Aswan University Medical Journal, volume 3 / No.1/ June 2023 (103-115) Online ISSN: **2735-3117**

ORIGINAL ARTICLE

Bile Duct Injuries: physical and social outcomes after Different Therapeutic Modalities

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ABSTRACT

Background: Bile duct injury (BDI) is a major complication in biliary surgery. The management of major BDI is a surgical challenge. **Aim:** evaluate different therapeutic modalities of bile duct injuries and which was better according to type and time of injury outcome and improvement of quality of life. **Methods**: This was a non-randomized clinical trial study was conducted on thirty cases at the Faculty of Medicine, Aswan & Assuit Universities, Egypt,from February 2018 till February 2022. All patients were grouped into either surgical, endoscopic and radiological groups. **Results**: 50.0% had endoscopic intervention, 33.3% had surgical intervention and 16.7% had radiological intervention. There was highly significant difference between studied groups as regards (mental health, physical score and body pain score), the quality-of-life scores were betters in radiological and endoscopic groups rather than surgical group. This study revealed that patients of bile duct injury managed by non-surgical way are satisfied and they can do well with less pain. **Conclusion**: Endoscopic management is relatively simple, minimally invasive. However, the success of endoscopic therapy depends on the type of injury. but for major leaks and complex problems, surgery is the aim.

Keywords: Bile duct injury, Cholecystectomy, Outcomes, Timing of repair

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INTRODUCTION

Bile duct injuries (BDI) take place in a wide spectrum of clinical settings. The mechanisms of injury, previous attempts of repair, surgical risk and general health status importantly influence the diagnostic and therapeutic decision-making pathway of every single case **[1]**. BDI may occur after gallbladder, pancreas and gastric surgery, with laparoscopic cholecystectomy responsible for 80%-85% of them (Although not statistically significant, BDI during laparoscopic cholecystectomy is twice as frequent compared to injuries during an open procedure (0.3% open versus 0.6% laparoscopic) **[2]**. The two most frequent scenarios are bile leak and bile duct obstruction. Most of BDIs after laparoscopic cholecystectomy are recognized Trans operatively or in the immediate post-operative 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 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

Submission date: (11/4/2023) - acceptance date: (6/5/2023)

result. The management of patients suffering from BDI is a true challenge for every surgeon, particularly for those specialized in hepatobiliary surgery.

Cystic duct stump leak, partial laceration of the common bile duct, or even small strictures can be managed by endoscopic retrograde or percutaneous stenting and dilation. The most severe lesions such as bile duct transection or recurrent strictures tend to require reconstructive surgery **[4].**

Collaboration among surgeons, gastroenterologists, and interventional radiologists is imperative in the management of these complex injuries. Many factors lead to this complication, including misinterpretation of anatomy, thermal injury from electrocautery, extensive inflammation, short length of the cystic duct, hemorrhage, and morbid obesity **[5].** Most of these injuries are not recognized intra operatively, leading to BDI and consequent increased rates of morbidity and mortality due to severe episodes of cholangitis, jaundice, and intra-abdominal sepsis **[6],** Evidence suggests that these patients have a long history of high rates of admissions to hospitals until their final treatment. Thus, early identification and repair can be life saving for patients with bile duct injuries **[7]**. The final choice of treatment depends upon the type of injury. Usually, when the bile duct has not lost its continuity and the patient does not suffer from severe episodes of cholangitis, more conservative options such as percutaneous drainage or endoscopic stenting are preferred alternatively, in cases of complete transection or in the presence of severe symptoms, surgical reconstruction is the treatment of choice. Some cases may even require hepatectomy as the last resort of treatment **[8].** Indications for this form of treatment include early (within 5 weeks after LC) vascular injury, proximal BDI, injury to the right hepatic artery, and sepsis caused by liver necrosis or bile duct necrosis. With more Chronic patients (over 4 months after LC) hepatectomy effectively manage recurrent cholangitis and liver atrophy **[9].**

AIM OF WORK

The aim of this study was to evaluate different therapeutic modalities of bile duct injuries and which was better according to type and time of injury (early or late presentation), physical and social outcome and improvement of quality of life.

