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Bile duct injuries: strategy and outcome of different therapeutic modalities

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ABSTRACT

Background: Bile duct injury (BDI) has been considered as one of the main complications in the context of biliary surgery which include laparoscopic cholecystectomy (LC). The treatment of major BDI is a surgical challenge even for skillful surgeons. **Aim:** To evaluate different therapeutic modalities of bile duct injuries and which was better according to type and time of injury (early or late presentation) outcome and improvement of quality of life (QoL). **Methods:** This was non randomized clinical trial study (prospective study), was conducted on thirty cases at the Faculty of Medicine, Aswan & Assuit Universities, Egypt during a period of 4 years. **Results:** The complications were significantly reduced in endoscopic group in comparison with surgical and radiological groups (p = 0.002). in our study 76.6 % of the patients has obesity which represent significant positive relationship to incidence of bile duct injury due to difficult surgery and dissection during cholecystectomy, excess fatty tissue can obscure important structure and leads to misidentification. **Conclusion:** Endoscopic management is comparatively simple, reversible, and minimally invasive. On the other hand, the success of endoscopic approach is mainly reliant on the type of injury. Endoscopy is comparable to surgery during the initial management of minor problems, however in terms of major leaking, ligation, transection, and complicated problems, surgery is the primary therapeutic modality because of its invasiveness

Introduction

Bile duct injuries (BDI) happen in a broad range of clinical contexts. The mechanism of injury, preceding trials of repair, surgical risk and general condition essentially interfere with the decision-making pathways [1]. BDI could develop following gallbladder, pancreas and gastric surgeries, with LC responsible for 82.5% of them (In spite of being non-significant, BDI throughout LC is two-fold as frequent in comparison with injuries during an open approach (0.3% open versus 0.6% LC) [2]. The main two adverse events are bile leaking and bile duct obstruction. The majority of BDIs following LC are detected during the surgery or in the postoperative period [3].

In Egypt which is a developing nation many studies on BDI lack with facilities of repair which lead to wrong decision and so wrong results and recommendations, also I have noticed that some previous studies lack with connection with studies at other places although it is the same country so

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and upon above words our study will aim to make maximum effort and facilities (radiological, fund and experience of other) to give true and definite statistics and recommendations to surgeons and we will call help of other centers to manage cases and mix our and their experience in BDI to give excellent result. The management of cases complaining from BDI is challenging for all surgeons, in particular those with a specialty of hepatobiliary surgery.

Cystic duct stump leak, incomplete lacerations of the common bile duct (CBD), or minor strictures could be treated by endoscopic retrograde or percutaneous stenting and dilation. The most extensive disorders which include bile duct transection or frequent strictures have a tendency to need reconstructive surgery [4].

Cooperation among surgeons, gastroenterologists, and interventional radiologists is crucial with regard to treatment of such complex injuries. A lot of parameters have been associated with such complication, comprising misunderstanding of anatomy, thermal injuries from electrocautery, severe inflammatory condition, blood loss, and obesity [5]. The majority of such injuries aren't identified intra operatively, which have been associated with BDI development with a subsequent increase in the rates of morbimortality owing to extensive attacks of cholangitis and jaundice, as well as intra-abdominal sepsis [6], Evidences suggest that such cases have a long-term history of high frequencies of hospital admission till their last management. As a result, rapid recognition and repair could be life-saving in the context of cases with bile duct injuries [7].

Of note, the ultimate selection of the therapeutic modality is mainly reliant on the injury type. In general, when the bile duct hasn't lost its continuity and the patient doesn't complain from extensive attacks of cholangitis, additional traditional modalities which include percutaneous drainage or endoscopic stenting are favored otherwise, in patients of total transection or in the existence of extensive manifestations, surgical reconstruction is the best therapeutic modality. Certain cases might even need hepatectomy as the terminal resort of management [8]. Indications for such therapeutic modality involve early (within five weeks following LC) vascular damage, proximal BDI, injuries to the right hepatic artery, and sepsis induced by hepatic necrosis. With more Chronic cases (over four months following LC) hepatectomy efficiently manage frequent cholangitis and hepatic atrophy [9].

Aim of Work

To assess various therapeutic approaches of bile duct injuries and which was better according to type and time of injury (early or late presentation), outcome and improvement of QoL.

