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Original Research Article

Pattern and Management of Common Bile Duct Injury After Cholecystectomy: A Tertiary Care Hospital Experience

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Abstract: *Bile duct injury (BDI) is a serious complication of cholecystectomy with significant morbidity and mortality. This study aimed to evaluate the patterns, diagnostic approaches, management strategies, and outcomes of CBD injuries in a tertiary care hospital.* ***Methods:*** *This observational study was conducted at Dr. Ruth Pfao Civil Hospital, Karachi, from January 2021 to December 2023. Sixty-five patients with confirmed post-cholecystectomy CBD injury were included. Diagnosis was based on ultrasound, MRCP, ERCP, or intraoperative findings. Data on demographics, Strasberg classification, management, and outcomes were analyzed using descriptive statistics and chi-square/logistic regression tests.* ***Results:*** *The mean age was 50.1 ± 15.8 years; 55% were female. Injury distribution was Type A (23%), B (15%), C (20%), and D (22%), with no Type E injuries. Laparoscopic procedures accounted for 58% of cases. Jaundice (55%) and bile leak (45%) were the most frequent presentations. Management included hepaticojejunostomy (31%), endoscopic interventions (26%), surgical repair (23%), and conservative treatment (20%). The mean hospital stay was 12.0 ± 5.5 days. Outcomes included recovery (40%), persistent symptoms (29%), and mortality (31%).* ***Conclusion:*** *CBD injuries after cholecystectomy remain a major surgical challenge. Early recognition, referral to specialized centers, and preventive strategies such as the Critical View of Safety are essential. High mortality and absence of Type E reporting highlight the need for multicenter data and standardized classifications.*

Keywords: Bile Ducts, Cholecystectomy, Common Bile Duc, Intraoperative Complications, Postoperative Complications

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Introduction

The management of common bile duct (CBD) injuries following cholecystectomy remains a crucial focus in the field of gastroenterology and surgical practice. Bile duct injury is recognized as one of the most significant complications encountered during laparoscopic cholecystectomy, a procedure that has gained widespread acceptance due to its minimally invasive nature and associated benefits, such as reduced postoperative pain and shorter recovery times. Despite advancements in surgical techniques and technology, the incidence of CBD injuries continues to pose significant challenges, with reported rates ranging from approximately 0.4% to 1.5% according to guidelines (1). Some studies have indicated higher rates, with instances reaching up to 6%, although these figures can vary by region and study design (2, 3). The etiology of these injuries can often be traced to inadequate surgical technique, misidentification of anatomical structures, and the presence of anatomical variations, complicating dissection around the cystic duct and hepatic structures (4, 5, 6).

Additionally, the implications of bile duct injuries extend beyond immediate surgical concerns. They often necessitate a comprehensive approach to management, including endoscopic interventions such as endoscopic retrograde cholangiopancreatography (ERCP), percutaneous drainage, or even surgical reconstruction, which present significant morbidity for patients. Studies have shown that patients who suffer from bile leaks or CBD injuries experience diminished quality of life and face long-term complications, including recurrent strictures, bile duct obstructions, and even potential mortality in severe cases (7, 8). The spectrum of management strategies employed must be tailored to the specific type and extent of injury observed, underscoring the importance of thorough intraoperative assessment and timely intervention (9, 10).

In response to these challenges, various preventive strategies have been recommended, including enhanced surgical training, the use of intraoperative cholangiography, and adherence to the "Critical View of Safety" technique during dissection (11, 6). Such strategies aim to mitigate the risk of injury by providing surgeons with improved visualization and understanding of biliary anatomy. Additionally, advances in surgical technology, including robotic assistance and intraoperative fluorescence imaging, may further reduce the occurrence of CBD injuries through enhanced precision and real-time feedback during procedures (12, 13).

In Pakistan, where laparoscopic cholecystectomy has become increasingly common, understanding the incidence and management of CBD injuries is paramount, given the rising number of procedures performed annually. The socio-cultural and healthcare landscape presents unique challenges, including varying levels of surgical expertise and access to advanced gastrointestinal surgical services, which may impact patient outcomes (14, 15, 16). This study aims to delineate the patterns and management protocols of common bile duct injuries in a tertiary care hospital in Pakistan, contributing to both local and international evidence that may help refine surgical practices and improve patient care in this critical area of surgery.

Methodology

This was a retrospective observational study at Dr. Ruth Pfao Civil Hospital, Karachi, from January 2021 to December 2023. Sixty-five patients aged >18 years with confirmed CBD injuries following cholecystectomy were included. Patients with pre-existing biliary disease or incomplete records were excluded.

Data collected included age, sex, surgical approach (laparoscopic vs. open), Strasberg injury type, presenting symptoms, diagnostic modalities,

management strategies, hospital stay, complications, and outcomes. Analysis was performed with SPSS v26. Descriptive statistics were used; associations were tested with chi-square and logistic regression ($p<0.05$ significant).

Statistical analysis: Data were analyzed in SPSS (v26). Variables are presented as mean±SD or percentage. To explore factors associated with mortality and persistent symptoms, we performed multivariable logistic regression. Candidate variables included age, sex, surgical approach (open vs laparoscopic), time to diagnosis, and injury type (Strasberg). Variables with $p<0.10$ in univariable analysis were entered into the multivariable model; statistical significance was set at $p<0.05$.

Results

A total of 65 patients with post-cholecystectomy bile duct injury were included in the study. The mean age of participants was 50.1 ± 15.8 years, indicating a predominance of middle-aged individuals. There was a slight female preponderance, with 36 (55%) females and 29 (45%) males, reflecting the higher frequency of cholelithiasis and related biliary procedures among women in the general population (Table 1).