PATIENTS AND METHODS

Study setting

This study was prospective non randomized clinical trial study conducted in general surgery department, Aswan University hospital, Assuit university hospitals, Egypt since February 2018 till February 2022.

Study population

This study was conducted on 30 patients with diagnosed bile duct injury after meeting the inclusion criteria. We included any patients with bile duct injury, both sexes were included. No patient with bile duct injury was excluded. All patients were grouped into either surgical, endoscopic and radiological group, based on the initial treatment 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 included in this study were subjected to full 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 procedures, time of diagnosis, and time to referral. Full radiological assessment included US, CT abdomen and MRCP while routine laboratory

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investigations included 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. One patient of these patient Patient presented with jaundice, abdominal pain and raised liver functions developed due to CBD stricture diagnosed with MRCP after 6 months of ERCP 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, C and type E 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, the other 2 patients treated with percutaneous transhepatic drainage due to ligated CBD to relieve high bilirubin level and reduce biliary liver congestion with improvement of the general condition and become laible for definitive treatment with bilio-enteric reconstruction . 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.

Procedure

- 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.
- 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 may be approximated into one “double-barrel” duct, and an end-to-side HJ can be performed.

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The technique begins by placing two corner stitches on the right and left sides incorporating at least 3 mm of duct and mucosa of the jejunum. Next 4-0 or 5-0 interrupted monofilament absorbable sutures are placed to approximate the posterior wall completely. An end-to-side jejunojejunostomy was created with a single layer continuous hand-sewn technique, allowing for an approximately 40 cm bilio-enteric limb length.

- Side-to-side anastomosis (2 patients): Strasberg class E where A transverse ductotomy was made in the LHD and may be extended into the RHD at the confluence. A side-to-side anastomosis is then performed starting with the posterior wall in an interrupted or running fashion utilizing a 4-0 or 5-0 monofilament absorbable suture. The cornerstone of the technique is to achieve 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 (complete blood count, bilirubin and liver enzymes).
- ✓ 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 were defined as any intraoperative or postoperative event that altered the clinical course, such as 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 of surgical complications. Wound infection was a wound requiring partial or complete opening for drainage, including T-tube tract infection.

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

Grade I: Any deviation from the normal postoperative course without the need for pharmacologic treatment or for surgical, endoscopic, or radiologic interventions.
Allowed therapeutic regimens are drugs such as antipyretics, antiemetics, diuretics, analgesics, electrolytes and physiotherapy. Also, this grade includes wound infections which opened at bedside.

Grade II: Complications requiring pharmacologic treatment with drugs other than those allowed for grade 1 complications.
Blood transfusions and total parenteral nutrition are also included.

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Grade III:	Complications requiring surgical, endoscopic, or radiological intervention.
IIIa	(A) intervention not using general anesthesia.
IIIb	(B) intervention using general anesthesia.
Grade IV:	Life threatening complications (including CNS complications) * requiring IC/ICU management.
IVa	(A) Single-organ dysfunction.
IVb	(B) Multiple-organ dysfunction.
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,social and physical activities follow up

Data management and Statistical Analysis

Data were then imported into Statistical Package for the Social Sciences (SPSS version 20.0) **(**Statistical Package for the Social Sciences) software for analysis. According to the type of data qualitative represent as number and percentage, quantitative continues group represent by mean ± SD. Chi-square test used to compare between categorical variables. where compare between more than two groups in non-related continuous variables; used One-Way ANOVA test for normal distributed variables and used Kruskal Wallis test for not normal distributed 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 patients were divided into three 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)** shows that there was highly significant difference between studied groups as regards Strasberg classification, in which type A injury was higher in endoscopic group while type E was higher in surgical group, and there was significant difference between studied groups as regards age in which age was older in radiological group, and there was significant difference between studied groups as regards sex types in which female was higher in surgery & radiological group 80.0% of cases. Table **(2)** shows 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 shows 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 **(3)** shows that according to type of intervention, 50.0% had endoscopic intervention, 33.3% had surgical intervention and 16.7% had radiological intervention. Table **(4)** shows that there was

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statistically insignificant difference between the studied cases according to Laboratory investigations (p >0.05).

