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Pattern of Common Bile Duct Injuries in Laparoscopic versus Open Cholecystectomy

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ABSTRACT

Objective: To determine the frequency of various patterns of injury to the common bile duct during laparoscopic versus open cholecystectomy.

Study Design: Prospective longitudinal study.

Place and Duration of Study: Pak Emirates Military Hospital, Rawalpindi Pakistan, from Sep 2023 to Mar 2024.

Methodology: A total of 98 patients fulfilling the inclusion criteria were included in the study. All the patients underwent cholecystectomy either by laparoscopic or open procedure, and the procedure performed was also documented. Any case of injury to the CBD was documented, and its pattern, based on the Strasberg Classification, was assessed and documented.

Results: Mean age was 45.23±6.85 years. 35(35.70%) were male, while 63(64.30%) were female. The mean body mass index was 32.50±2.85 kg/m^2. The mean duration since diagnosis of gallstones was 7.45±1.18 months. 69(70.40%) had laparoscopic cholecystectomy, while 29(29.60%) had open cholecystectomy. The composite frequency of iatrogenic injury to the common bile duct (CBDI) was 7(7.10%). CBD injury occurred in 4(5.79%) in laparoscopic cholecystectomy, while in open cholecystectomy, it occurred in 3(10.34%), (p=0.425). In the laparoscopy Group, 2(2.89%) had Strasberg Class A injuries, and 2(2.89%) had Strasberg Class D injuries. In contrast, in the open procedure Group, 2(6.89%) had Strasberg Class D injuries, and 1(3.44%) had a Strasberg Class E injury.

Conclusion: The CBD injury rate is lower with the laparoscopic approach of gallbladder removal and is associated with lesser severity of injury.

Keywords: CBD Injury, Laparoscopic cholecystectomy, Open cholecystectomy.

How to Cite This Article: *Raza M, Butt MQ, Ashraf S, Zain MA, Haider F, Bhatti MWA. Pattern of Common Bile Duct Injuries in Laparoscopic versus Open Cholecystectomy. Pak Armed Forces Med J 2025; 75(3): 482-486. DOI: https://doi.org/10.51253/pafmj.v75i3.10608*

INTRODUCTION

Injury to the biliary duct during cholecystectomy is a challenging hazard for both the patient and the surgeon to deal with because it can have serious consequences for the condition of the patient after surgery and negatively impact their lives significantly.[1,2] Leakage from a cyst duct, damage to an accessory duct, or damage to the common bile duct are all examples of biliary duct injuries; the portal vein and/or right hepatic artery may also be damaged. These injuries can lead to other problems, such as chronic cholangitis and secondary biliary cirrhosis, leading possibly to the demand for transplantation of the liver.[3]

The danger of bile duct trauma may be raised by anomalous morphology or misinterpreted architecture, complex disease, bleeding, heat trauma, lack of experience or competence of the operating doctors, and the operative technique.[4] On the other hand, procedures such as subtotal cholecystectomy in complicated cases such as cholecystitis with hepatic pedicle inflammation, or converting laparoscopic procedure to an open one or modifying the surgical technique as deemed appropriate with the situation, may decrease the likelihood of injury to the bile duct.[5] Another such method mentioned in the guidelines is the use of cholangiography preoperatively. However, its safety has yet to be established.[6]

In the current era of surgical advancement, cholecystectomy procedures have almost completely shifted to a laparoscopic approach. It is now considered the gold standard for managing patients with symptomatic gallstones.[7] At the same time, in developing countries like Pakistan, a large number of healthcare establishments still lack the facility for laparoscopic procedures, either due to the unavailability of equipment or a lack of qualified surgeons to handle complex surgical situations. To address this complication, surgeons must first assess the degree of injury, for which several Classifications have been suggested in the literature to help categorize iatrogenic bile duct injuries.[8,9] Some of these Classifications mentioned in the literature include the Bismuth Classification, the Strasberg Classification, the McMahon Classification, the Stewart-Way

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Received: 10 Jul 2023; revision received: 04 Mar 2024; accepted: 05 Mar 2024

Classification, the Hannover Classification, and the Mattox Classification. It has been found that laparoscopic cholecystectomy is associated with a significantly higher risk of perioperative injury to the bile duct.[9] While other studies report a much higher incidence of this complication in the case of open procedure.[10]

Based on this, the present study was conducted with the aim of not only determining the frequency of bile duct injury during cholecystectomy (either open or laparoscopic) but also identifying differences in the patterns of iatrogenic bile duct injury between these two operative techniques.