Patients and methods

Study setting

This was a prospective study carried out in general surgery department, Aswan University hospital, Assuit University hospitals, Egypt since February 2018 till February 2022.

Study population

This study was carried out on 30 cases with diagnosed bile duct injury after meeting the inclusion criteria, 11 patients had injury after LC, 13 patients had injury after open cholecystectomy and 3 patients had injury after hydatid cyst surgery, two patients had injury after trauma and one patient had injury after liver abscess drainage. We included any patients with bile duct injury, both sexes were included. No patient with bile duct injury was excluded. Entire cases were grouped into either surgical, endoscopic and radiological group, according to the initial management undertaken at the tertiary center Aswan and Assuit university hospitals, the patients were managed at a step wise manner starting by endoscopic approach alone or combined with radiological access like pig tail abdominal drainage (percutaneous access) following then by surgery unless surgery started firstly due to biliary problems like biliary peritonitis.

Methods

The eligible subjects were subjected to complete history that included personal data (age, gender), comorbidities (hypertension, diabetes, obesity, cirrhosis), and etiology of bile duct injury (post-cholecystectomy, hydatid cyst surgery and trauma). Full Clinical assessment included vital signs (temperature, pulse, blood pressure), clinical presentation (bile in drain output, abdominal pain, jaundice, sepsis, fever), type of injury, diagnostic approaches, time of diagnosis, and time to referral. Full radiological assessment included US, CT abdomen and MRCP while routine laboratory investigations comprised complete blood picture, liver and kidney functions, thyroid functions tests, pulmonary function tests, ECG and echo.

Interventions

Endoscopic Approach

Fifteen Patient prepared for ERCP (radiological group) 10 of them treated with sphinctrotomy and stenting, while 5 patients treated with sphinctrotomy without stenting. Patient presented with jaundice, abdominal pain and raised liver functions developed due to CBD stricture diagnosed with MRCP after 6 months of follow up due to displaced stent and they treated with endoscopic dilatation with no recurrence of stricture for one year after. Definition of success of endoscopic approach was that the patient relieved from biliary manifestations, normalization of liver functions with no recurrence for 6 months after the procedure. Ten patients in this study were candidate for surgery. In this intervention we included patients diagnosed with bile duct injury in the early period post operative (6 weeks) with Strasberg type A injury and bile duct stricture and any patient diagnosed with bile duct injury failed to be treated with endoscopic and radiological approaches.

Radiological Intervention

In this intervention we include any patient came post operative with localized or free bile collection with Strasberge type B, E and type C bile duct injuries, this intervention was done in 5 cases (radiological group) in this study with localized or free bile collection where intrabdominal pig tail inserted under ultrasound guidance (3 patients) to prepare the patient for elective approach like endoscopic or surgical intervention and to avoid biliary peritonitis and sepsis, two patients gave successful conservative management with no need for another procedure but one patient needed ERCP with stenting with smooth post ERCP follow up. Definition of successful radiological approach meant relieve of biliary manifestations and improvement of the general condition of the patient to be discharged safely to home or be candidate for operative biliary reconstruction.

Surgical Intervention

Surgical approach was done for 10 patient (operative group) whom had Strasberg Class D and E bile duct injury, patients came with Biliary peritonitis and any patient diagnosed with bile duct injury failed to be treated with endoscopic and radiological approaches.

Procedures:

-One-immediate surgery was done in one patient that was discovered intraoperatively.

-Repair over T-tube to correct iatrogenic CBD injury (2 patients).

-Two-urgent surgeries (peritoneal lavage and abdominal drains) were done in one patient who presented with biliary peritonitis, the definitive surgery could not be done in this patient because wide spread of sepsis and fibrosis, definitive surgery was done with hepatico-jejunostomy (sise-to- side) after spending 4 weeks in ICU and ward but developed biliary leak with successful conservative treatment in the hospital.

-3-planned surgeries for 2 patients with good general conditions and prepared under umbrella of antibiotics with bilio enteric anastomosis (choledocho-jejunostomy) for CBD stricture and fibrosis.

