

Bile Duct Injury as a Complication of Laparoscopic/Open Cholecystectomy -Clinical Profile and Management

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ABSTRACT

INTRODUCTION: The biliary tract is a complex organ system that performs the simple though vital task of collecting, storing, and delivering bile to the gastrointestinal tract.

Diseases of the biliary tract can be extremely painful, debilitating, and occasionally life threatening.

AIMS AND OBJECTIVES: To study the occurrence, contributing factors, clinical features and management of bile duct injuries.

METHODS: Prospective study. 1462 patients undergoing Cholecystectomy in the department of general surgery GMCH during the period June 2021 to May 2022 were taken .

RESULTS: Out of 1462 cholecystectomies (551 LC and 911 OC), 50 cases were identified as BDI (3.41%).

In our study, 29 cases of BDI were identified in <1 week and 21 in >1 week of undergoing cholecystectomy. 6 of these underwent hepaticojejunostomy, 6 required a

choledochoduodenostomy, 18 were managed with percutaneous drainage postoperatively, 18 cases were managed with ERCP and stenting and 12 cases were managed by primary suturing.

Out of 50 cases of BDI, 26 were LC and 24 were OC. Chi-square statistics was calculated to be 4.5155. p-value was found to be 0.03359 indicating BDI is more associated with LC than with OC.

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I. INTRODUCTION

Bile duct injuries are third most common injuries encountered in general surgical practice. It is always associated with increased incidence of mortality and morbidity and cholecystectomy remains the greatest source of post-operative biliary injuries.

Types of Injury :

- Bile leaks (Usually minor)
- Bile duct transections / stricturing type (Major)

Common causes bile leaks are :-

- Leak from cystic duct stump
- Transected aberrant right hepatic duct
- Lateral injury to the main bile duct.
- unidentified cholecysto hepatic duct

Common presentations :

- In the first week of laparoscopic cholecystectomy are pain, fever and mild hyperbilirubinaemia (up to 2.5 mg /dl) from a bilioma or bile peritonitis. Placing a drain relieves from bilioma.
- bloating or anorexia more than few days after laparoscopic cholecystectomy.
- bile duct strictures

Modes of Injury during Laparoscopic Cholecystectomy

Basic two error groups which lead to bile duct injuries are:

1. Misinterpretation of anatomy
2. Technical Error

Risk factors for Bile duct injuries:

1. Experience of the surgeon
2. excessive fat and adhesions in porta hepatis which makes the dissection difficult.
3. Anomalies of biliary tract (10-15%) , most important among them is an aberrant right hepatic duct inserting low into common hepatic bile duct mistaken for cystic duct.

Prevention of Bile Duct Injuries in laparoscopic cholecystectomy

1. Thorough knowledge of the anatomy, risk factors and mechanisms of injury.
2. Meticulous technique of safe cholecystectomy.
3. Timely decision for elective conversion to open in the presence of difficult anatomy.
4. Developing skills of interpreting Intra operative cholangiogram.
5. Meticulous technique like proper traction, limiting dissection close to gallbladder, Critical window and display of structures in Calot`s triangle usually reduces bile duct injuries.

Roux-en-Y Hepatico Jejunostomy /choledochojejunostomy :procedure of choice for major transectional and stricture injuries. It

can be used along with internal stents to avoid anastamotic site stricture.

AIMS AND OBJECTIVE

The objective of the current study is

1. To study the occurrence of bile duct injuries
2. To study contributing factors, clinical features and management of bile duct injuries.

II. MATERIALS AND METHODS

Source of data

Patients admitted to Gauhati Medical College and Hospital, who underwent cholecystectomy and on those referred with documented bile duct injuries for further management.

Method of collection of data

Prospective analysis . On all patients with an iatrogenic BDI from June 2021 to May 2022.

The case papers, referral letters, operative and postoperative records were scrutinized and data was collected.

Factors noted in the study are :

- injuries sustained during cholecystectomy
- timing of cholecystectomy after the onset of symptoms (< 72 hours or >72 hours
- age
- sex
- presence of gall stone pancreatitis
- acute cholecystitis or cholangitis
- time between cholecystectomy and recognition of BDI
- time from injury to definite management
- type of injury
- endoscopic retrograde cholangiography and stenting .

