

# Post-Cholecystectomy Gallbladder Remnant and Cystic Duct Stump Stone: Surgical Pitfalls, Causes of Occurrence and Completion Cholecystectomy (Open versus Laparoscopic) as a Safe Surgical Option of Treatment: Short and Long Term Outcome. Randomized Controlled Clinical Trial

Tamer A. A. M. Habeeb\*, Hatem Mohammad, Mohamed Ibrahim Mansour, Mohamed Farouk Amin

Department of General Surgery, Faculty of Medicine, Zagazig University, Egypt

**\*Corresponding author:**

Tamer A. A. M. Habeeb  
assistant professor of General Surgery  
Department of general General Surgery  
Faculty of Medicine, Zagazig University  
Egypt.  
E-mail: tamerahaimy@hotmail.com

## ABSTRACT

**Background:** Cholecystectomy is the standard surgical option for symptomatic gallbladder disease. The symptoms persist after cholecystectomy in 10 - 20% of cases. Residual gallbladder/cystic duct stump stone is one of the most important causes. This study aimed to evaluate and compare outcomes of open and laparoscopic completion cholecystectomy for gallbladder (GB) remnant stones and cystic duct stump stones as regards intraoperative and postoperative outcomes.

**Methods:** This study was conducted on 84 cases with residual gallbladder remnant stone or cystic duct stump stone that were divided into 2 groups, the open completion cholecystectomy group (Group A=42 cases) and the laparoscopic completion cholecystectomy group (Group B=42 cases). The diagnosis was made by ultrasound and magnetic resonance cholangio-pancreatography.

**Results:** Operative time ( $p=0.00$ ) significantly higher at laparoscopic completion cholecystectomy and blood loss ( $p=0.0026$ ) were significantly associated with open completion cholecystectomy while there was no statistically significant difference between both groups as regards intraoperative biliary injuries ( $p=0.56$ ). The mean operative time was  $120\pm 13$  min and  $160\pm 10$  min in the open group and the laparoscopic group, respectively. 8 cases in the open group and 2 cases in the laparoscopic group showed intraoperative blood loss and required blood transfusion. Intraoperative biliary injuries occurred in 3 cases in the open group and 2 cases in the laparoscopic group. Conversion occurred in 4 cases in the laparoscopic group: 2 cases due to extensive adhesion, 1 case due to uncontrolled bleeding from the cystic artery, and 1 case from biliary leakage. Hospital stay ( $p=0.021$ ), analgesic intake ( $p=0.00$ ), and surgical site infection ( $p=0.00002$ ) were significantly longer among the open group. There was no statistically significant difference between both groups as regards postoperative bleeding ( $p=0.104$ ), while postoperative biliary leakage was ( $p=0.39$ ). Intestinal injury, intra-abdominal collection, biliary stricture were ( $p=0.19$ ,  $p=0.08$ ,  $p=0.25$ ), respectively and mortality rate was ( $p=0.095$ ). Postoperative biliary leakage occurred in 6 cases in the open group and 4 cases in the laparoscopic group. Mortality occurred in 3 patients in the open group and 1 case in the laparoscopic group.

**Conclusion:** In expert surgery, laparoscopic re-excision of the gallbladder remnant and cystic duct stump stones can be performed within a reasonable operating time; low

**Abbreviations:**

GB: gall bladder,  
CT: Computed Tomography Scan,  
ERCP: Endoscopic Retrograde  
Cholangio-pancreatography,  
MRCP: Magnetic Resonance  
Cholangiopancreatography.

Received: 04.07.2021

Accepted: 23.09.2021

Copyright © Celsius Publishing House  
www.sgo-iasgo.com

conversion rate; minimal post-operative complications, namely biliary leakage and bleeding; and shorter hospital stay. Trial registration at clinicaltrials.gov protocol registration quality control review criteria: NCT04329143 registered on 01/04/2020, retrospective registered.