-End-to-side anastomosis (2 patients): E4 lesions the separated right and left hepatic ducts could be approached into one “double-barrel” duct, and an end-to-side HJ could be carried out. The approach starts by placing 2 corner stitches on the right and left sides incorporating at least three mm of duct and jejunal mucosa. Then, 4-0 interrupted monofilament absorbable sutures are positioned to induce a complete approximation of the posterior wall. An end-to-side jejunojejunostomy was formed with a single layer continuous hand-sewn approach, permitting for about 40cm bilio-enteric limb length.

-Side-to-side anastomosis (2 patients): Strasberg class E where A transverse ductotomy was performed in the LHD and might be extended into the RHD at the confluence. A side-to-side anastomosis is after that carried out beginning with the posterior wall in an interrupted manner by using a 4-0 monofilament absorbable suture. The main aim of the approach is to attain a tension-free anastomosis.

Definition of successful operative strategy meant relieve of biliary manifestations and normalized liver function with no recurrence, stricture or leakage for two years follow up after the procedure.

Postoperative follow up on daily basis by

*Laboratory investigations (CBC, bilirubin and LFTs).

*Monitoring and recording amount of drain till removed.

*Follow up ultrasound (Biliary system, Abdominal collection, Free fluid, Residual stones, Bile leakage).

*Presence of septicemia and fever.

*Searching for bile leakage after the procedure in the 3 groups of study in abdomen which may be minor leakage for 1 or 2 days and pass conservatively without any intervention, or it may be sever and causing biliary peritonitis and acute abdomen which need per cutaneous drainage or urgent exploration.

Complications Assessment

Complications have been described as intraoperative or postsurgical events which affected the clinical course, which include bleeding, bile leakage, biliary peritonitis, abdominal collections, pancreatitis wound infection. We defined postoperative mortality as the number of deaths within 30 days following intervention. The post-operative morbidity was defined as the number of procedure related complications that developed within 30 days of procedure. Complications were graded according to the Clavien-Dindo classification. Wound infection was requiring incomplete or complete opening for drainage, comprising T-tube tract infections.

Clavien–Dindo classification of surgical complications: [10].

Grade I: Deviations from the usual postsurgical course with no the need for pharmacologic therapy or for surgical, endoscopic, or radiologic interferences.

Permitted therapeutic strategies are medications such as antipyretics, antiemetics, diuretics, analgesics, electrolytes and physiotherapy. Also, this grade involves wound infections which opened at bedside.

GradeII: Adverse events needing pharmacological therapy with medications other than those allowed for grade 1 complications.

Blood transfusions and total intravenous nutrition are comprised too.

Grade III: Adverse events requiring surgical, endoscopic, or radiological intervention.

IIIa (A) interference without general anesthesia

IIIb (B) interference by using general anesthesia.

Grade IV: Fatal adverse events (such as neurological adverse events) * needing IC/ICU management.

Iva (A) Single-organ dysfunction.

IVb (B) Multiple-organ dysfunctions.

Grade V:Death of the patient.

Follow Up

Follow up was for two years after operative approach and for 6 months after endoscopic approach and for 6 months after the radiological approach. For patient treated with ERCP stent removed after a period of 6 weeks, while those who developed stenosis treated by serial stenting and dilatation over a period of 18 month. Complete evaluation was 3, 6, 12 and 24 months after surgery including clinical parameters, radiological and biochemistry lab results

Data management and Statistical Analysis

The collected data were after that inserted into Statistical Package for the Social Sciences (SPSS version 20.0) software for analysis. Based on the data type qualitative represent as number and percentage, quantitative continues group represent by mean±SD. Chi-square test utilized for comparison between categorical variables. where compare between more than two groups in non-related continuous variables; used One-Way ANOVA test for normal distribution of variables and used Kruskal Wallis test for non-normal distribution of variables. P-value meant the level of significance where, $P > 0.05$ meant Non-significant (NS), $P < 0.05$ meant Significant (S) and $P < 0.01$ meant Highly significant (HS).

Results

The current study was non-randomized clinical trial (N-RCT) included 30 patients diagnosed with bile duct injury after meeting the inclusion/exclusion criteria selected from the outpatient clinic/inpatient wards of the surgical Department, Aswan and Assuit University hospitals. The recruited cases were divided into 3 groups: ERCP (Group-1, n = 15), either with or without stenting, Operative Group-2, n = 10, either choledocho-jejunostomy,

simple repair, repair over T-tube or HJ side to side, and radiological Group-3 (n = 5): either pig-tail drainage, PTD drainage.