Bile duct injury were noted as bile leak intraoperatively or in the postoperative period as evidenced by :

- bilious drainage
- failure to recover along expected lines
- abdominal pain
- sepsis

BDI were classified using Strasberg and Bismuth`s classification.

Inclusion Criteria:

Patients who underwent cholecystectomy from June 2021 to May 2022 in General Surgery department GMCH 1 and patients referred with bile duct injuries occurring as complication of cholecystectomy .

Exclusion Criteria:

Bile duct injuries occurring as a complication of other surgeries apart from cholecystectomy

1. As a complication of ERCP
2. Penetrating and blunt injuries to the abdomen.
3. Cholecystectomies done along with other surgeries-such as formalignancy.

Statistical Analysis :

Out of 1462 cholecystectomies , 551 were LC and 911 were OC. 50 cases were identified as BDI. 26 of them had LC while 24 had OC.

Descriptive statistics using proportions to describe occurrence of BDI. Chi Square test was used to assess the statistical difference between major variable such as route of cholecystectomy(OC/LC). p-value was be calculated keeping 0.05 as Significance level.

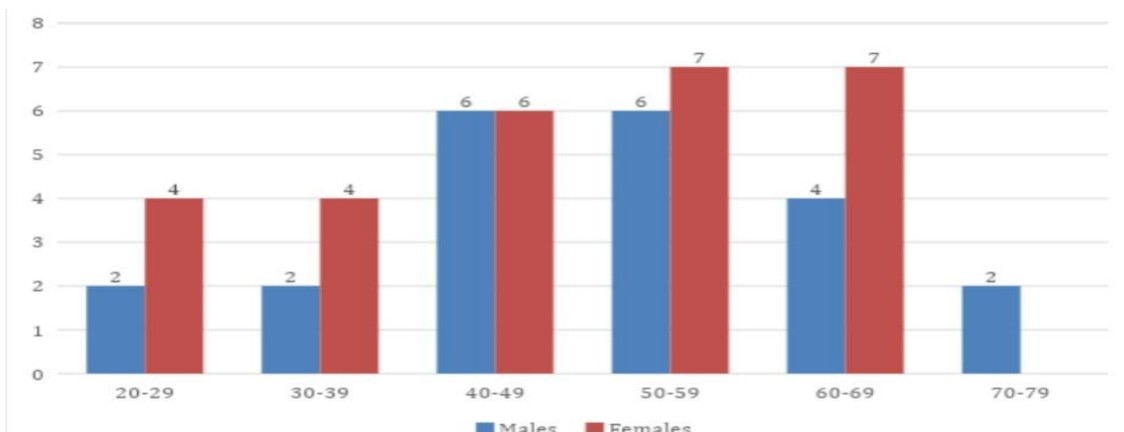
III. Results And Observations

Out of 1462 cholecystectomies , 551 were LC and 911 were OC. 50 cases were identified as BDI. 26 of them had LC while 24 had OC. The incidence of Bile duct injury was 3.41% .

The mean age was 48.36 yrs and a range of 20-78 yrs.