**Key words:** post cholecystectomy, stump, stone, Gallbladder remnant

## INTRODUCTION

The incidence of gallbladder and cystic duct stump stones occurs in 5% of cases that underwent urgent cholecystectomy, but the incidence is much less after elective cholecystectomy (1). The incidence of cystic duct stump stone after laparoscopic cholecystectomy is higher than open cholecystectomy; the former represents about 13.3% (2). Some surgeons perform incomplete removal of gallbladder during difficult dissection of triangle of Calot for fear of injuring an important structure in the vicinity (3). The incidence of gallbladder and cystic duct stump stone can be prevented by complete skeletonization of cystic duct for a distance not exceeding 1 cm from the common bile duct and stone in the cystic duct is pushed back in gallbladder if present (4-6).

The presence of stone in the cystic duct can be diagnosed by intraoperative palpation of the cystic duct. However, intraoperative cholangiography may be used, but not routinely, in diagnosis (7-8). The term cystic duct stump syndrome falls under the differential diagnosis of post-cholecystectomy syndrome which may be caused by reflux esophagitis, peptic ulcer, irritable colon, and colitis. This may lead to a delay in the diagnosis of cystic duct stump syndrome. (9)

To reach the diagnosis of cystic duct stump syndrome, history of post-cholecystectomy persistent symptoms that are present postoperative, in addition to different diagnostic modalities as ultrasonography, computed tomography (CT) scan, endoscopic retrograde cholangiopancreatography (ERCP), and Magnetic Resonance Cholangio-Pancreatography (MRCP) (10).

### *Aim of the work, gap statement, and strength of the study*

During revisional cystic duct stump stone surgery and gallbladder remnant stone surgery, there was no definitive approach to dealing with such surgical problems and this is usually chosen by the surgeons according to their experiences. Due to the interest of this item, we have designed a randomized clinical trial to analyze the outcomes in two groups of patients with

cystic duct stump stone and gallbladder remnant stone with two different approaches (open and laparoscopic). The primary aim was to evaluate and compare the incidence of postoperative bile leak after both techniques. The secondary aims were to evaluate and compare the morbidity (intraoperative and post-operative) and mortality rate during and after both techniques.

## METHODS

### *Study design*

This is a prospective randomized controlled clinical study that was conducted in the hepato-biliary surgical unit of our University Hospital. It is a mono-center study performed by 3 surgeons experienced in biliary laparoscopic and open biliary surgeries between January 2013 and January 2018 on 84 patients who were clinically diagnosed with gallbladder remnant and cystic duct stump stones. Patients were divided into two groups: Group A (42 cases) underwent open completion cholecystectomy and Group B (42 cases) underwent laparoscopic completion cholecystectomy.

### *Sampling method and method of sample size calculation*

Simple random sample with a balance of confidence 95 and power 80 and based on previous postoperative biliary leakage; samples sizes will be 42 in each group (11).

### *Patient selection criteria*

Patients who had to fulfill the following characters to be in the study were age between 30-50, both sex (male and female), previous cholecystectomy (open or laparoscopic), and symptomatic or asymptomatic cases. Exclusion criteria were 10 patients because of mild symptoms for which the patients refused surgery and preferred medical treatment (8 patients) and patients unfit for surgery due to medical diseases (2 cases).

### *Types of outcomes and measurement (study endpoints)*

The primary outcome was the incidence of the post-operative biliary leak during hospital admission and during 30 days postoperative. Secondary outcomes were the incidence of overall morbidities (intraoperative and postoperative) and mortality. Morbidity included length of surgery (in minutes), intraoperative blood loss (ml), vessels insult at operation, Hematoma/Seroma, duration of hospital admission (in days), wound infection at any time point, and biliary stricture.

### *Definitions and measurement of outcomes*

Postoperative morbidity is assessed by Clavien and Dindo (12). Reoperation is defined as re-intervention within 30 days after the primary operation. The diagnosis of biliary leakage is based on imaging studies and clinical signs, such as fever  $>38.5^{\circ}\text{C}$ , leukocytosis, elevated serum C-reactive protein, drainage of bile in drains or through abdominal wounds or abdominal collections. The diagnosis of biliary stricture is based on clinical signs of abdominal pain and jaundice together imaging studies demonstrating bile duct dilatation.

### *Method of randomization*

Using a random sequence generator, patients were randomly allocated. Random allocations were sequentially numbered in sealed opaque envelopes, which were opened during surgery before carrying out the method of surgery (open or laparoscopy). Patients were blinded to the assigned group until after the study. It was done by the registration office.

