

Incidence of Bile Duct Injury after Laparoscopic Cholecystectomy at Combined Military Hospital Rawalpindi

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ABSTRACT

Objective: To determine the incidence and risk factors of bile duct injury after laparoscopic cholecystectomy.

Study Design: Prospective cross-sectional study.

Place and Duration of Study: Combined Military hospital, Rawalpindi Pakistan, from Jan to Nov 2022.

Methodology: All patients with age 18 to 70 years of either gender undergoing laparoscopic cholecystectomy were followed for 30 days. Common bile duct injuries were defined based on the Strasberg-Bismuth classification. Injuries following laparoscopic cholecystectomy are categorized using the McMahon categorization system as either major or minor, depending on their severity.

Results: Of 962 patients, the incidence of bile duct injury was observed in 8(0.8%) patients. A statistically significant association of incidence of bile duct injury was observed with cholecystitis (p -value 0.029), renal disease (p -value 0.038), and obesity (p -value 0.026). Of 8 patients with bile duct injury, obesity was found in all, i.e., 8(100%). Most of the bile duct injuries were diagnosed postoperatively, i.e., 6(75.0%) whereas 2(25.0%) were diagnosed intraoperatively. Half of the patients with CBD injury had Type A Strasberg-Bismuth injury, i.e., 4(50.0%), 2(25.0%) had type D, whereas 1(12.5%) had type E1 and type E5 each. While McMahon classification report that 5(62.5%) had a minor depth of injury whereas 3(3.4%) had a major depth of injury.

Conclusion: Incidence of laparoscopic cholecystectomy was observed in less than 1% of the patients. Patients with cholecystitis, renal disease, and obesity are at-risk. Type A Strasberg-Bismuth injury was found in majority of the patients.

Keywords: Bile Duct Injury, Cholelithiasis, Laparoscopic Cholecystectomy.

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INTRODUCTION

One of the most popular surgical techniques, laparoscopic cholecystectomy, was first used to treat symptomatic gall bladder stones and has since become the gold standard for the treatment of this condition.^{1,2} The disadvantage of laparoscopic access is that, in comparison to the period of an open cholecystectomy, it is associated with a greater frequency of bile leakage and damage to the common bile ducts. Even if the treatment has many advantages, such as less discomfort and a shorter hospital stay, this is still the case.^{2,3}

Although there is a very low recorded incidence of problems such as bile duct damage, the effects might be quite serious if it does occur. Along with early surgical problems, there is a chance of long-term consequences such as common bile duct strictures and

recurrent cholangitis attacks.⁴⁻⁶

The rationale of this study is that as gall stone is a major health problem with increasing prevalence, there is a need for continuous monitoring of therapeutic outcomes in patients treated for the disease. Though previously there are studies that have reported complications of laparoscopic cholecystectomy and their causes from Pakistan, for the sake of continuous improvement and strict adherence to evidence-based practices, a recent study is utmost required that evaluated the bile duct injury in patients undergoing laparoscopic cholecystectomy. Combined Military Hospital, Rawalpindi is a large tertiary care hospital that facilitates a number of such cases on daily basis. The findings from this study will greatly help in the evaluation of treatment outcomes which will ultimately help in the better management of patients in the future.

METHODOLOGY

This prospective cross-sectional study was carried out at the Combined Military hospital,

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Rawalpindi Pakistan, from Jan 2022 to Nov 2022. Ethical approval was obtained from the institute before conducting the study (IRB #265). Additionally, after outlining the study's objectives, all qualified study participants signed informed consent forms.

For sample size estimation, an epi info calculator was used. The confidence level was considered 95%, the margin of error 0.6%, and the reported prevalence of common bile duct 0.9%.⁷ The sample size came out to be 951. However, the current study has enrolled 962 patients by using Non probability consecutive sampling technique.

Inclusion Criteria: The were patients aged 18 to 70 years of either gender undergoing laparoscopic cholecystectomy. The incidence of bile duct injury was evaluated both intraoperatively and 30 days postoperatively.

Exclusion Criteria: Those with in-born diseases such as iron deficiency anemia, thalassemia, and other related blood disorders were excluded. Moreover, those who lost follow-up or were unwilling to participate in the study were also excluded.

Common bile duct injuries were defined based on the Strasberg-Bismuth classification. The presence of cystic or aberrant ducts was labelled as type A, aberrant right hepatic duct type B, aberrant duct without continuity with the common bile duct as type C, lateral damage extrahepatic duct as type D, hepatic ducts strictures as type E, common duct stump of greater than 2 cm as type E1, common bile duct as type E2, hepatic confluence as type E3, division of right or left hepatic duct 2 as type E4, and aberrant right hepatic duct with concomitant stricture of the common hepatic duct as type E5.⁸ The incidence was labelled as positive if any of the Strasberg-Bismuth classifications was reported in the patient.