Table (1): 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	χ^2= **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	χ^2= **23.583**	**0.003****
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		
E	0	0.0	7	70.0	2	40.0		

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

F: F value of One-Way ANOVA test. p: p value for comparing between **three studied groups**

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

Table (2): Distribution of the studied cases according to 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

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Table (3): Distribution of the studied cases according to 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 (4): Descriptive analysis of the studied cases according to post-operative Laboratory investigations (n=30)

Laboratory investigations	**Endoscopic (n=15)**	**Surgery (n=10)**	**Radiological (n=5)**	**F=**	**p**
Hemoglobin Mean ± SD.	11.38 ± 1.31	10.98 ± 1.52	10.98 ± 2.55	0.227	0.799
WBCs Mean ± SD.	11866.67 ± 2191.43	12600 ± 3405.88	12800 ± 1923.54	0.357	0.703
AST Mean ± SD.	62.69 ± 13.79	63.38 ± 9.54	66.43 ± 9.88	0.185	0.832
ALT Mean ± SD.	51.76 ± 11.11	46.99 ± 12.04	57.41 ± 9.34	1.492	0.243
Total bilirubin Mean ± SD.	3.02 ± 0.92	3.22 ± 1.47	2.46 ± 0.61	0.806	0.457
Creatinine Mean ± SD.	0.98 ± 0.42	1.03 ± 0.51	1.16 ± 0.28	0.301	0.742

SD: **Standard deviation** **F: F value of One-Way ANOVA test**

p: p value for comparing between **three studied groups** *: Statistically significant at $p < 0.05$, **: Statistically significant at $p < 0.01$.

Table **(5)** shows that there was highly significant difference between studied groups as regards need of further intervention, in which cases need with 40% in radiological, and there was highly significant difference between studied groups as regards hospital stay per days in which hospital stays was the longest period of time in surgical group while the shortest period of time in endoscopic group. There was statistically insignificant difference between the studied cases according to normalization of Bilirubin (days) and normalization of AST (days).

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Table (5): 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	χ^2=	--
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	χ^2= **10.714**	**0.005****
No	15	100.0	10	100.0	3	60.0		
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** **χ^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 **(6)** shows 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 were wound infection this is related to obesity of most of the patients.

Table (6): Comparison between Treatment Modality according to Post operative Complication (n=30)

	Endoscopic (n=15)		**Surgery (n=10)**		**Radiological (n=5)**		**Test of sign.**	**p**
Procedure related complications	**No.**	**%**	**No.**	%	**No.**	%		
Wound infection	1	10.0	4	26.7	1	20.0	χ^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		

χ^2: Chi square test
p: p value for comparing between **three studied groups**
*: Statistically significant at p < 0.05, **: Statistically significant at p < 0.01.

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Table **(7)** shows that there was highly significant difference between studied groups as regards (mental health, physical score and body pain score), the quality-of-life scores were betters in radiological and endoscopic groups rather than surgical group. This study revealed that patients of bile duct injury managed by non-surgical way are satisfied and socially contacting well and physically they can do well with less pain, these results encourage us to adopt non-surgical management of bile duct injury patients and decision of surgery is magnified and be by multidisciplinary team not single person experience.

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

SF-36 score	Endoscopic (n=15) Median (IQ range)	Surgery (n=10) Median (IQ range)	Radiological (n=5) Median (IQ range)	Test of sign.	p
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=**16.86**	**<0.001****

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

p: p value for comparing between three studied groups
*: Statistically significant at $p < 0.05$, **: Statistically significant at $p < 0.001$.