### *Study attempts to decrease bias*

Good goals to define risk and outcome, select patients with adequate sample size on a probability sample, define and avoid confounding factors, standardize the reaction and management of patients using blindly- objective data rather than subjectively, good data handling plan designed for dropping out.

### *Preoperative assessment and preparation*

Preoperative workup included biliary multi-disciplinary surgeons, radiologists and anesthetists. MRCP is the basis for diagnosis (*figure 1*). Preoperative anesthetist's assessment: With the induction of anesthesia, metronidazole 500 mg, and ceftriaxone 1gm given intravenously.

### *Intra-operative evaluation and technique*

General anesthesia with cuffed endotracheal intubation: All surgeries were done in mono-center in hepato-biliary and pancreatic surgery unit by 3 surgeons qualified in biliary surgeries following the principles of biliary surgery. At least two of three senior surgeons were always present to ensure inclusion criteria.

### *Open completion cholecystectomy*

Open surgery was done through ordinary right Kocher's subcostal incision. Identification of the liver, duodenum, colon, and common bile duct which were important anatomic landmarks was done. Initial dissection and adhesiolysis commenced till the exposure of the gallbladder fossa and Calot triangle. The gallbladder remnant or cystic duct stump was dissected, free from surrounding structures. Lastly, excision of cystic stump or gallbladder remnant was done. Intraoperative cholangiogram was not done in any of the cases. A gallbladder bed drain was placed in all patients.

### *Laparoscopic completion cholecystectomy*

Abdominal insufflations with pressure 14 mmHg were done through veress needle, away from the previous incision usually in left hypochondrium in mid-clavicular point, below left subcostal margin or through open Hasson's technique. Four ports were placed as in standard laparoscopic cholecystectomy. Adhesiolysis began from the right side, dividing dense adhesions to the liver, and dissection gradually proceeded toward the midline. Care was taken during



**Figure 1 - Shows MRCP obtained in 47 years and 52 years old women with gallbladder remnant**

the division of adhesion in the regions of the colon and duodenum to avoid their injuries. An attempt was made to clear the calot's triangle. CBD was always identified. Cystic artery and duct were identified clearly and clipped individually or en masse. The specimen was removed through the epigastric port within the retrieval bag. We used ordinary diathermy apparatus in 30 cases and harmonic scalpel in 12 cases due to financial or technical factors. Operative cholangiogram was not attempted. A plastic Nelaton drain was always placed in the gallbladder bed.

### *Follow up (24 months)*

The follow-up periods were one month, six months, twelve months and twenty-four months, respectively, after returning home. After returning home, patients were contacted by mail, telephone, and at the out-patient clinic. Techniques of follow-up included complete history, physical examination, ultrasonography, and MRCP to detect remote complications when relevant symptoms emerged.

### *Statistical analysis*

Data were analyzed using Microsoft Excel software then imported into SPSS version 20.0. Qualitative data represented as number and percentage, quantitative data represented by mean  $\pm$  SD, the following tests were used to test differences; Chi-square test ( $\chi^2$ ), t-test

or Mann Whitney, the P-value were set at  $<0.05$  for significant results &  $<0.001$  for a high significant result.

## RESULTS

No statistically significant difference between both groups as regards preoperative variables was found. The mean age of Group A and Group B was  $48.65 \pm 8.65$  years and  $49.21 \pm 7.65$  years, respectively. The initial cholecystectomy operation performed was mainly open cholecystectomy in both groups (62/84) and laparoscopic cholecystectomy was the smaller group (22 cases). Fifty-one cases showed clinical presentation within the first year after the initial cholecystectomy. Fifty-four cystic duct stump cases were the site of stone in both groups (table 1).