Table: Distribution of age and sex among the study population

AGE (years)	MALE	FEMALE	TOTAL
20-29	2	4	6
30-39	2	4	6
40-49	6	6	12
50-59	6	7	13
60-69	4	7	11
70-79	2	0	2
TOTAL	22	28	50

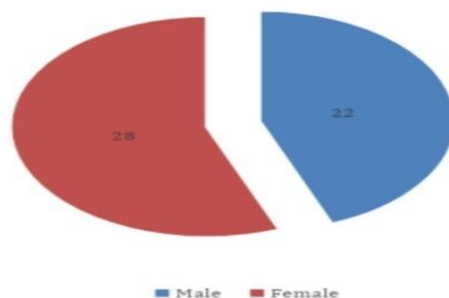


Graph 1 : Distribution of age and sex among the study population

Table 4 : Sex incidence of BDI

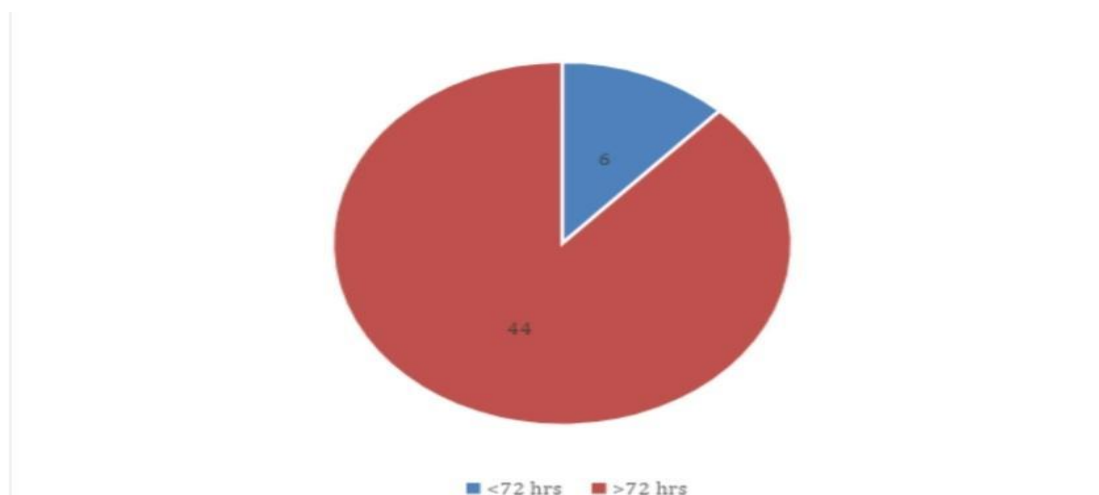
Gender	Number of patients
MALE	22
FEMALE	28
TOTAL	50

Graph 2 : Sex distribution among study population

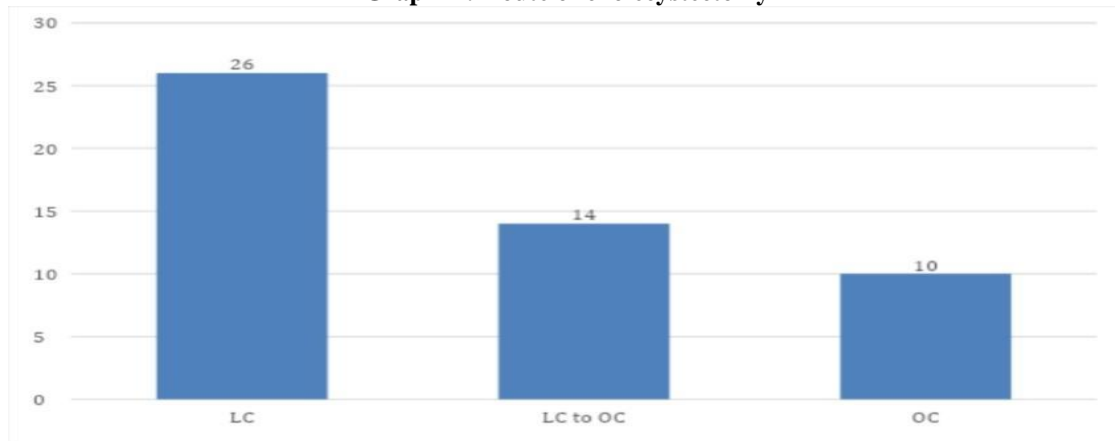


Majority of the bile duct injuries were seen in patients undergoing cholecystectomy for cholecystitis of > 72 hours duration. Among the 50 cases of BDI 26 cases were done laparoscopically and 10 were open cholecystectomies. 14 cases of LC were converted to open.