The SF-36 is a health status profile originally designed to measure health status of patients and outcomes of patients. Health status could be compared between groups of patients by type of intervention, disease, or type of health insurance. The 36 questions on the SF-36 are meant to reflect 8 domains of health, including physical functioning, physical role, pain, general health, vitality, social function, emotional role, and mental health. The categories of physical role and emotional role reflect performance at the activity and participation levels.The SF-36 has been found to be reliable and valid for measuring health-related quality of life of individuals with several chronic health conditions especially the physical functioning domain of the SF-36 measures mobility disability in several patient populations.

DISCUSSION

Cholecystectomy is the most common abdominal surgical procedure worldwide. If approach of cholecystectomy performed (laparoscopic or open), it is still associated with a variable incidence of iatrogenic bile duct injury (IBDI). Although its incidence decreases with refinement of technique and standardization of the procedure, IBDIs remain an important problem in gastrointestinal surgery and remain a big challenge for a surgeon **[11]**. Laparoscopic cholecystectomy (LC) is considered the gold standard for the treatment of symptomatic gall stones; however, LC is associated with two- to four-fold increase in the risk of bile duct injury (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].**

Iatrogenic injury to the bile ducts is the most feared complication, with an incidence of around 0.2-2.9% **[13].** In the majority of cases, the BDI is discovered postoperatively where the patients usually present with nonspecific symptoms such as vague abdominal pain, nausea and vomiting, and a low-grade fever due to bile leak into the peritoneal cavity with formation of bile ascites and further 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 **[14].**

The early and accurate diagnosis of IBDI is very important for both patients and gastrointestinal surgeons because unrecognized IBDI leads to serious complications, The choice of the appropriate

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treatment for IBDI is very important because it may avoid these serious complications and improve patients' quality of life **[15].**

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 are not included in this classification; however, these types are not common, and the surgeon must be aware of them in order to make a proper diagnosis and timely referral to a more specialized center if needed **[16].** The aim of this study was 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.

In this study we found that the mean 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. **Aziz *et al.* [17]** 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.

The results showed that there was highly significant difference between studied groups as regards Strasberg classification, in which type A injury was higher in endoscopic group while type E was higher in surgical group. **Al-Jiffry *et al.*, [16]** 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.*, [18]** found that patients with type A injury, who are mostly treated by endoscopic or radiological means, had a significantly higher ASA classification (ASA > 3) compared with patients with other injuries, which supports the assumption of bias in selection. On the other hand, surgery has been used for more severe injuries with transection of the CBD, when no other treatment options are available.

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.*, [17]** illustrated that management of patients was planned electively with 29 (29.6%) patients treated by nonsurgical 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 common bile duct (CBD) stricture 1 month after removal of CBD stent. Seventy-two (73.4%) patients underwent operative surgery in the form of Roux-en-Y H.J, also, **Booij *et al.*, [18]** found that Endoscopic intervention was the definitive treatment in 398 patients (49.8%), surgery in 272 patients (34.0%), and radiological intervention in 96 patients (12.0%).

In this study we found that there was significant difference between 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.

Boerma *et al.*, [19] found that Endoscopic treatment was performed in 69 patients and was functionally successful in 93%. The long-term results of surgery depended on the timing of the procedure. The overall success rate of hepaticojejunostomy was 84%, but in patients who underwent delayed reconstruction (suggested previously as optimal treatment and performed in the latter phase of this study), success was achieved in 94%. Whether endoscopic or surgical treatment is indicated depends mainly on the type of injury and the time of detection, and the indications for both modalities are completely different.

El-Shafei *et al.*, [20] showed that in the endoscopic group, mortality rate was 0% compared with 4.8% of the surgical group ($P = 0.05$). Recurrent stenosis was evidenced in 2.5% patients of the

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endoscopic group and 9.5% in patients of the surgical group. Restenosis after endoscopic treatment developed before 10 months compared with the surgical approach (2 years; $P = 0.05$).

Booij *et al.*, [18] found that Patients treated surgically had the best outcome compared with other treatments. This outcome is in part explained by patient selection, as all patients in our cohort had been referred to a tertiary referral center.