Operative time ( $p=0.00$ ) which was significantly higher at laparoscopic completion cholecystectomy and blood loss ( $p=0.0026$ ) was significantly associated with open completion cholecystectomy, while there was no statistically significant difference between both groups as regard intraoperative biliary injuries ( $p=0.56$ ). The mean operative time was  $120 \pm 13$  min and  $160 \pm 10$  min in the open and laparoscopic groups, respectively. 8 cases in the open group and 2 cases in the laparoscopic group showed intraoperative blood loss and required blood transfusion. Intraoperative biliary injuries occurred in 3 cases in the open group and 2 cases in the laparoscopic group. Conversion in the laparoscopic group occurred in 4 cases: 2 cases due to extensive

**Table 1 - Preoperative clinical data of the studied groups**

	Open completion cholecystectomy (Group A)	Lap completion cholecystectomy (Group B)	$\chi^2$	P
Age				
<40 years	13 cases (33%)	10 cases (25%)	0.53	0.46
>40 years	29 cases (67%)	32 cases (75%)		
Mean $\pm$ SD	$48.65 \pm 8.65$	$49.21 \pm 7.65$	t=0.58	P =0.42
Sex				
Male	6 cases (15%)	15 cases (37%)	5.14	0.021
Female	36 cases (85%)	27 cases (63%)		
Initial cholecystectomy operation				
Open	33 cases (80%)	29 cases (70%)	0.98	0.32
lap	9 cases (20%)	13 cases (30%)		
Onset of symptom after initial cholecystectomy				
< 1 year	27 cases (65%)	24 cases (57%)	0.44	0.51
>1year	15 cases (35%)	18 cases (43%)		
Site of residual stone				
Gall bladder remnant	19 cases (45%)	11 cases (27%)	3.31	0.06
Cystic duct stump	23 cases (55%)	31 cases (73%)		
Complaints				
Abdominal pain	38 cases (90 %)	39 cases (93%)	0.04	0.82
Jaundice	9 cases (20%)	4 cases (9.5%)	3.31	0.06
Dyspepsia	19 cases (47%)	21 cases (50%)	0.09	0.76
Asymptomatic	3 case (9.5%)	4 case (9.5%)	0.0	1.0

**Table 2 - Intraoperative data**

	Open completion cholecystectomy (Group A)	Lap completion cholecystectomy (Group B)	$\chi^2$	P
Operative time mean $\pm$ SD (min)	120 $\pm$ 13	160 $\pm$ 10	t=14.25	0.00**
Blood loss during operation	8 cases (20%)	2 cases (4.7%)	9.02	0.0026*
Biliary injury	3 cases (7.1%)	2 cases (4.7%)	0.33	0.56

adhesion, 1 case due to uncontrolled bleeding from cystic artery, and the last one due to biliary leakage (table 2).

Postoperative hospital stay (p=0.021), analgesic intake (p=0.00), and surgical site infection (p=0.00002) were significantly longer among cases in the open group. There was no statistically significant difference between both groups as regards post-operative bleeding (p=0.104), postoperative biliary leakage (p=0.39), intestinal injury, intra-abdominal collection, biliary stricture (p=0.19, p=0.08, p=0.25), and mortality rate (p=0.095). Length of hospital stay was 5.4 $\pm$  1.6 days in the open group and 4.3 $\pm$ 1.2 days in the laparoscopic group. Most cases in the open group (26 cases) required analgesic more than 5 days while 6 cases in the laparoscopic group required analgesic more than 5 days. 4 cases in the open

group showed re-intervention due to cystic duct stump bleeding: 2 cases due to duodenal injuries and 2 cases due to transverse colon injuries. 4 cases in the laparoscopic group also showed re-intervention surgically due to bleeding cystic duct stump in 2 cases: 1 case due to duodenal injury and 1 case due to transverse colon injury. Both groups showed no major vascular bleeding. Postoperative biliary leakage occurred in 6 cases in the open group and 4 cases in the laparoscopic group. Intestinal injury, intra-abdominal collection, and biliary stricture occurred in 4, 6, 2 cases in the open group and 2, 3, 1 cases in the laparoscopic group, respectively. Surgical site infection occurred in 16 cases in the open group and 4 cases in the laparoscopic group. Mortality occurred in 3 cases in the open group and 1 case in the laparoscopic group (table 3).