Graph 3 : Timing of cholecystectomy from onset of symptoms



Graph 4 : Route of cholecystectomy

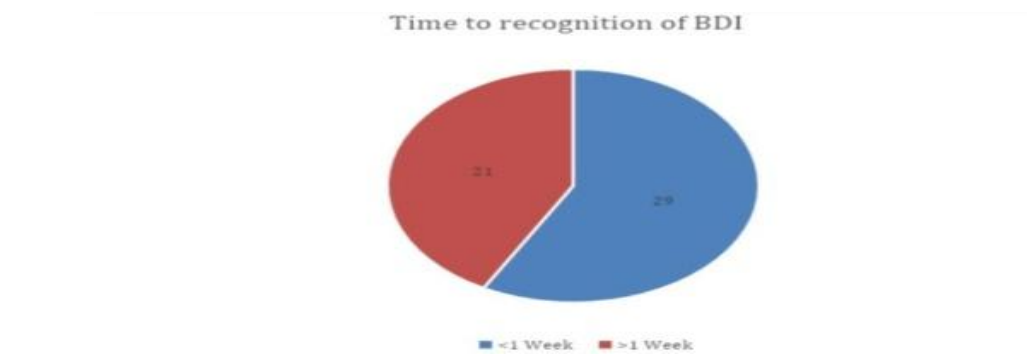


Among the 50 cases of BDI, In the early postoperative period (<1wk) in 58% and 42% cases were identified in the late postoperative period (>1wk).

Table 5 : Time to recognition of BDI

Time to recognition of BDI	No of cases
<1 Week	29
>1 Week	21
Total	50

Graph 5 : Time to recognition of BDI

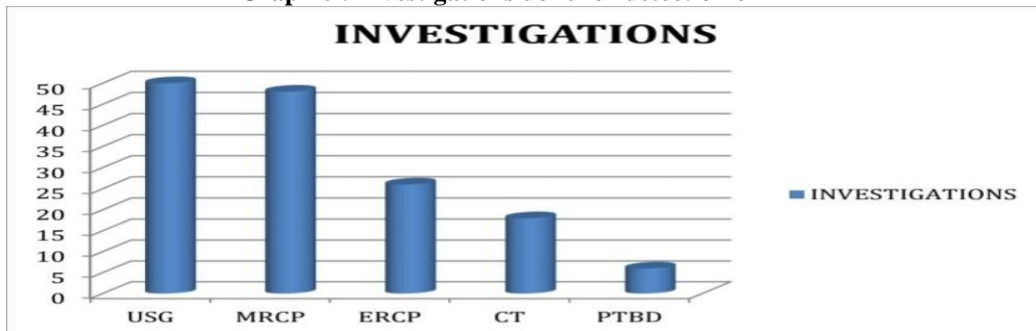


In the patients with BDI, 3 (6%) had cholangitis, 11 (22%) had pancreatitis and 10 (20%) had choledocholithiasis. 6 patients (12%) with BDI had cholecystitis of <72hrs duration.

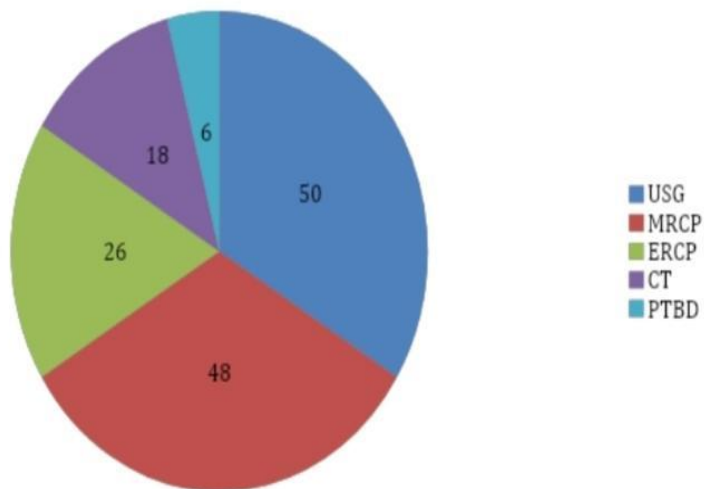
Majority of the patients who did not undergo any definitive surgery for the bile duct injury immediately in the same setting were evaluated postoperatively by :

- ultrasound abdomen and pelvis(100%)
- CT abdomen(36%)
- ERCP(52%)
- PTBD(12%)
- MRCP (96%).