Table (1) demonstrates that the mean age of the studied group was 49.27 (±11.97 SD) with range (29-73), among the studied cases there were 13 (43.3%) males and 17 (56.7%) females, 43.3 had Hypertension, 46.7% had Diabetes, 76.7% were obese and 6.7% had cirrhosis, these data give us an idea that female are more complaining of calcular gall bladder and also obesity has relation to difficulty of surgery and its complications. Table (2) demonstrates that according to causes of bile duct injury, 80.0% was post-cholecystectomy, 3.3% was Liver abscess, 10.0% was Hydatid cyst surgery and 6.7% was trauma, although traumatic bile duct injury was rare but luckily, we watched cases during period of our study; one case was with stabbing abdomen and the other patient was blunt abdominal trauma with high energy speed, both of these two cases was associated with liver lacerations grade 2 to 4. Also, the table demonstrates that nearly all cases 73.3% suffered from bile in drain, 80.0% had Abdominal pain, 46.7% had Jaundice, 13.3% had sepsis and 40.0% had fever

Table (1): Distribution of the studied cases based on Demographic data (n=30)

Age (years)		
Min. – Max.	29 – 73	
Mean ± SD.	49.27 ± 11.97	
Sex	**No.**	**%**
Male	13	43.3
Female	17	56.7
Comorbidity	**No.**	**%**
Hypertension	13	43.3
Diabetes	14	46.7
Obesity	23	76.7
Cirrhosis	2	6.7

Table (2): Distribution of the studied cases based on Etiology of bile duct injury (n=30)

Etiologies	No.	%	
Post-cholecystectomy	24	80.0	
Liver abscess		1	3.3
Hydatid cyst surgery	3	10.0	
Trauma		2	6.7
Clinical Presentation			
Bile in drain output		22	73.3
Abdominal pain		24	80.0
Jaundice	14	46.7	
Sepsis	4	13.3	
Fever	12	40.0	

Table (3) demonstrates that there were 40.0% had type A injury, 6.7% had Type B, 10.0% had type C, 13.3% had type D injury and 30.0% had Type E injury, mean of time injury diagnosis was 6.60 (±2.11 SD) days and mean of Time injury-referral 12.90 (±3.65 SD) days. Table (4) demonstrates that according to type of intervention, 50.0% had endoscopic intervention, 33.3% had surgical intervention and 16.7% had radiological intervention.

Table (3): Distribution of the studied cases based on Type of injury (n=30)

Strasberg classification	**No.**	**%**
A	12	40.0
B	2	6.7
C	3	10.0
D	4	13.3
E	9	30.0
Time injury-diagnosis (days) Mean±SD		6.60±2.11
Time injury-referral (days) Mean±SD		12.90±3.65

Table (4): Distribution of the studied cases based on Interventions in referring hospital (n=30)

Type of Interventions	**No.**	**%**
Endoscopic	**15**	**50.0**
With stent	10	33.3
Without stent	5	16.7
Surgery	**10**	**33.3**
Repair over T-tube	2	6.7
Simple repair over stent	1	3.3
Choledocho-jejunostomy	2	6.7
HJ (Hepatico-jejunostomy)	5	16.7
Radiological	**5**	**16.7**
Pigtail drainage	3	10.0
PTD drainage	2	6.7

Table (5): Comparison between Treatment Modality according to Demographic data (n=30)

	Endoscopic (n=15)		**Surgery (n=10)**		**Radiological (n=5)**		**Test of sign.**	**p**
Age (Mean ± SD)	45.4 ± 9.18		48.7 ± 13.43		62 ± 8.86		F = 4.498	0.021*
Sex	**No.**	**%**	**No.**	**%**	**No.**	**%**		
Male	10	66.7	2	20.0	1	20.0	$\chi2$= 6.652	0.036*
Female	5	33.3	8	80.0	4	80.0		
Strasberg classification	**No.**	**%**	**No.**	**%**	**No.**	**%**		
A	10	66.7	0	0.0	2	40.0		
B	2	13.3	0	0.0	0	0.0		
C	2	13.3	0	0.0	1	20.0		
D	1	6.7	3	30.0	0	0.0	$\chi2$= 23.583	0.003**
E	0	0.0	7	70.0	2	40.0		

SD: Standard deviation **x^2:** Chi square test

F: F value of One-Way ANOVA test. **p:** p value to compare among the three studied groups

*: Statistically significant at $p < 0.05$, **: Statistically significant at $p < 0.01$.