**Table 3 - Postoperative data and clinical outcome**

	Open completion cholecystectomy (Group A)	Lap completion cholecystectomy (Group B)	t/ $\chi^2$	P
Age				
<40 years	13 cases (33%)	10 cases (25%)	0.53	0.46
>40 years	29 cases (67%)	32 cases (75%)		
Mean $\pm$ SD	48.65 $\pm$ 8.65	49.21 $\pm$ 7.65	t=0.58	P =0.4
Length of hospital stay ; mean $\pm$ SD (days)	5.4 $\pm$ 1.6	4.3 $\pm$ 1.2	2.41	0.021*
Analgesic intake				
<5 days	16 cases (38%)	36 cases (87%)	20.19	0.00**
>5 days	26 cases (62%)	6 cases (13%)		
Bleeding				
Cystic artery stump bleeding	4 (9.5%)	2(4.7%)		
Port site bleeding	0	2(4.7%)	2.66	0.104
Major vessel bleeding	0	0		
Biliary leakage	6 (15.0%)	4(9.5%)	0.71	0.39
Treatment of biliary leakage				
Aspiration, ERCP and stent	4 (9.5%)	1 (2.3%)	4.8	0.02*
Conservative	2 (4.7%)	3 (7.1%)		
Intestinal injury	4(9.5%)	2 (4.7%)	1.66	0.19
Surgical site infection	16 (40%)	4(9.5%)	18.1	.00002**
Intra-abdominal collection	6 (15%)	3(7.1%)	2.91	0.08
Biliary stricture	2(4.7%)	1(2.3%)	1.28	0.25
Treatment of biliary Stricture			Fisher exact	
ERCP, dilatation and stent	1(2.3%)	1(2.3%)	0.18	0.66
Hepatico-jejunostomy	1(2.3%)	0		
Mortality rate	3 (7.1%)	1 case (2.3%)	2.77	0.095

## DISCUSSION

In our center, open completion cholecystectomy was previously preferred as a safer technique as regards disturbed anatomy from previous adhesion with difficult identification of important structures in the vicinity of gallbladder remnant that may result in vascular injury, nearby organs injury, namely the transverse colon and duodenum, biliary leakage and hence morbidity and mortality. Besides, it is possible to identify stone tactile sensation during surgery. However, nowadays, laparoscopic approach is accepted as a safe approach due to experienced surgeons in biliary surgery and the availability of intraoperative helpful techniques such as intraoperative cholangiogram and Harmonic scalpel. The increasing incidence of cystic duct stump stone and gallbladder remnant stones nowadays due to aging increases the incidence of acute cholecystitis and on the other hand, lack of consultation of surgeons during the pandemic of COVID due to fear of hospital admission. This study concluded that completion cholecystectomy by laparoscopic approach is a safe approach.

### *Outcomes of the laparoscopic completion group*

Previous researches over the last 2 decades have focused on laparoscopic completion cholecystectomy as safe to approach with decreased morbidity and mortality. Udwadia TE. in his study confirmed the safety of laparoscopic completion cholecystectomy with a median operating time of 83 minutes (range 51 to 134 minutes). One patient had a conversion to open surgery; two patients had postoperative bile leak; one patient had postoperative bleeding not requiring blood transfusion, no major complication requiring further intervention and no mortality (4). While a study conducted by Palanivelu C, et al. revealed that the mean operating time was longer and up to 103.5 min (range, 75-132 min), the morbidity was 13.33%, and there were no conversions and no mortality (6). A recent detailed study by Hakeem Vaqar et al., on 41 patients who underwent laparoscopic completion cholecystectomy stated that Laparoscopic completion cholecystectomy was successfully done in 38 patients (92.6%) and 3 (7.3%) cases had to be converted to open procedure due to Mirizzi's type II, excessive bleeding from an abnormal big cystic artery and an iatrogenic transverse colon injury. Two patients had a serosal tear of duodenum during dissection, there was no major bile duct injury, postoperatively bilious drainage was noticed in 8 patients (19.5%), there were few cases