Direct trauma or electrocautery may be to blame for the harm. Based on the degree of the damage, the McMahon categorization system was utilized to categorize the injuries that resulted during laparoscopic cholecystectomy as major or minor. If a laceration was reported to be less than 25% of the circumference of the CBD or cystic-CBD confluence, the injury was classified as mild. When the CBD was completely severed, lacerated by more than 25%, or there was postoperative bile duct stricture, the damage was categorized as serious.⁹

Statistical Package for the social sciences (SPSS) version 24:00 was used for the purpose of statistical

analysis. Mean along with standard deviation was calculated for quantitative variables such as age, weight, height, and BMI. Frequency and percentages were calculated for qualitative variables like gender, diabetes, hypertension, dyslipidemia, renal disease, cholecystitis, previous laparotomy, pancreatitis, and incidence of bile duct injury. Moreover, the Strasberg-Bismuth injury classification and McMahon classification were also reported. Inferential statistics were explored using Chi-square test/Fisher-Exact. The *p*-value of ≤ 0.05 was considered significant.

RESULTS

Of 962 patients, the mean age of the patients was 51.40 ± 11.27 years (min 26 years; max 68 years). There were 570(59.3%) females and 392(40.7%) males. The patients' mean weight, height, and BMI were 1.55 ± 0.05 kg, 65.17 ± 10.82 cm, and 27.01 ± 4.22 kg/m² respectively. Obesity was observed in 588(61.1%) of the patients.

There were 493(51.2%) of the patients with diabetes, 553(57.5%) with hypertension, 195(20.3%) with dyslipidemia, whereas renal disease was observed in 172(17.9%) of the patients.

Cholecystitis was observed in 245(25.5%), previous laparotomy in 269(28.0%), and pancreatitis in 172(17.9%).

In 8(0.8%) of the patients, there was evidence of bile duct injury. The incidence of bile duct injury was highly associated with cholecystitis (*p*-value 0.029), renal disease (*p*-value 0.038), and obesity (*p*-value 0.038). (*p*-value 0.026) (Table-I).

Of 8 patients with bile duct injury, obesity was found in all, i.e., 8(100%) of the patients. Diabetes mellitus and hypertension in 7(87.5%) each, dyslipidemia in 3(37.5%), and renal disease was observed in 4(50%). Most of the bile duct injuries were diagnosed postoperatively, i.e., 6(75.0%) whereas 2(25.0%) were diagnosed intraoperatively (Table-II).

Strasberg-Bismuth injury classification has shown that half of the patients with CBD injury had Type A injury classification, i.e., 4(50.0%), 2(25.0%) had type D, whereas 1(12.5%) had type E1 and type E5 each. While McMahon classification report that 5(62.5%) had a minor depth of injury whereas 3(3.4%) had a major depth of injury (Table-III).

In most cases, common bile duct injuries were treated with main bile duct stenting, i.e., 6(75%) followed by biliary surgery 2(25.0%). The median age from laparoscopic cholecystectomy to definitive

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treatment was 54(37-75) days. None of the patients had liver resection or transplantation due to bile duct injury. Furthermore, mortality was not reported in any patient.

Table-I: Comparison of Incidence of CBD Injury Incidence with Baseline Characteristics (n=962)

	Total	Incidence of CBD Injury		p-value
		Yes (n=8)	No (n=954)	
Age, years				
≤50	444	6(1.4)	438(98.6)	0.101
>50	518	2(0.4)	516(99.6)	
Gender				
Female	570	3(0.5)	567(99.5)	0.282
Male	392	5(1.3)	387(98.7)	
Risk Factors				
Cholecystitis				
Yes	245	5(2.0)	240(98.0)	0.029
No	717	3(0.4)	714(99.6)	
Previous Laparoscopy				
Yes	269	4(1.5)	265(98.5)	0.230
No	693	4(0.6)	689(99.4)	
Pancreatitis				
Yes	172	3(1.7)	169(98.3)	0.158
No	790	5(0.6)	785(99.4)	
Bleeding				
Yes	413	4(1.0)	409(99.0)	0.731
No	549	4(0.7)	545(99.3)	
HTN				
Yes	553	7(1.3)	546(98.7)	0.148
No	409	1(0.2)	408(99.8)	
Dyslipidemia				
Yes	195	3(1.5)	192(98.5)	0.208
No	767	5(0.7)	762(99.3)	
Renal Disease				
Yes	172	4(2.3)	168(97.7)	0.038
No	790	4(0.5)	786(99.5)	
Obesity				
Yes	588	8(1.4)	580(98.6)	0.026
No	374	0(0)	374(100)	

n: number, HTN: Hypertension

Chi-square/Fisher-Exact Test applied, p-value ≤0.05 considered as significant

Table-II: Characteristics of the Patients with Bile Duct Injury (n=8)