Khalaf *et al.*, [21] found that all patients were treated by primary repair of BDI by biliary stent therapy; a successful outcome was obtained in 15 of 17 patients, 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 and hospital stay.

In this study we demonstrated that the complications were significantly lower in endoscopic group compared to surgical and radiological groups (p = 0.002). **El-Shafei *et al.*, [20]** showed that the overall treatment-related complication rate was significantly higher in the surgical group (53.8 vs 20% in the endoscopic group ($P = 0.05$).

Booij *et al.*, [18] found that there was a significant difference between the different types of treatment as regards general complications (p <0.05). There were significantly more patients with cardiopulmonary and bleeding complications after radiologic treatment and more patients with intraabdominal abscess, liver abscess formation, cholangitis, and reoperation after surgical treatment.

In this study we found that the quality of life was slightly better in endoscopic group compared to surgical and radiological groups but still insignificant only in mental health the difference was significant (p =0.04). **Booij *et al.*, [18]** found that Surgical patients reported a significantly worse SF-36 score compared with the endoscopic group (median 46.3, IQR 36.3–54.7) versus median 53.9 (IQR 44.3–57.6) (P < 0.05).

Also**, Boerma *et al.*, [19]** found that patients were treated by endoscopy or by (major) surgery, mental and physical QOL was equally poor. Mental outcome was negatively influenced by the duration of treatment (i.e., the number of days between the time of diagnosis until the last therapeutic intervention; $P = .009$). endoscopic treatment to be better QOL, probably because endoscopic treatment often consists of repetitive 1-day outpatient procedures.

CONCLUSION

In conclusion, the most common types of post-cholecystectomy problems are biliary leakage. A multidisciplinary approach between the biliary endoscopist, surgeon, and the radiologist is required for managing patients in many phases for treatment of post-cholecystectomy problems. Endoscopic management is relatively simple, reversible, and minimally invasive. Thus, endoscopic management should be an integral part of the therapeutic algorithm in the majority of patients with significant biliary tract injuries. However, the success of endoscopic therapy depends on the type of injury. Also we found that non surgical management give good physical , social and emotional out comes and pain scale is less in comparison to surgical intervention so we insist to adopt conservative strategy in bile duct injuries and to magnify decision of surgical intervention to be not single person decision and to be multidisciplinary team decision oweing to its bad effect on life style of patient .

Conflict of interest: The investigators declare no conflict of interest.

Sources of funding: The current study didn't receive any specialized grant from funding agencies.

Limitations

This study had some limitations in which the small sample size which may affect our results so further studies with larger sample size is needed to establish our results.

REFERENCES

Submission date: (11/4/2023) - acceptance date: (6/5/2023)

1. **Karvonen J., Gullichsen R., Laine S., *et al.* (2007)**: Bile duct injuries during laparoscopic cholecystectomy: primary and long-term results from a single institution. Surgical endoscopy, 21(1069-73.

2. **Mercado M., Chan C., Orozco H., *et al.* (2003)**: Acute bile duct injury. Surgical Endoscopy and Other Interventional Techniques, 17(1351-5.

3. **Bektas H., Schrem H., Winny M., *et al.* (2007)**: Surgical treatment and outcome of iatrogenic bile duct lesions after cholecystectomy and the impact of different clinical classification systems. Journal of British Surgery, 94(9), 1119-27.

4. **Fischer C.P., Fahy B.N., Aloia T.A., *et al.* (2009)**: Timing of referral impacts surgical outcomes in patients undergoing repair of bile duct injuries. Hpb, 11(1), 32-7.

5. **Felekouras E., Petrou A., Neofytou K., *et al.* (2015)**: Early or delayed intervention for bile duct injuries following laparoscopic cholecystectomy? A dilemma looking for an answer. Gastroenterology Research and Practice, 2015(

6. **Nordin A., Halme L., Mäkisalo H., *et al.* (2002)**: Management and outcome of major bile duct injuries after laparoscopic cholecystectomy: from therapeutic endoscopy to liver transplantation. Liver transplantation, 8(11), 1036-43.