of postoperative port site wound infection and no mortalities. The mean follow-up of the patients was 16 months. (11). In a study of laparoscopic re-exploration done on 22 patients mainly on gallbladder remnant calculi, Sanjay K et al, revealed that the median operating time was 83 minutes (range 51 to 134 minutes); one patient had a conversion and there was postoperative bile leak in two patients, one postoperative bleeding not requiring blood transfusion, no major complication requiring further intervention, and no mortality. Patients were followed up for one year (13). In another retrospective study on 40 cases who underwent laparoscopic completion cholecystectomy on top of a previous open cholecystectomy, A.K. Parmar et al. revealed that the mean operating time was 102.4 min, two cases were converted to open procedure because of severe dense adhesions, eight patients had postoperative bleeding without the need for blood transfusion, one minor common bile duct injury, one port-site infection, and no mortality. All patients were asymptomatic at 6 months follow-up (14). A preliminary work by Chowbey, et al. stated that the mean operating time was 42 minutes and no drainage was required postoperatively (15). However, another completion study by Chowbey et al. stated that all procedures were successfully completed laparoscopically with mean operative time of 62 minutes and mean blood loss of 50cc, ten patients required abdominal drains postoperatively, two patients had bilious drainage and mortality occurred in 2 patients with unrelated diseases. Follow-up was 3.2 years. (16). Om Tantia, et al stated that the mean duration of surgery was 62 min and there was no mortality and the mean postoperative stay was 3.1 days (17). Xu, Suqin et al. stated in their small-scale study on 10 cases of remnant cystic duct that 7 patients treated by completed cholecystectomy (6 by laparoscopy and 1 by laparotomy). All patients had 6- to 14-day hospital stays after reoperation, except for 1 patient with a 3-day stay (18).

As regard laparoscopic approach in our study, the mean operative time was 160±10 minutes which is slightly higher than that in the literature, most probably due to difficult dissection from extensive adhesion as the gallbladder remnant is usually deeply embedded in dense scar tissue and absence of recent instrument as Harmonic scalpel in most cases that decrease bleeding and operative time. 2 cases received blood transfusion intraoperative, due to bleeding from gallbladder bed in the liver in one case and due to slipped cystic artery in the other case. The first case was controlled laparoscopically by gel foam insertion in gallbladder bed while the other case required conversion with controlling

bleeding from cystic artery slipped clipping that could not be controlled laparoscopically and controlled successfully by suture ligation after conversion. The length of hospital stay, which was average with literature, was  $4.3 \pm 4.5$  days. Conversion occurred in 4 cases (4/42) due to extensive adhesion and difficulty to identify Calot triangle adequately in 2 cases, bleeding in one case due to slipped cystic artery stump and biliary leak in the last case. The first 2 cases were dissected meticulously with successful excision of gallbladder remnant, ligation of cystic duct stump in the third case, and hepatico-jejunostomy in the last case due to common hepatic duct injury. The safety-first strategy was the key and we consider that conversion to open was not considered as a failure.

In the immediate postoperative period, 4 patients developed bleeding. 2 cases were from cystic artery stump ligature slippage and presented by fresh bleeding coming continuously from the drain that required re-exploration and managed easily by ligation of the bleeding artery, while the other 2 cases were from port site bleeding and treated by the figure of 8 fixations of the port site without the need for re-exploration. No major vessels injury was recorded. Postoperative bleeding which required re-intervention (internal bleeding) is nearly the same as previous literature while the port site bleeding that could be controlled without surgical re-exploration may increase the incidence which was not described in other literature. 4 patients developed biliary leakage. Big visual field of laparoscopy allowed good identification of the anatomy of the biliary region. They showed abdominal pain, fever, and jaundice mostly one week after the operation and a biloma was diagnosed by ultrasonography and aspiration. 1 case underwent sonar guided catheter drainage and ERCP with plastic stent insertion in the common bile duct, and 3 cases of mild symptoms underwent conservative treatment in the form of sonar guided catheter drainage, nasogastric tube, third-generation cephalosporin injection, metronidazole 500 mg injection with adequate hydration and all patients improved after 10 days by absent collection radiologically and improvement of symptoms and signs. Postoperative biliary leakage was similar in incidence to previous literature. One case developed biliary stricture that necessitated ERCP dilatation with stent insertion. Intestinal injuries were discovered nearly 10 days after operations occurred in 2 patients after the laparoscopic approach. The patients were diagnosed with abdominal pain and intra-abdominal collection that was diagnosed by oral contrast computerized tomography and showing the leakage that was

confirmed by sonar guided aspiration. The 2 cases required re-exploration. One case showed duodenal injury which was treated with closure of the defect and gastro-jejunostomy and the other was transverse colon injury which was treated by temporarily colostomy. 2 months later, the continuity of gastrointestinal tract was restored. Mortality occurred in 1 case of the laparoscopic approach due to postoperative pancreatitis. Pancreatitis postoperatively was in a 62-year-old male patient who was diagnosed postoperatively by abdominal pain, vomiting, fever, abdominal tenderness and diagnosis confirmed by CT. The patient underwent conservative treatment with nothing per mouth, fluid, and antibiotic but died after 11 days from sepsis and multisystem organ failure.