METHODOLOGY

The prospective longitudinal study was conducted at the Surgery unit of PEMH Rawalpindi, Pakistan from September 2023 to March 2024, following approval from the Ethical Review Board of PEMH Rawalpindi (ERB No. 377, dated September 1, 2022). A sample size of 98 was calculated using the WHO sample size calculator by assuming anticipated frequency of injury to common bile duct during cholecystectomy as 12.18%.[11]

Inclusion Criteria: Patients aged between 25 to 75 years, who were either male or female, had symptomatic gallstones, and were admitted to the indoor department to have scheduled elective cholecystectomy, were included.

Exclusion Criteria: Patients who had preexisting obstructive jaundice, who were known to have carcinoma of the gallbladder, those who had choledocolithiasis, were unfit for surgery or had a previous history of hepato-biliary surgery/procedure were excluded.

The study population was selected using a non-probability consecutive sampling method. A consent letter obtained from the study participants was considered an obligatory prerequisite. Baseline characteristics of all included study participants, including age, gender, body mass index (BMI), and duration since diagnosis of gallstones (in months), were documented. After that, based on the surgical team's decision, patients chose to undergo either laparoscopic or open procedures, and this decision was also documented.[12] All patients underwent surgery performed by the same team of skilled surgeons, headed by two consultant surgeons with over two years of experience. During the procedure, if there was the occurrence of conversion of laparoscopic procedure to open cholecystectomy, the surgery was considered as an open one in terms of outcome. In case of any iatrogenic injury to the common bile duct, the event was documented. The pattern of injury was assessed based on the Strasberg Classification, as shown in Table-I.[13,14]

Table-I: Strasberg Classification

Strasberg Class	Description
A	Bile leak from the small duct located in the liver bed or from the cystic duct without injury
B	Partial occlusion of the biliary tree from aberrant right hepatic duct
C	Bile leak from aberrant right hepatic duct not communicating with the Common Bile Duct
D	Lateral injury to CBD without loss of continuity
E	Circumferential injury with loss of continuity

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) 22.00. The normality of data was checked by the Shapiro-Wilk test. Quantitative data (age, BMI, and duration since diagnosis of gallstones) were represented using the mean with standard deviation and the median (interquartile range, IQR). Qualitative data (gender, type of cholecystectomy, presence, and pattern of CBD injury) were represented using percentages and frequencies. Chi-square test (for qualitative variables) and unpaired t-test (for quantitative variables) were applied, and the *p*-value of ≤0.05 was taken as significant.

RESULTS

A total of 98 patients were included in this study. The mean age was 45.23±6.85 years. There were 35(35.70%) male participants, while the remaining 63(64.30%) participants were female. The mean body mass index was 32.50±2.85 kg/m^2. The mean duration since diagnosis of gallstones was 7.45±1.18 months. 69(70.40%) had laparoscopic cholecystectomy, while only 29(29.60%) had open cholecystectomy. These are summarized in Table-II.

Upon comparison of age, gender distribution, BMI, and duration since diagnosis of gallstones between patients who had their gallbladder removed by laparoscopic versus those who had this by an open technique, it was found that the mean age of patients who were in Group A was 44.88±6.52 years while in Group B it was 46.07±7.62 years, (p=0.437). The mean BMI in the laparoscopic Group was 32.68±2.86 kg/m^2, while in the open technique Group, it was 32.07±2.84 kg/m^2 (p=0.335). The mean duration since diagnosis of

gallstones in Group A was 7.45±1.22 months, while in Group B, it was 7.45±1.09 months (p=0.997) Table-III.