Graph 6 : Investigations done for detection of BDI

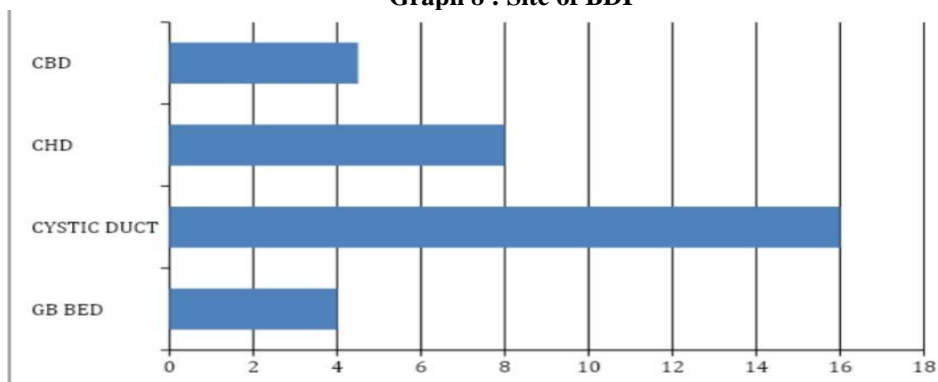


Graph 7 : Pie chart suggesting investigations done for detection of BDI

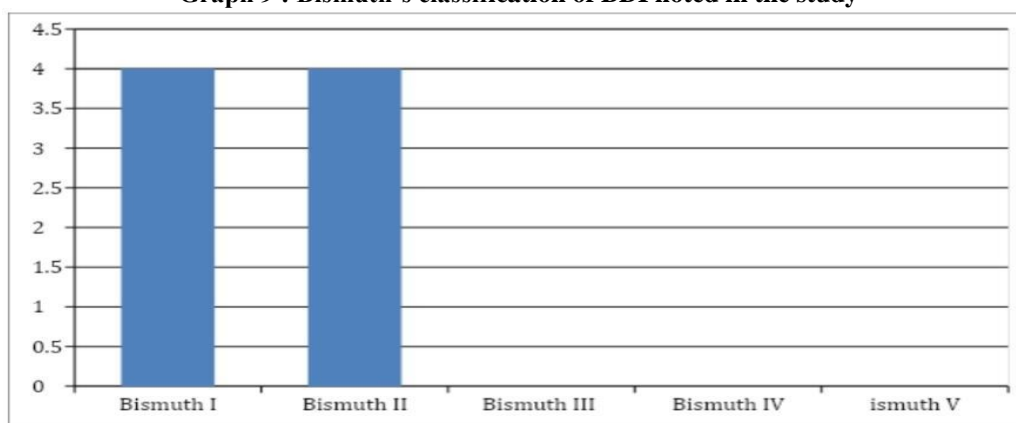


The site of BDI was determined to be CHD in 16%, CBD in 44%, cystic duct in 32% and from the gall bladder bed in 8% of the cases.

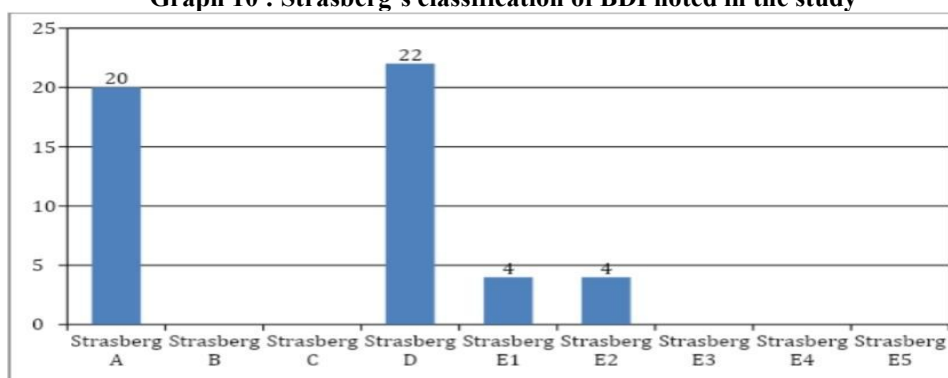
Graph 8 : Site of BDI



Graph 9 : Bismuth’s classification of BDI noted in the study



Graph 10 : Strasberg’s classification of BDI noted in the study



40% of the BDI were of Strasberg type A. 8% were Strasberg E1 and E2, nil patients had Strasberg B, C, E3, E4 and E5 type of injury.44% had Strasberg D type, the most common type of injury in our study.

