Surg 2013; 51:116–121.
8 Karvonen J, Gullichsen R, Laine S, Salminen P, Grönroos JM. Bile duct injuries during laparoscopic cholecystectomy: primary and long-term results from a single institution. Surg Endosc 2007; 21:1069–1073.
9 Davids PH, Rauws EA, Tytgat GN, Huibregtse K. Postoperative bile leakage: endoscopic management. Gut 1992; 33:1118–1122.
10 Mortensen J, Kruse A. Endoscopic management of postoperative bile leaks. Br J Surg 1992; 79:1339–1341.
11 Collins PG, Gorey TF. Iatrogenic biliary stricture: presentation and management. Br J Surg 1984; 71:980–982.
12 Way LW, Stewart L, Gantert W, Liu K, Lee CM, Whang K, *et al.* Causes and prevention of laparoscopic bile duct injuries: analysis of 252 cases from a human factors and cognitive psychology perspective. Ann Surg 2003; 237:460–469.
13 Rauws EAJ, Gouma DJ. Endoscopic and surgical management of bile duct injury after laparoscopic cholecystectomy. Best Pract Res Clin Gastroenterol 2004; 18:829–846.
14 Agarwal N, Sharma BC, Garg S, Kumar R, Sarin SK. Endoscopic management of postoperative bile leaks. Hepatobiliary Pancreat Dis Int 2006; 5:273–277.
15 de Reuver PR, Busch OR, Rauws EA, Lameris JS, van Gulik TM, Gouma DJ. Long-term results of a primary end-to-end anastomosis in peroperative detected bile duct injury. J Gastrointest Surg 2007; 11:296–302.
16 Singh V, Narasimhan KL, Verma GR, Singh G. Endoscopic management of traumatic hepatobiliary injuries. J Gastroenterol Hepatol 2007; 22:1205–1209.
17 Chaudhary A. Treatment of post-cholecystectomy bile duct strictures – push or sidestep? Indian J Gastroenterol 2006; 25:199–201.
18 Bertrand C. Prevalence of bile duct injury following cholecystectomy. Acta Chir Belg 2003; 103.
19 Sicklick JK, Camp MS, Lillemoe KD, *et al.* Surgical management of bile duct injuries sustained during laparoscopic cholecystectomy: perioperative results in 200 patients. Ann Surg 2005; 241:786–795.
20 Russell JC, Walsh SJ, Mattie AS, Lynch JT. Bile duct injuries, 1989-1993. A state wide experience. Conneticut laparoscopic cholecystectomy registry. Arch Surg 1996; 131:382–388.
21 Fletcher DR, Hobbs MS, Tan P, Valinsky LJ, Hockey RL, Pikora TJ, *et al.* Complications of cholecystectomy: risks of the laparoscopic approach and protective efforts of operative cholangiography: a population-based study. Ann Surg 1999; 229:449–457.
22 Woods MS, Traverso LW, Kozarek RA, Tsao J, Rossi RL, Gough D, Donohue JH. Characteristics of biliary tract complications during laparoscopic cholecystectomy: a multi-institutional study. Am J Surg 1994; 167:27–33.
23 Walsh RM, Henderson JM, Vogt DP, Mayes JT, Grundfest-Broniatowski S, Gagner M, *et al.* Trends in bile duct injuries from laparoscopic cholecystectomy. J Gastrointest Surg 1998; 2:458–462.
24 Carroll BJ, Friedman RL, Liberman MA, Phillips EH. Routine cholangiography reduces sequelae of common bile duct injuries. Surg Endoscopic 1996; 10:1194–1197.
25 Adamsen S, Hansen OH, Funch-Jensen P, Schulze S, Stage JG, Wara P. Bile duct injury during laparoscopic cholecystectomy: a prospective nationwide series. J Am Coll Surg 1997; 184:571–578.
26 Ali U, Ma ZH, Pan CE, Ma QY. Iatrogenic bile duct injuries from biliary tract surgery. Hepatobiliary Pancreat Dis Int 2007; 6:326–329.
27 Lau WY, Lai EC. Classification of iatrogenic bile duct injury. Hepatobiliary Pancreat Dis Int 2007; 6:459–463.
28 Hii MW, Gyorki DE, Sakata K, Cade RJ, Banting SW. Endoscopic management of post-cholecystectomy biliary fistula. HPB (Oxford). 2011; 13:699–705.

29 Chen XPPS. Causes and treatment of bile leakage. Zhongguo Shiyong Waike Zazhi 2001; 21:102–104.

30 Mungai F, Berti V, Colagrande S. Bile leak after elective laparoscopic cholecystectomy: Role of MR imaging. Radiol Case 2013; 7:25–32.

31 Strasberg SM, Hertl M, Soper N. An analysis of the problem of biliary injury during laparoscopic cholecystectomy. J Am Coll Surg 1995; 180:101–125.

32 Aduna M, Larena JA, Martin D, Martínez-Guereñu B, Aguirre I, Astigarraga E. Bile duct leaks after laparoscopic cholecystectomy: value of contrast-enhanced MRCP. Abdom Imaging 2005; 30:480–487.

33 Hassan AM, Mohammed AQ, El-Gawad Shawky MA. Common bile duct exploration with transpapillary stenting versus T-tube drainage for management of irretrievable common bile duct stones. Al-Azhar Assiut Med J 2017; 15:117–121.

34 Tzovaras G, Peyser P, Kow L, Wilson T, Padbury R, Toouli J. Minimally invasive management of bile leak after laparoscopic cholecystectomy. HPB (Oxford). 2001; 3:165–168.

35 Rizk H, Salama AF, Jamal W, Hamdy H, Makki AM, Helmy AHI. laparoscopic cholecystectomy for acute cholecystitis, when to do?. J Am Sci 2016; 12:107–110.

36 Helmy AH, Naser M, Saied M, El sebae M, El Ansari M. Preoperative factors that determine technical difficulty during laparoscopic cholecystectomy for symptomatic calcular cholecystitis. Kaser EL-Aini J Surg 2006; 7:55–61.