Table (6): Comparison between Treatment Modality according to Outcome(n=30)

	Endoscopic (n=15)		**Surgery (n=10)**		**Radiological (n=5)**		**Test of sign.**	**p**
Normalization of Bilirubin (days): Median (IQ range)	4(3-6)		5(3.75-7)		5(4.5-6.5)		H= 1.257	0.533
Normalization of AST (days): Median (IQ range)	4(4-5)		5(3.75-5)		5(3.5-5)		H=0.150	0.928
Outcome	**No.**	**%**	**No.**	**%**	**No.**	**%**		
Success	15	100.0	10	100.0	5	100.0	$\chi2$=	--
Failed	0	0.0	0	0.0	0	0.0		
Need of further intervention	No.	%	No.	%	No.	%		
Yes	0	0.0	0	0.0	2	40.0	$\chi2$=	0.005**
No	15	100.0	10	100.0	3	60.0	10.714	
Hospital stay (days):Median (IQ range)	4(3-4)		11(10-12.25)		9(7-18.5)		H= 22.001	<0.001**

SD: Standard deviation **IQR:** Inter quartile range **x^2**: Chi square test

H: Kruskal-Wallis H value test **p:** p value for comparing between three studied groups*: Statistically significant at $p < 0.05$, **: Statistically significant at $p < 0.01$.

Table (7) demonstrates that the complications was statistically insignificant difference between the studied cases according to procedure related complications and follow up (p >0.05), in this study the most common complications was wound infection and this was related to obesity of most of the patients and open approach in most of the patients. Also, there was highly significant difference among the studied groups with regard to (mental health, physical score and body pain score), the quality-of-life scores were betters in radiological and endoscopic groups rather than surgical group.

Table (7): Comparison between Treatment Modality according to Post operative Complication and Quality-of-life SF-36 Score (n=30)

	Endoscopic (n=15)		**Surgery (n=10)**		**Radiological (n=5)**		**Test of sign.**	**p**
Procedure related complications	No.	%	No.	%	No.	%		
Wound infection	4	26.7	1	10.0	1	20.0	$\chi 2$= 18.250	0.439
Biliary leakage	0	0.0	3	30.0	0	0.0		
Cholangitis	2	13.3	0	0.0	1	20.0		
Pancreatitis	1	6.7	0	0.0	0	0.0		
Chest infection	0	0.0	1	10.0	0	0.0		
Dvt	0	0.0	1	10.0	0	0.0		
Melena	1	6.7	0	0.0	0	0.0		
Stent dislocation	0	0.0	1	10.0	0	0.0		
Subphrenic abscess	1	6.7	0	0.0	0	0.0		
No	6	40.0	3	30.0	3	60.0		
Quality-of-life SF-36 Score	Median (IQ range)		Median (IQ range)		Median (IQ range)			
Mental Health score	83 (80-90)		55 (53-57.75)		87 (81-89)		H=19.137	<0.001**
Physical score	88 (77-90)		55 (49.75-55.25)		88 (83.5-89)		H=16.098	<0.001**
Body pain score	44 (44-56)		83.5 (76.75-89)		44 (40-46.5)		H=16.860	<0.001**

x^2: Chi square test **p:** p value for comparing between three studied groups

IQR: Inter quartile range **H: Kruskal-Wallis H value test**

*: Statistically significant at p < 0.05, **: Statistically significant at p < 0.01.

Discussion

Cholecystectomy is the most common abdominal surgical procedure worldwide. If approach of cholecystectomy performed (laparoscopic or open), it is still accompanied by a variable incidence of iatrogenic bile duct injury (IBDI). Although its incidence decreases with refinement of technique and standardization of the procedure, IBDIs are still an essential problem with regard to gastrointestinal (GIT) surgeries and remain a major challenge for a surgeon [11]. LC is considered the best approach in the context of the management of symptomatic gall stones; however, LC is accompanied by two- to four-fold increase in the possibility of BDI more than the conventional cholecystectomy. In less than one-third of cases, BDI can be discovered intraoperatively, and the diagnosis is confirmed by cholangiography, mostly intraoperative cholangiography (IOC) [12].