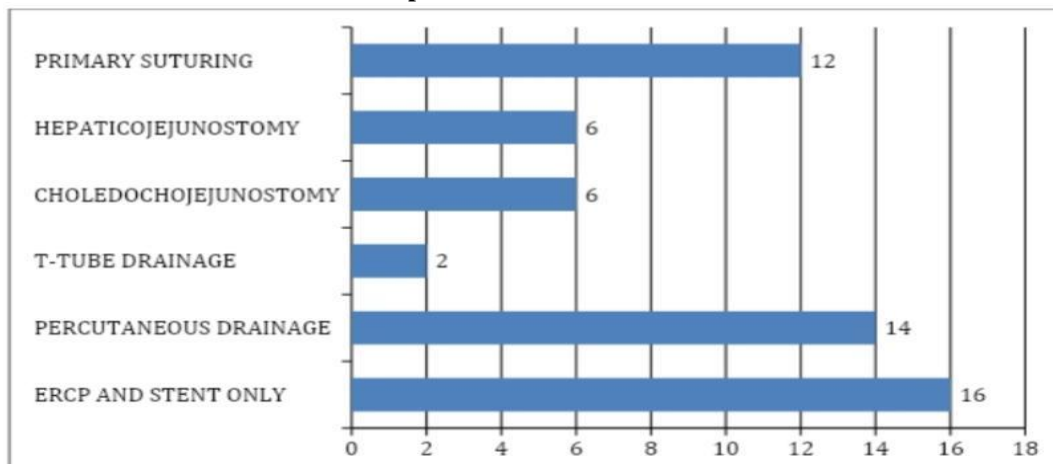
29 cases of BDI were identified within a week of undergoing cholecystectomy , out of which :

- 4 cases underwent hepaticojejunostomy
- 1 case required choledochoduodenostomy
- 15 cases required percutaneous drainage postoperatively
- 7 cases underwent ERCP and stenting
- 10 cases required primary suturing

21 cases of BDI was recognized in the late postoperative period (>1wk), out of which :

- 2 cases underwent hepaticojejunostomy
- 5 cases required choledochoduodenostomy
- 3 cases were required percutaneous drainage postoperatively
- 11 cases underwent ERCP and stenting
- 2 cases required primary suturing.

Graph 11 : Treatment of BDI



Out of 1462 cholecystectomies carried out in the study period, 551 were LC and 911 were OC. 50 cases were identified as BDI. 26 of them had LC while 24 had OC. Chi-square statistics was calculated to be 4.5155. p-value was found to be 0.03359.

Table 5 : 2*2 table for calculating chi square test and p-value.

	LC	OC	
BDI	26	24	
NO BDI	525	887	
TOTAL	551	911	=1462

IV. DISCUSSION

BDI following LC has become recognized as a major health problem, as evidenced by studies evaluating the postoperative management and outcomes of patients.

Proper diagnosis and appropriate treatment of BDI are paramount in preventing life-threatening complications such as :

- cholangitis
- biliary cirrhosis
- portal hypertension
- end-stage liver disease
- death.

Although the mechanisms of bile duct injury during laparoscopic cholecystectomy are varied, the common denominator is failure to recognize the anatomy of the triangle of Calot.

This failure can be attributed to:

- anatomic risk factors
- factors inherent in the laparoscopic technique
- inadequate training.

Anatomic risk factors may include :

- acute or severe chronic inflammation
- morbid obesity
- bleeding
- the presence of anatomic anomalies.

Factors inherent in the laparoscopic technique include :

- the lack of depth perception
- differences in the lines of traction of the gallbladder
- difficulty of performing antegrade cholecystectomy
- use of the electrocautery or laser in a limited field that can be easily obscured by blood or bile.

The current study illustrates the magnitude of the problem resulting from BDI.

The study was performed on all patients who underwent cholecystectomy from June 2021 to May 2022 in General Surgery, GMCH and all patients referred with bile duct injuries occurring as a complication of cholecystectomy (done elsewhere).

