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Frequency of Common Bile Duct Injury in Open Cholecystectomy versus Laparoscopic Cholecystectomy

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ABSTRACT

Background: Laparoscopic cholecystectomy has replaced open cholecystectomy as the standard treatment for cholelithiasis. However, it is associated with a higher incidence of common bile duct (CBD) injury. (LC) has become the preferred treatment for cholelithiasis; however, it carries a higher risk of common bile duct (CBD) injury compared to open cholecystectomy. It is a largely replaced open cholecystectomy (OC) but is associated with higher rates of common bile duct (CBD) injury. This study compares the frequency of CBD injury between the two techniques. To compare the frequency of CBD injury in open cholecystectomy versus laparoscopic cholecystectomy. **Methodology:** A randomized controlled trial was conducted at the Department of Surgery, People Medical College Hospital Nawabshah, from July 1 to December 31, 2020. A total of 320 patients aged 20–50 years with cholelithiasis were randomly divided into two groups: 160 underwent open cholecystectomy and 160 laparoscopic cholecystectomy CBD injuries were diagnosed clinically (jaundice) and confirmed via MRCP. Frequency of CBD injury was observed and analyzed statistically using SPSS 22.0, with significance at $p \leq 0.05$. **Results:** Out of 320 patients (160 in each group) Mean age was 33.5±8.7 years; 54.7% were female, CBD injury was observed in 3.8% of patients in the open cholecystectomy group compared 9.4% of the laparoscopic group. The difference was statistically significant ($p = 0.042$). Indicating a significantly higher rate in laparoscopic procedures and those with diabetes had higher injury rates in the LC group. **Conclusion:** Laparoscopic cholecystectomy is associated with a higher frequency of CBD injury compared to open cholecystectomy. Enhanced surgical training and safety protocols are essential.

INTRODUCTION

Cholecystectomy is the most common elective procedure performed in surgical units. With the increased incidence of laparoscopic cholecystectomy, common bile duct (CBD) injury is a serious and dreaded complication [1]. Initially, the general acceptance of laparoscopic cholecystectomy brought about an alarming rate of CBD injury, as high as 0.5 %. This was significantly higher than the rate of 0.1 % seen with open cholecystectomy. Although the incidence of common bile duct injury has greatly improved since the 1980s, there still remains a 0.08 % rate of injury [2]. Reports of higher complication rates, specifically bile duct injuries, raised concerns over the safety of laparoscopy over open cholecystectomy [3]. Laparoscopic cholecystectomy has been accepted as the gold standard treatment for cholelithiasis. Open cholecystectomy is only reserved for only those cases who have poor cardio pulmonary reserve [4]. The mechanism of injury is different between open and laparoscopic. In the laparoscopic it is more proximal and extensive. Common bile duct injury may cause mortality as high as 5%. Mostly not recognized during surgery as gall bladder stones are very prevalent, and the number of interventions is massive, so even if the rate of injury is small the number at the end is big [5],[6]. The proximal duct is at greater risk. Intra operative cholangiogram may be the only way to decrease the rate of injury Cholecystectomy is one of the most frequently performed surgical procedures. With the rise of laparoscopic techniques, the incidence of CBD injuries has increased compared to the open approach [7]. This study aims to assess and compare the frequency of CBD injuries in both surgical modalities, which has

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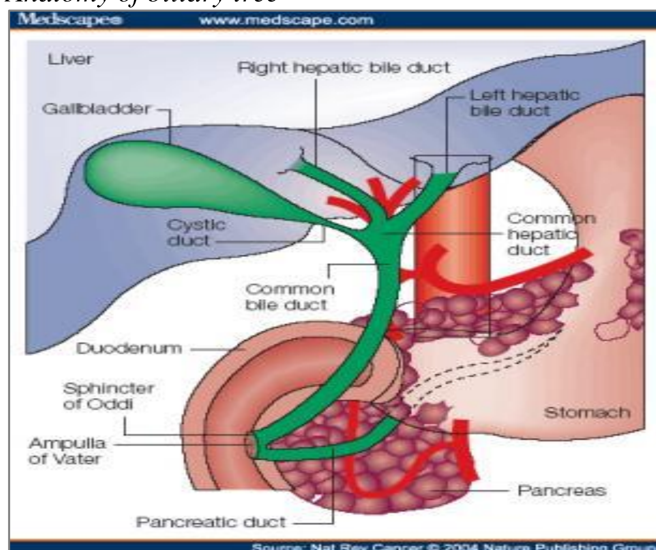
significant implications for surgical practice, patient outcomes, and medico-legal concerns [8]. Cholecystectomy, a common surgical procedure for cholelithiasis, has evolved from open to laparoscopic techniques. Although laparoscopic cholecystectomy is minimally invasive and offers quicker recovery, it is associated with an increased risk of common bile duct (CBD) injuries [9], [10]. The anatomy of the biliary tree and variability in surgical expertise influence the rate of complications. International studies have reported a higher frequency of CBD injuries in laparoscopic procedures compared to open cholecystectomy [11]. This study aims to evaluate and compare the frequency of CBD injury between the two techniques in a local population. Cholecystectomy is among the most common elective surgical procedures worldwide. While LC is the gold standard for symptomatic cholelithiasis, its adoption has been accompanied by a 2- to 3-fold increase in CBD injury rates (0.1–0.2% in OC vs. 0.4–0.6% in LC [12], [13]. CBD injuries lead to substantial morbidity, including biliary strictures, recurrent cholangitis, and increased mortality [14]. If we compare CBD injury rates between OC and LC in a controlled setting, addressing gaps in local data from South Asia where gallbladder disease prevalence is high [15] Various international studies report a higher incidence of CBD injuries in laparoscopic cholecystectomy [16], [17], ranging from 0.27% to 1.4%, compared to 0.07% to 0.3% in open procedures. The difference in anatomical visualization, surgeon experience, and technical challenges