Of note, IBDI is the most feared adverse event representing about 0.2-2.9% [13]. In the majority of cases, the BDI is discovered postoperatively where the patients usually present with non-specific manifestations which include ambiguous abdominal pain, emesis, and a low-grade fever due to bile leaking into the peritoneal cavity with formation of bile ascites and additional delay usually leads to peritonitis, sepsis, cholangitis, or external biliary fistulae. The patient may present later after the development of stricture with jaundice with or without cholangitis; furthermore, BDIs with vascular affection might be associated with abscess formation, secondary biliary cirrhosis, or acute hepatic necrosis, and, in some situations, liver transplant may be required [14].

The rapid and precise IBDI diagnosis is of great importance for patients and GIT surgeons as unrecognized IBDI leads to serious complications which include biliary cirrhosis and liver cell failure which may untimely ends in death. The selection of the proper management for IBDI is of great importance as it could avoid such critical adverse events and enhance patients' QoL [15].

Endoscopic retrograde cholangiopancreatography (ERCP) must be performed to appropriately evaluate the biliary anatomy and confirm the presence and type of a biliary injury. ERCP has a definitive therapeutic value in minor biliary injuries and in complex injuries [16]. Various classifications of BDIs were developed to facilitate treatment options, and most of the authors consider the Strasberg classification of BDI as the most complete and easy-to-understand classification. It divides BDI into five groups (A to E) where the E class is analogous to the Bismuth classification. Only right and left partial injuries aren't comprised in such classification; however, these types are not common, and the surgeon must be aware of them to make an appropriate diagnosis and timely referral to a more specialized center if needed [17]. The aim of this study was to assess various therapeutic approaches of bile duct injuries and which was better according to type and time of injury (early or late presentation), outcome and improvement of QoL.

In this study we found that the average age of the studied group was 46 (±15 SD) with range (57-69), among the studied cases there were 13 (43.3%) males and 17 (56.7%) females, 40% had Hypertension, 46.7% had Diabetes, 40% were obese and 6.7% had cirrhosis. Abdel-Raouf et al. found in study to assess endoscopic management of postsurgical bile duct injuries that the mean age was 45.3 years with a range of 18 to 68 years. In addition, 162 were females [male to female ratio was 162 (58.5%)/115 (41.5%)]. Aziz et al. [18] illustrated that there were 36 men and 64 women, with a mean age of 45.4 ± 11.5 years (range, 19-67 years). Sixty-nine (69%) patients had comorbid illnesses, whereas liver cirrhosis was in 27 cases, obesity in 24 cases, and previous abdominal surgery in 18 cases

In this study, we illustrated that according to causes of bile duct injury, in 53.3% was post-cholecystectomy, 23.3% was Liver abscess, 16.7% was Hydatid cyst surgery and 6.7% was trauma. Giri et al. [19] found that the causes of bile leaking were post-cholecystectomy injuries in 34 (47.8%), hepatic abscess in 20 (28.1%), post-hydatid cyst surgeries in 11 (15.4%), injury throughout different surgeries in 5 (7.0%), and trauma in 1 (1.4%) patient.

In this study we demonstrated that nearly all cases 93.3% suffered from bile in drain, 46.7% had Abdominal pain, 40% had Jaundice, 20% had sepsis and 30% had fever. El-Shafei et al. [20] showed that the most frequent postsurgical presentation is bile leakage in 14 of the cases (46.66%), then jaundice in six of the cases (20%) and abdominal pain in four cases (13.3%).

In this study. we found that there were 26.7% had type A injury, 6.7% had Type B, 10% had type C, 13.3% had type D injury, 30% had Type E injury, mean of time injury diagnosis was 6.60 (±2.11 SD) days and mean of Time injury-referral 12.90 (±3.65 SD) days. Giri et al. [19] found that among the BDI cases, 23 (58.9%) presented with class A injury, 2 (5.1%) with class C injury, 13 (33.3%) with class D

injury, and 1 (2.5%) with class E injury according to the Strasberg classification. Major bile duct injury was noticed in 14 (35.8%) and minor bile duct injuries in 25 (64.1%) patients.