The present study comprises of 1462 patients undergoing cholecystectomy as described above. 50 Patients with iatrogenic BDI were identified (taking into account the inclusion and exclusion criteria).

INCIDENCE CBD INJURY:

Out of 1462 patients, 50 were identified to have BDI (taking into account the inclusion and exclusion criteria).

The incidence of Bile duct injury was 3.41% .

However, compared to our study incidence is lower in studies like David R Flum et al¹, L L Ooi et al², Nicola de' Angelis et al³, Philip H Pucher et al⁴, Christopher W Mangieri et al⁵, Meredith Barrett et al⁶, Shaohua Yang et al⁷, Fazaldin Moghu et al⁸, Antonio Pesce et al⁹. The study by Harry C Alexander et al¹⁰ showed higher incidence than present study.

AGE INCIDENCE:

The study showed, the maximum number of patients were in 5th decade with highest number in 51-59 age group with 0.88% incidence. The mean age was 48.36 yrs and a range of 20-78 yrs.

It correlated to the results in study done by Shaohua Yang et al⁷, David R Flum et al¹, G.E.I.Shallaly et al¹¹, Rafał Stankiewicz et al¹², Waage A et al¹³, Juan Pekolj et al¹⁴, Jason K Sicklick et al¹⁵, C K Kum et al¹⁶.

SEX INCIDENCE:

In our study, female predominance was seen than number of male patients which was consistent with various studies like C K Kum et al¹⁶, Jason K Sicklick et al¹⁵, Juan Pekolj et al¹⁴, David R Flum et al¹, Rafał Stankiewicz et al¹². In contrast to present study there are few studies like Anne Waage et al¹³ which shows male predominance.

ACUTE CHOLECYSTITIS

Risk of BDI was higher when associated with Acute Cholecystitis (12%) in our study.

BDI IN PATIENTS WITH RESPECT TO ROUTE OF CHOLECYSTECTOMY AND CONVERSION FROM LC TO OC

There is a 28% conversion rate from laparoscopic to open cholecystectomy which is comparable with some of the studies conducted previously as follows.

However, some studies like Juan Pekolj et al¹⁴, Harry C Alexander et al¹⁰ had very high conversion rate.

Total of 1462 cholecystectomies were carried out in the study period, out of which 551 were LC and 911 were OC. 50 cases were identified as BDI. 26 of them had LC while 24 had OC. Chi-square statistics was calculated to be 4.5155. p-value was found to be 0.03359 indicating BDI is more associated with LC than with OC.

IDENTIFICATION

In the present study, among the 50 cases of BDI 29 (58%) were identified in the early postoperative period (<1wk) and 21 (42%) cases were identified in the late postoperative period (>1wk). Which was comparable with study by Jason K Sicklick et al¹⁵

COMPLICATIONS

In the present study on patients with BDI, complications seen were:

- cholangitis (3 cases -6%)
- pancreatitis (11 cases -22 %)
- choledocholithiasis (10 cases -20%)
- cholecystitis of <72hrs duration (6 cases - 12 %)

Jaundice was the predominant complication seen in study by L L Ooi et al⁵⁵ unlike our study where pancreatitis is the main complication. Wound infection was the predominant complication seen in study by Jason K Sicklick et al¹⁵.

SITE OF BDI

- CHD (16%)
- CBD (44%)
- cystic duct (32%)
- gall bladder (8%)

According to Strasberg classification:

- 40% were Strasberg type A
- 8% were Strasberg E1 and E2
- nil patients had Strasberg B, C, E3, E4 and E5 type of injury
- 44% had Strasberg D type (most common type of injury in our study).

TREATMENT

In our study, 29 cases of BDI were identified within a week of undergoing cholecystectomy, managed by:

- Hepaticojejunostomy (4 cases)
- choledochoduodenostomy (1 case)
- percutaneous drainage postoperatively (15 cases)
- ERCP and stenting (7 cases)
- primary suturing (10 cases)

21 cases of BDI was recognized in the late postoperative period (>1wk), managed by:

- Hepaticojejunostomy (2 cases)
- Choledochoduodenostomy (5 cases)
- Percutaneous drainage postoperatively (3 cases)
- ERCP and stenting (11 cases)
- Primary suturing (2 cases)

SUMMARY

This study was done to determine the problem of bile duct injuries post cholecystectomy in our institution.