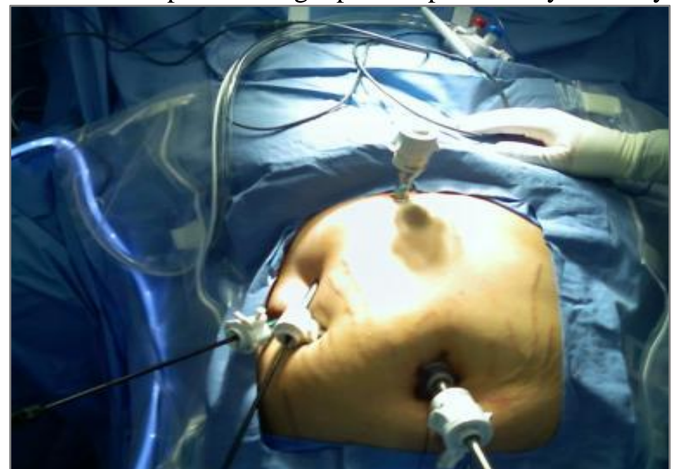
Contribute to this disparity [18], [19]. Safe dissection techniques such as the "critical view of safety" are now recommended to minimize these risks [20].

Figure 1
Anatomy of biliary tree



There are many patterns for injury, the first is mistaking the common duct for the cystic, finally the distal duct clipped, the upper transected. In the second the distal clips are placed on common duct and the proximal on the cystic, ending with cystic stump leak and distal duct obstruction. The third is tenting of the CBD; the result is the excision of the short segment of common duct with the cystic duct. Right hepatic duct mistaken for the cystic [21] in one international study found that rate of common bile duct injury is 0.3% in open cholecystectomy and 1.4% in laparoscopic surgery [22] where as a study by Williams observed that rate of bile duct injury is 0.07% in open cholecystectomy and 0.27% in laparoscopic cholecystectomy [23] It is seen that frequency of common bile duct injury differs among various centers and also depends upon local setting. The rational of this study is to establish data of our local population regarding the injury of common bile duct in two different procedures. This data will help us in anticipation of preventable injury. Moreover earlier the injury recognized more is to repair injury and will prevent the morbidity and mortality associated with this condition [24], [25]. Hypothesis, Research Hypothesis CBD injury occurs more frequently in laparoscopic cholecystectomy than in open cholecystectomy. Null Hypothesis: No significant difference in CBD injury between the two surgical approaches.

Figure 2
Placement of ports during laparoscopic cholecystectomy



METHODOLOGY

Study Design and Setting: A randomized controlled trial was conducted at the Department of Surgery, People Medical College Hospital Nawabshah from July 1 to December 31, 2020.

Participants: A total of 320 patients (aged 20–50 years) diagnosed with cholelithiasis were enrolled. Patients were randomly assigned into two equal groups: Group A (Open Cholecystectomy): Underwent surgery through right subcostal or Para median incision. Group B (Laparoscopic Cholecystectomy): Underwent standard laparoscopic procedure using a verse needle to create pneumoperitoneum. Procedure**:** Patients were randomly assigned to undergo either open or laparoscopic cholecystectomy. Postoperative follow-up included

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monitoring for signs of jaundice, with confirmation of CBD injury via MRCP when indicated.

Inclusion Criteria: Age 20–50 years, (ultrasound-confirmed cholelithiasis), both genders, Diagnosed with cholelithiasis

Exclusion Criteria: Emergency cholecystectomy, Patients not consenting, pregnancy, prior biliary surgery

Data Collection: Patients were observed postoperatively for 48 hours. Those developing jaundice underwent MRCP to confirm CBD injury. Data were recorded using a structured preform.