In this study we found that according to type of intervention, 50% had endoscopic intervention, 33.3% had surgical intervention and 16.7% had radiological intervention. Aziz et al. [18] illustrated that management of patients was planned electively with 29 (29.6%) patients managed by non-surgical procedures. These were in the form of ERCP and stenting (45.8% with Type A, 8.3% with Type C, and 45.8% with Type D) and percutaneous abdominal drainage (7.7% with Type A injury). Of these conservatively treated patients, one developed internal fistula and returned after 3 months by obstructive jaundice, and another two patients developed CBD stricture 1 month after removal of CBD stent. Seventy-two (73.4%) patients underwent surgeries in the form of Roux-en-Y hepaticojejunostomy.

Our study demonstrated that there was no significant difference among the three studied groups with regard to sociodemographic characteristics ($p > 0.05$). Booij et al. [21] found that demographics didn't significantly vary between various therapeutic approaches.

Our study demonstrated that there was highly significant difference between studied groups with regard to Strasberg classification, in which type A injury was higher in endoscopic group while type E was higher in surgical group. Al-Jiffry et al. [17] found that ERCP was successful in 87.5% of cases as a therapeutic modality in Strasberg type A patients to stop biliary leak. Booij et al. [21] have demonstrated that cases with type A injury, commonly managed by endoscopic or radiological means, had a significant increase in ASA classification (ASA > 3) in comparison with vases with different injuries, supporting the assumption of bias in selection. In contrast, surgery has been utilized in the context of extensive injuries with CBD transection, when no different therapeutic approaches are available.

In this study we have demonstrated that there was significant difference among the three studied groups as regards Normalization of AST (days), outcome and Hospital stay ($p < 0.05$). in which Endoscopic group, normalization of AST was faster, also success was higher and hospital stay was shorter

El-Shafei et al. [20] showed that in the endoscopic group, death rate was zero percent in comparison to 4.8% of the surgical group (P=0.05). Frequent stenosis was reported in 2.5% cases of the endoscopic group and 9.5% in patients of the surgical group. Restenosis following endoscopic management developed before ten months in comparison with the surgery (2 years; =0.05). Khalaf et al. [22] found that all cases were treated by primary repair of BDI by biliary stent therapy; efficient outcomes were acquired in 15 of 17 cases, with no sign of stenosis or leakage. However, two patients required surgical revision (because of stent migration) using the Roux-en-Y technique. It was also significantly longer for time of operation (2–4 to 3–6 h), hospital stay (5–8 to 10–42 days).

In this study we demonstrated that the complications were significantly reduced in endoscopic group compared to surgical and radiological groups (p=0.002). Booij et al. [21] have demonstrated that there was a significant difference among the different types of treatment as regards general complications ($p <0.05$). There were significant increases in the numbers of cases with cardiopulmonary and blood loss following radiological therapy and more cases with intra-abdominal abscess, hepatic abscess development, cholangitis, and re-operation following surgery. Aziz et al. [18] illustrated that short-term complications showed that prior ERCP intervention was associated with high incidence of postoperative complication ($P = 0.047$).

In this study we found that the QoL was slightly better in endoscopic group in comparison with surgical and radiological groups but still insignificant only in mental health where the difference was significant ($p =0.04$). Booij et al. [21] have demonstrated that Surgical patients recorded a significantly worse SF-36 score in comparison to the endoscopic group (median 46.3) versus median 53.9 (IQR 44.3–57.6) ($P < 0.05$).

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Limitations

Despite the promising outcomes of the current study, small sample size is considered the main limitation that could interfere with the results, hence additional researches with larger sample size is needed to confirm the current results.

Conclusion

In conclusion, the most common types of post-cholecystectomy problems are biliary leakage. A multidisciplinary procedure among the biliary endoscopist, surgeon, and the radiologist is needed

for treating cases in several phases for treatment of post-cholecystectomy problems. Endoscopic procedure is simple, reversible, and minimally invasive. As a result, endoscopic procedure has to be an essential component of the therapeutic process in most of cases with significant biliary tract injuries. On the other hand, the success of endoscopic procedure depends on the injury type. Endoscopy is comparable to surgery during the initial management of simple problems, but for major leaks, ligation, transection, and complicated problems, surgery is the primary therapeutic option because of its invasiveness

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