Out of 1462 cholecystectomies in the study period, 551 were LC and 911 were OC.

50 cases were identified as BDI. 26 of them had LC while 24 had OC. Bile duct injury rate of 3.41% was noted.

The mean age of patients with BDI in our study was 48.36yrs and a range of 20-78 yrs.

Male : Female ratio was 1:1.27.

12% of the bile duct injuries were noted in patients with Acute cholecystitis.

In our study, in the patients with BDI, the routes of cholecystectomy were LC in 52%, LC to OC in 28% and OC in 20%.

58% and 42% cases were identified in early postoperative period (<1wk) and late postoperative period (>1wk) respectively.

Out of 50 patients in our study, 3 (6%) had cholangitis, 11 (22%) had pancreatitis and 10 (20%) had choledocholithiasis.

Ultrasound abdomen and pelvis was done in 100% of the patients. Further evaluation to detect the site of injury was done with a CT abdomen (in 36% patients), ERCP (in 52% patients), PTBD (in 12% patients) and MRCP (in 96% patients).

The site of BDI was determined to be CHD in 16%, CBD in 44%, cystic duct in 32% and from the gall bladder bed in 8% of the cases.

While doing the classification of BDI, in our study 40% of the BDI were of Strasberg type A. 8% were Strasberg E1 and E2, nil patients had Strasberg B, C, E3, E4 and E5 type of injury. 44% had Strasberg D type, the most common type of injury in our study.

Biliary injuries are complex problems requiring a multidisciplinary approach.

In our study, 29 cases of BDI were identified within a week of undergoing cholecystectomy. 4 of these underwent hepaticojejunostomy, 1 required a choledochoduodenostomy, 15 were managed with percutaneous drainage postoperatively, 7 cases were managed with ERCP and stenting and 10 cases were managed by primary suturing.

21 cases of BDI were recognized in the late postoperative period (>1wk), 2 of these underwent hepaticojejunostomy, 5 required a choledochoduodenostomy, 3 were managed with percutaneous drainage postoperatively, 11 cases were managed with ERCP and stenting and 2 cases were managed by primary suturing.

Out of 1462 cholecystectomies , 551 were LC and 911 were OC.

50 cases were identified as BDI. 26 of them had LC while 24 had OC.

Chi-square statistics was calculated to be 4.5155. p-value was found to be 0.03359 indicating BDI is more associated with LC than with OC.

Given the unforgiving nature of the biliary tract, favourable outcomes requires high index of suspicion for such injuries in difficult cases, proper planning of route of surgery, tackling complications intra operatively, meticulous dissection, appropriate investigations/interventions and help of an experienced surgeon in difficulties.

V. Conclusion:

-Incidence of BDI at our institution is higher in comparison to most of the other similar studies.

- Bile duct injury remains a dreaded complication in all cases of cholecystectomy.

-The incidence would naturally be higher in teaching institutes.

-In our study acute cholecystitis was a contributory factor to the occurrence of BDI and help of senior colleagues should be sought in cases with such comorbidities.

-Favourable outcomes requires high index of suspicion for such injuries in difficult cases, proper planning of route of surgery, tackling complications intra operatively, meticulous dissection, appropriate investigations/interventions and help of an experienced surgeon in difficulties.

-Detailed investigations to determine the site of injury is a must prior to any definitive repair.

-Early recognition of BDI is of paramount importance and limiting the diagnosis delay is crucial for an optimal postoperative outcome.

-The management of iatrogenic bile duct injuries should be carefully planned with a multidisciplinary approach. The therapeutic management depends on the type and gravity of the biliary lesion, and includes endoscopic, radiologic, and surgical approaches.

-The predictive factors affecting morbidity and mortality are important in determining the best modality for managing iatrogenic bile duct injuries. **CONCLUSION** | The long-term impact of BDI is considerable, both in terms of clinical outcomes and QOL. Treatment should be performed in tertiary expert centers to optimize outcomes.

-Patients require a long-term follow-up to detect anastomotic strictures.

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