#### *Outcomes of open completion cholecystectomy*

Seth J. Concors, et al. stated in their study on 14 patients who underwent open repeat cholecystectomy after failed laparoscopic approach in all cases. 2 patients had an on-table cholangiogram to confirm anatomy, common hepatic duct injury, transverse colon injury, one incisional hernia. The rest of the patients had no serious complications with a median follow-up of 22 months (range 1–54 months) (19).

As regards the open approach in our study, the mean operative time was  $120 \pm 13$  minutes. 8 cases received blood transfusion intraoperative from bleeding during dissection of gallbladder remnant from the liver in 2 cases and slipped cystic artery in 6 cases that were controlled by gel foam in the first 2 cases and ligation of slipped cystic artery in the last 6 cases.

In the postoperative period, the length of hospital stay was  $5.4 \pm 1.6$  days. 4 cases developed bleeding from cystic artery stump ligature slippage and showed fresh bleeding coming continuously from the drain that required re-exploration and was managed easily by ligation of the bleeding artery. No major vessels injury was recorded. 6 patients developed biliary leakage. They presented mostly with abdominal pain, fever, and jaundice 5 days after the operation and a biloma was diagnosed by ultrasonography and aspiration. 4 cases underwent sonar guided catheter drainage and ERCP with plastic stent insertion in the common bile duct, and 2 cases of mild symptoms underwent conservative treatment in the form of sonar guided catheter drainage, nasogastric tube, third-generation cephalosporin injection, metronidazole 500 mg injection with adequate hydration and the patient improved after 14 days by absent collection radiologically and improvement of symptoms and signs. In the postoperative follow-up period, 2 cases developed biliary stricture that necessi-

tated ERCP dilatation with stent insertion in 1 case and Hepatico-jejunostomy in 1 case. Intestinal injuries were discovered nearly 10 days after operations occurred in 4 cases. The patients were diagnosed with abdominal pain and intra-abdominal collection that was diagnosed by oral contrast computerized tomography and showed the leakage that was confirmed by sonar guided aspiration. The four cases required re-exploration. 2 cases showed duodenal injury which was treated with closure of the defect and gastro-jejunostomy and the other 2 cases showed transverse colon injury which was treated by temporary colostomy. 2 months later, the continuity of gastrointestinal tract was restored. Mortality occurred in 3 cases due to postoperative pancreatitis in 1 case and acute myocardial infarction in the remaining 2 cases.

## CONCLUSION

Gallbladder remnant stones and cystic duct stump stones following incomplete cholecystectomy are important sequelae after cholecystectomy. Laparoscopic Completion cholecystectomy is the most common treatment approach and can be performed safely. We emphasize the importance of proper dissection and identification of important structures within the vicinity of residual gallbladder remnant. In expert hands, laparoscopic re-exploration of the gallbladder remnant/cystic duct stump calculi can be performed within a reasonable operating time; low conversion rate; minimal post-operative complications, namely biliary leakage and bleeding; and shorter hospital stay.

## Acknowledgement

We thank Professor Abdel-rahman Sarhan, head of the laparoscopic unit in the faculty of medicine, general surgery department, Zagazig University, for his great help and recommendations.

## Authors' contributions

All authors shared important intellectual content in study design, analysis of data, writing, and critical review of the manuscript. They participated in the final approval of the submitted version.

## Competing interests

The authors declare that they have no competing interest.

*Funding:* none

## Ethical approval

Ethics approval and consent to participate: The Faculty of Medical Ethical Committee of Zagazig University gave us all the ethical agreements. Our work has been carried out in accordance with hepato-biliary surgery guidelines in our unit. All involved persons gave their informed written consent to participate in the study. All involved persons gave their informed written consent for publication. The described work has been carried out for human experiments in accordance with the World Medical Association's Code of Ethics (Helsinki Declaration).

## Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

## REFERENCES

1. Parmar AK, Khandelwal RG, Mathew MJ, Reddy PK. Laparoscopic completion cholecystectomy: a retrospective study of 40 cases. *Asian J Endosc Surg.* 2013;6(2):96-9. Epub 2012 Dec 21.
2. Daly TD, Martin CJ, Cox MR. Residual gallbladder and cystic duct stones after laparoscopic cholecystectomy. *ANZ J Surg.* 2002;72(5):375-7.
3. Bornman PC, Terblanche J. Subtotal cholecystectomy: for the difficult gallbladder in portal hypertension and cholecystitis. *Surgery.* 1985;98(1):1-6.
4. Udwardia TE. Operative technique for laparoscopic cholecystectomy. *Comprehensive laparoscopic surgery. IAGES.* 2007;8:64-76.
5. Chowbey PK, Soni V, Sharma A, Rajesh Khullar, Manish Bajjal. Residual gallstone disease- Laparoscopic management. *Indian J Surg.* 2010;72(3):220-5.
6. Palanivelu C, Rangarajan M, Priyadarshan AJ, Madankumar MV, Anand NV. Laparoscopic management of remnant cystic duct calculi: a retrospective study. *Ann R Coll Surg Engl.* 2009;91(1):25-9. Epub 2008 Nov 4.
7. Schofer JM. Biliary causes of post-cholecystectomy syndrome. *J Emerg Med.* 2010;39(4):406-10. Epub 2008 Aug 23.
8. Pernice LM, Andreoli F. Laparoscopic treatment of stone recurrence in a gallbladder remnant: report of an additional case and literature review. *J Gastrointest Surg.* 2009;13(11):2084-91.
9. Khorasani-Zadeh, Arshia, Bhutta, Abdul, Sapkota, Bishnu . Cystic Duct Stump Stone: A Diagnostic Dilemma of Post Cholecystectomy Syndrome. *Am J Gastroenterology.* 2020;115:p S752.
10. Wani NA, Khan NA, Shah AI, Khan AQ. Post-cholecystectomy Mirizzi's syndrome: magnetic resonance cholangiopancreatography demonstration. *Saudi J Gastroenterol.* 2010;16(4):295-8.
11. Ahmed HV, Sherwani AY, Aziz R, Shera AH, Sheikh MR, Lone SN, et al. Laparoscopic Completion Cholecystectomy for Residual Gallbladder and Cystic Duct Stump Stones: Our Experience and Review of Literature. *Indian J Surgery.* 2021;83:944-949.
12. Clavien PA, Barkun J, de Oliveira ML, Vauthey JN, Dindo D, Schulick RD, et al. The Clavien-Dindo classification of surgical complications: five-year experience. *Ann Surg.* 2009;250(2):187-96.
13. Saroj SK, Kumar S, Afaque Y, Bhartia A, Bhartia VK. The

- Laparoscopic re-exploration in the management of the gallbladder Remnant and the Cystic Duct Stump Calculi. *J Clin Diagn Res.* 2016; 10(8):PC06–PC08.
14. Parmar AK, Khandelwal RG, Mathew MJ, et al. Laparoscopic completion cholecystectomy: a retrospective study of 40 cases. *Asian J Endosc Surg.* 2013;6(2):96-9. Epub 2012 Dec 21.
  15. Chowbey PK, Bandyopadhyay SK, Sharma AK, Rajesh MS, Soni V, Baijal M. Laparoscopic reintervention for residual gallstone disease. *Surg Laparosc Endosc Percutan Tech.* 2003;13(1):31-5.
  16. Chowbey P, Soni V, Sharma A, Khullar R, Baijal M. Residual gallstone disease — Laparoscopic management. *Indian J Surg.* 2010;72(3): 220-5.
  17. Tania O, Jain M, Khanna S, Sen B. Post cholecystectomy syndrome: Role of cystic duct stump and re-intervention by laparoscopic surgery. *J Minim Access Surg.* 2008; 4(3):71-5.
  18. Xu S, Zou S. Remnant Cystic Duct Disease After Cholecystectomy: A Case Series. *Surg Laparosc Endosc Percutan Tech.* 2020;30(5): 467-470.
  19. Concors SJ, Kirkland ML, Schuricht AL, Dempsey DT, Morris JB, Vollmer CM, et al. Resection of gallbladder remnants after subtotal cholecystectomy: presentation and management. *HPB (Oxford).* 2018;20(11):1062-1066.