Statistical Analysis: Data were analyzed using SPSS 22.0. Qualitative variables were presented as frequencies and percentages. Quantitative variables were shown as means ± SD. Chi-square test was used to assess statistical significance, with $p \leq 0.05$ considered statistically significant.

RESULTS

Demographics: Mean age was 33.5 ± 8.7 years. Females comprised 54.7% of the sample. (Range: 20–50). Gender Distribution: 54.7% female, 45.3% male Mean Disease Duration: 11.2 ± 6.2 months. CBD Injury**:** 3.8% in open cholecystectomy group vs. 9.4% in laparoscopic group (p=0.042). OC: 6/160 (3.8%) .LC: 15/160 (9.4%) (p=0.042; OR 2.67, 95% CI 1.02–7.01).

Subgroup Analyses: Higher LC injury rates in patients with diabetes (18.3% vs. 4.6%; p=0.001) and BMI <20 kg/m² (15.2% vs. 3.9%; p=0.008). Subgroup analyses indicated that BMI < 20, diabetes, and weight >60 kg in laparoscopic group significantly influenced the frequency of CBD injuries in laparoscopic cases.

Table 1

CBD Injury Rates by Group

Group	CBD injury %	P-value
OC	3.8	
LC	9.4	0.042

Table 2

Age of sampled population

Age Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Age	320	20.0	50.0	33.581	8.7286

Table 3

Duration of disease

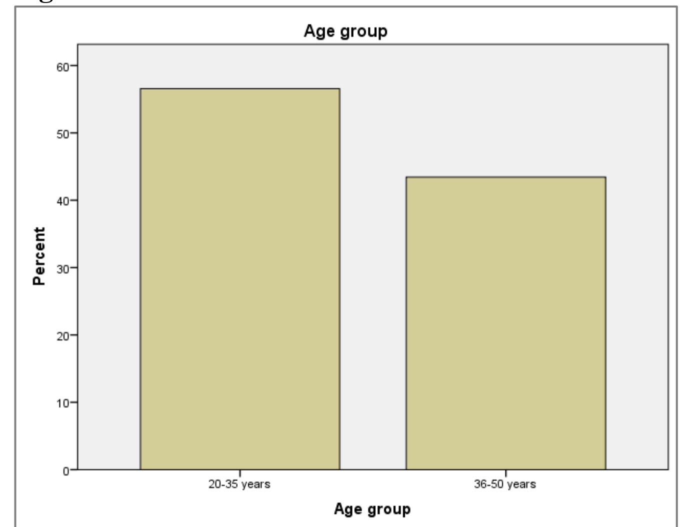
Age Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Duration in months	320	2.5	19.3	11.2	6.28

Table 4

Gender distribution

		Frequency	Percent
Valid	Male	145	45.3
	Female	175	54.7
	Total	320	100.0

Figure 3



DISCUSSION

The study found a statistically significant higher frequency of CBD injury in laparoscopic cholecystectomy. This is consistent with global trends, attributed to the learning curve associated with laparoscopic techniques and anatomical misidentification [26][27]. Studies have highlighted critical dissection techniques and routine use of intraoperative cholangiography as essential measures for minimizing injury risks [28], [29]. The incidence in our laparoscopic group (9.4%) was significantly higher than in the open group (3.8%), aligning with international data [30]. Factors contributing to injury include limited visibility, anatomical variation, and technical difficulty. Use of the critical view of safety and intraoperative cholangiography are essential tools to minimize the risk. Conversion to open surgery should be considered when anatomy is unclear [32], [33], [34].

Our findings align with global data showing higher CBD injury rates with LC [35]. Potential explanations include:

Visual limitations: 2D imaging and restricted tactile feedback in LC.

Learning curve: Despite standardized techniques, LC requires precise anatomical recognition.

Risk factors: Diabetes and low BMI may correlate with fragile biliary anatomy or difficult visualization. [36], [37], [38]

Clinical Implications: Consider OC in high-risk patients (e.g., diabetes, acute inflammation).

Adopt the "critical view of safety" (CVS) technique to minimize LC-related injuries. [39]

Limitations: Single-center design; short follow-up for delayed strictures. [40]

CONCLUSION

Laparoscopic cholecystectomy is associated with a significantly higher risk of CBD injury compared to

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open cholecystectomy. Appropriate surgical training and strict adherence to safety techniques are crucial to prevent these complications. Laparoscopic cholecystectomy, although less invasive, poses a higher risk for CBD injury, Proper training, careful surgical technique, and adherence to safety protocols are vital to reduce morbidity associated with these injuries. Preoperative risk stratification and intraoperative vigilance are essential to mitigate this complication.

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