Age, years	Gender	BMI, kg/m ²	Diagnosis to definitive treatment, days	Strasberg-Bismuth	McMahon Classification	Diagnosis	Treatment
47	Female	25.39	2	Type A	Minor	Postoperative	ERCP and Stents
45	Male	26.49	28	Type A	Minor	Postoperative	ERCP and Stents
48	Male	27.83	24	Type A	Minor	Postoperative	ERCP and Stents
41	Male	27.47	22	Type D	Major	Intraoperative	ERCP and Stents
40	Female	27.22	24	Type D	Major	Intraoperative	ERCP and Stents
45	Female	25.10	19	Type A	Major	Postoperative	ERCP and Stents
60	Male	27.89	14	Type E1	Minor	Postoperative	Biliary surgery
62	Male	27.12	12	Type E5	Minor	Postoperative	Biliary surgery
47	Female	25.39	2	Type A	Minor	Postoperative	ERCP and Stents

DISCUSSION

Bile duct injury was found to occur in 0.8% of the participants in the current research. Similar findings were observed in previous studies conducted by Viste *et al.*, Martin *et al.*, and El-Dhuwaib *et al.*¹⁰⁻¹² According to Mangieri *et al.*, study, doing laparoscopic cholecystectomies in North America is no longer linked to higher bile duct injury. In addition, the author further stated that the risk of bile duct injury increases a hundredfold when a cholecystectomy requires conversion from a laparoscopic to an open approach.⁶ In a study by Reinsoo *et al.*, no significant difference in the incidence of bile duct injuries was observed in eleven years. The author reported an overall incidence similar to the current study with the preponderance of minor bile duct injury cases.¹³ The majority of the patients in the current study had a minor depth of injury whereas three had a major depth of injury.

According to the current study findings, a significant association of incidence of bile duct injury was observed with cholecystitis, diabetes mellitus, renal disease, and obesity. In a systematic review by Yang *et al.*, the most common factors associated with bile duct injury in laparoscopic cholecystectomy were older age, having an abnormal preoperative liver function, and cholelithiasis complicated with effusion. In addition to this, thickness, inflammation, and anatomic variations of the gallbladder were also considerable risk factors for bile duct injury in patients who underwent laparoscopic cholecystectomy.¹⁴ Handaya *et al.*, in their study reported no significant difference in the degree of gall bladder adhesion and common bile duct injury.¹⁵ A recent study found that decreased rate of bile duct damage and postoperative problems in laparoscopic cholecystectomy was associated with intraoperative picture capture of the crucial perspective of safety.¹⁶ Another recent study

reported that residents had higher rates of satisfactory critical view of safety in elective laparoscopic cholecystectomy compared with consultants.¹⁷ According to reports, when compared to emergency situations, elective laparoscopic cholecystectomy procedures adopt a critical perspective of safety more frequently.^{17,18} The author of one of the study reported that residents and surgeons still failed to complete a critical view of safety during laparoscopic cholecystectomy. The importance of ongoing education and effort for the effective use of a critical viewpoint on safety in laparoscopic cholecystectomy has been highlighted by the author.¹⁸

Table-III: Frequency of Strasberg-Bismuth and McMahon Classification of Common Bile Duct Injury (n=8)

	n(%)
Strasberg-Bismuth Injury Classification	
Type A	4(50.0)
Type D	2(25.0)
Type E1	1(12.5)
Type E5	1(12.5)
McMahon Classification	
Major	3(37.5)
Minor	5(62.5)

n: number

Strasberg-Bismuth injury classification has shown that half of the patients with CBD injury had Type A injury classification followed by type D, type E1, and type E5. In a previously published study by Díaz-Martínez *et al.*, Bismuth type III was observed in most patients. In addition, cholangitis and bile leak were reported as short-term complications whereas stricture was reported as a long-term complication.¹⁹

Despite the limitation of a single centre and the limited number of samples in the current study, this study is of significance as the study has reported prospective findings of laparoscopic cholecystectomy from Pakistan. Most of the previously conducted studies on the topic particularly in Pakistan were from retrospective in nature. These studies with retrospective study design had a higher chance of selection bias. Additionally, the results of the current study have been compared to those from industrialized nations. Thus, patients were treated in the most advanced healthcare setup and with higher resources. It is reported in the literature that the incidence of bile duct injury in patients who underwent laparoscopic cholecystectomy is also depended upon the available resources and experience of the surgeons.

CONCLUSION

After laparoscopic cholecystectomy, bile duct injury is still a problem. Comorbidities were found to be a substantial risk factor. It is advised that further extensive prospective studies be conducted in order to rule out the conclusions of this study.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

SAA & ASM: Data acquisition, data analysis, critical review, approval of the final version to be published.

IA & JIN: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

JAS & HM: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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