7. **Yang W.-L., Zhang D.-W., Zhang X.-C. (2006)**: Clinical analysis of patients with iatrogenic bile duct injury. Hepatobiliary & Pancreatic Diseases International: HBPD INT, 5(2), 283-5.

8. **Felekouras E., Megas T., Michail O.P., *et al.* (2007)**: Emergency liver resection for combined biliary and vascular injury following laparoscopic cholecystectomy: case report and review of the literature. SOUTHERN MEDICAL JOURNAL-BIRMINGHAM ALABAMA-, 100(3), 317.

9. **Li J., Frilling A., Nadalin S., *et al.* (2012)**: Timing and risk factors of hepatectomy in the management of complications following laparoscopic cholecystectomy. Journal of gastrointestinal surgery, 16(815-20.

10. **Dindo D., Demartines N., Clavien P.-A.J.A.o.s. (2004)**: Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. 240(2), 205.

11. **Michael Brunt L., Deziel D.J., Telem D.A., *et al.* (2020)**: Safe cholecystectomy multi-society practice guideline and state-of-the-art consensus conference on prevention of bile duct injury during cholecystectomy. Surgical Endoscopy, 34(2827-55.

12. **Schreuder A.M., Busch O.R., Besselink M.G., *et al.* (2020)**: Long-term impact of iatrogenic bile duct injury. Digestive surgery, 37(1), 10-21.

13. **Serrano O.K. (2022)**: Iatrogenic Bile Duct Injury: Call for Help, Refer Early, Reduce Infection. Invited Commentary: Liver Transplantation as Definitive Treatment of Postcholecystectomy Bile Duct Injury: Experience in a High-volume Repair Center. Annals of Surgery, 275(5), e733-e4.

Submission date: (11/4/2023) - acceptance date: (6/5/2023)

14. **Julian D., Martín d.S., Martín P., *et al.* (2022)**: Role of laparoscopy in the immediate, intermediate, and long-term management of iatrogenic bile duct injuries during laparoscopic cholecystectomy. Langenbeck's Archives of Surgery, 407(2), 663-73.

15. **Lopez-Lopez V., Gil-Vazquez P.J., Ferreras D., *et al.* (2022)**: Multi-institutional expert update on the use of laparoscopic bile duct exploration in the management of choledocholithiasis: Lesson learned from 3950 procedures. Journal of Hepato-Biliary-Pancreatic Sciences,

16. **Al-Jiffry B.O., Al Saeed M., Al-Mourgi M., *et al.* (2019)**: Management of nonvascular postlaparoscopic bile duct injury. Saudi Surgical Journal, 7(3), 95.

17. **Aziz A.M., Shoreem H., Sallam A., *et al.* (2016)**: Iatrogenic bile duct injury: A retrospective analysis of short-and long-term outcomes after surgical repair. Saudi Surgical Journal, 4(2), 61.

18. **Booij K.A., de Reuver P.R., van Dieren S., *et al.* (2018)**: Long-term impact of bile duct injury on morbidity, mortality, quality of life, and work related limitations. Annals of surgery, 268(1), 143-50.

19. **Boerma D., Rauws E.A., Keulemans Y.C., *et al.* (2001)**: Impaired quality of life 5 years after bile duct injury during laparoscopic cholecystectomy: a prospective analysis. Annals of surgery, 234(6), 750.

20. **El-Shafei M.E.D., Helmy A.A., Ahmed M.A.F. (2020)**: Management of postcholecystectomy biliary injury in Assiut University Hospital clinical audit. Journal of Current Medical Research and Practice, 5(3), 322.

21. **Khalaf A.M. (2013)**: Management of bile duct injuries: comparative study between Roux-en-Y hepaticojejunostomy and primary repair with stent placement. Journal of The Arab Society for Medical Research, 8(2), 89.

Submission date: (11/4/2023) - acceptance date: (6/5/2023)