Table-II: Baseline Characteristics of Study Participants (n=98)

Parameters	n (%)
Mean age	45.23±6.85 years
Gender	
Male	35(35.70%)
Female	63(64.30%)
Mean Body Mass Index (BMI)	32.50±2.85 kg/m²
Mean duration since diagnosis of gallstones	7.45±1.18 months
Type of surgery	
Laparoscopic (Group A)	69(70.40%)
Open (Group B)	29(29.60%)

Table-III: Comparison of Baseline Characteristics Between Groups (n=98)

Parameters	Laparoscopic Group (n=69)	Open Group (n=29)	*p*-value
Age (years)	44.88±6.52	46.07±7.62	0.437
Body Mass Index (kg/m²)	32.68±2.86	32.07±2.84	0.335
Duration since Diagnosis of Gallstones (months)	7.45±1.22	7.45±1.09	0.997

In this study, it was found that the composite frequency of iatrogenic injury to the common bile duct (CBDI) was 7(7.10%). Upon comparison between Groups, it was observed that the frequency of CBD injury in patients who underwent laparoscopic cholecystectomy was 4(5.79%), while in the open cholecystectomy Group, it was 3(10.34%) (p=0.425). In the laparoscopy Group, it was found that 2(2.89%) had a Strasberg Class A injury, 2(2.89%) had a Strasberg Class D injury, and none had a type B, C, or E Class injury in this Group. On the other hand, in patients who underwent an open procedure, 2(6.89%) had a Strasberg Class D injury, 1(3.44%) had a Strasberg Class E injury, and none had Class A, B, or C injuries Table-IV.

Table-IV: Comparison of Common Bile Duct Injuries and its Pattern between Groups (n = 98)

Parameters	Laparoscopic Group (n=69)		Open Group (n=29)		*p*-value
Common Bile Duct Injuries	4 (5.79%)		3 (10.34%)		0.425
Pattern of Common Bile Duct Injuries	A	2(2.89%)	A	0(0.00%)	0.255
	B	0(0.00%)	B	0(0.00%)	
	C	0(0.00%)	C	0(0.00%)	
	D	2(2.89%)	D	2(6.89%)	
	E	0(0.00%)	E	1(3.44%)	

DISCUSSION

Cholecystectomy is one of the most commonly performed procedures all across the globe. In this modern era of surgical advancement, the laparoscopic approach to the removal of the inflamed gallbladder has replaced the traditional open procedure. However, in resource-rich regions of the world, a large number of procedures are still carried out through the open technique, and in some cases, this approach becomes necessary.[15] During the laparoscopic or open procedure, complications can occur either due to surgical negligence, incompetence, or even when the natural anatomy of the operative field is distorted. One such complication is injury to the common bile duct. This study was thus conducted, focusing on this complication of the cholecystectomy procedure.[16]

In the present study, it was found that the patients were predominantly in the middle age Group, i.e., in their forties, and concomitantly, more patients were female. This finding was consistent with the observation made by a demographic study conducted by Patel *et al.*[17] in which they found that female gender and age over forty years are strongly linked to the presence of gallstones. In the current study, it was also found that most patients had a body mass index (BMI) in the overweight or obese category. This may be because a raised BMI is one of the strongest factors that pose the risk of developing gallbladder stones.[18] When it comes to the frequency of injury of CBD during surgery, the frequency observed in the present study was much lower as compared to what was observed by Tagar *et al.*[11] On the other hand, when it was compared with the reported frequency in a study conducted by Pesce *et al.*[19] the frequency of injury to CBD in the current study was much higher.

In this study, it was observed that the frequency of injury to CBD was higher in the open cholecystectomy Group as compared to the laparoscopic cholecystectomy Group, which was congruent with the findings of research conducted by Tagar *et al.*[11] and Faridoon *et al.*[20] However, opposite to this finding, Mostafa *et al.*[21] in their study stated that frequency of this particular complication has seen a rise since the introduction of laparoscopy. Lastly, in terms of pattern, the Strasberg Classification was employed, which is one of the most widely used and accepted methods for determining the pattern of iatrogenic injury to the biliary system. It was found that the pattern of more severe injury was observed in

cases of open cholecystectomy as compared to laparoscopic cholecystectomy.

Injury to the common bile duct (CBD) is a serious complication that can occur in both laparoscopic as well as open cholecystectomy. However, as per the findings of our study, not only is its frequency lower with the laparoscopic approach, but the severity of injury is also less severe in these cases. Therefore, it is suggested that surgeons should acquire the necessary surgical skills and competence to have laparoscopic expertise for reducing iatrogenic CBD injury.

CONCLUSION

Common bile duct (CBD) injury rate is lower with the laparoscopic approach of gallbladder removal and is associated with lesser severity of injury.

Conflict of Interest: None.

Funding Source: None.

Authors Contribution

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

MR & MQB: Data acquisition, data analysis, drafting the manuscript, critical review, approval of the final version to be published.

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

FH & MWAB: 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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