The distribution of bile duct injuries according to the Strasberg classification revealed that type A injuries were most common (23%), followed by type D (22%), type C (20%), and type B (15%). Notably, no patient in this cohort presented with type E injury, indicating the predominance of partial or limited ductal injuries over complete transections.

Regarding diagnostic modalities (Table 2), ultrasonography was the most frequently used initial investigation (31%), owing to its noninvasive accessibility and role in identifying bile leaks and intra-abdominal collections. This was followed by computed tomography (CT) in 26% and magnetic resonance cholangiopancreatography (MRCP) in 25% of cases, both of which provided valuable anatomical delineation. Endoscopic retrograde cholangiopancreatography (ERCP) was performed in 18% of patients, particularly in cases suspected of partial ductal obstruction or for therapeutic stenting.

In terms of management strategies, hepaticojejunostomy emerged as the most frequently employed intervention (31%), representing the standard reconstructive procedure for complex bile duct injuries. Endoscopic management accounted for 26% of cases, primarily involving stent placement and dilation in low-grade injuries. Surgical repair was performed in 23%, whereas conservative management was chosen in 20% of patients, typically in those with minimal bile leak and stable clinical condition.

The mean hospital stay was 12.0 ± 5.5 days, indicating a considerable recovery duration due to the complexity of bile duct injuries (Table 3). Postoperative complications were observed in 30 patients (46%), most commonly including bile leaks, wound infections, and cholangitis. A total of 26 patients (40%) achieved full recovery following appropriate management. However, persistent symptoms such as intermittent abdominal pain or cholestasis were noted in 19 (29%) cases. The mortality rate was notably high at 31% (n = 20), emphasizing the serious prognostic implications of bile duct injuries, particularly in delayed or complex cases.

Table 1. Demographics and Injury Types

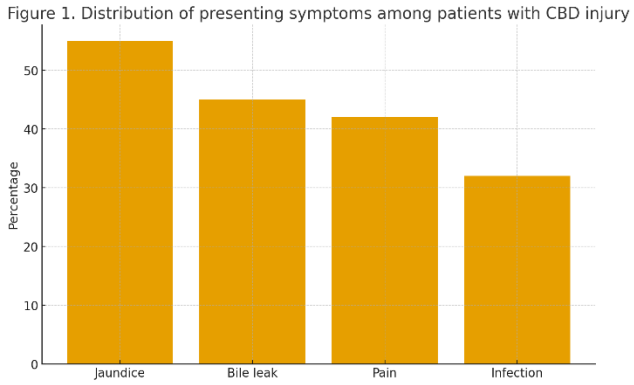
Variable	Value
Mean age (years)	50.1 ± 15.8
Female	36 (55%)
Male	29 (45%)
Strasberg A	15 (23%)
Strasberg B	10 (15%)
Strasberg C	13 (20%)
Strasberg D	14 (22%)
Strasberg E	0 (0%)

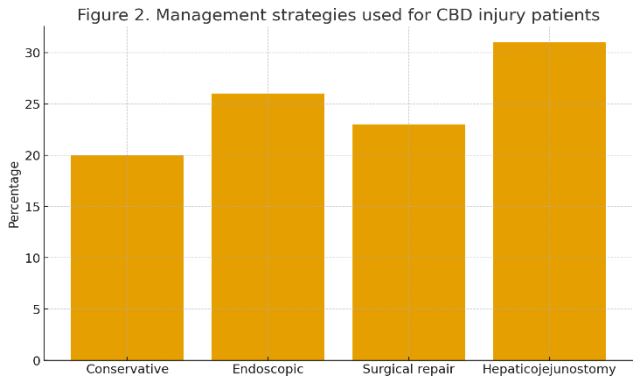
Table 2. Diagnostic and Management Profile

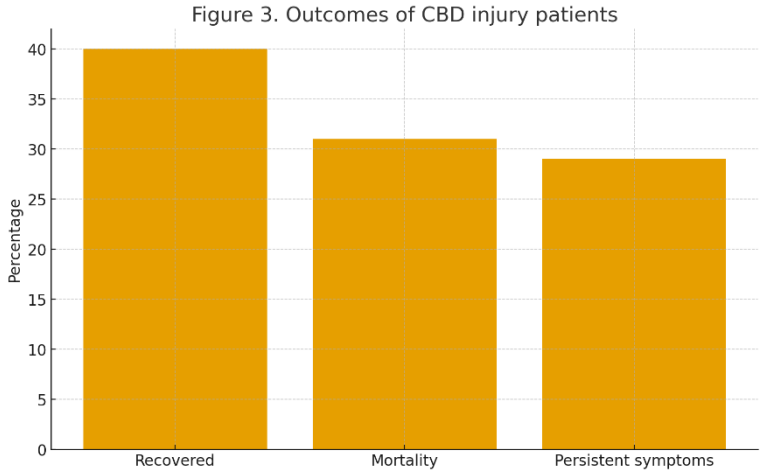
Variable	Frequency (%)
Ultrasound	31 (31%)
CT	26 (26%)
MRCP	25 (25%)
ERCP	18 (18%)
Conservative	13 (20%)
Hepaticojejunostomy	20 (31%)
Endoscopic	17 (26%)
Surgical repair	15 (23%)

Table 3. Outcomes

Outcome	Value
Mean hospital stay (days)	12.0 ± 5.5
Complications	30 (46%)
Recovered	26 (40%)
Mortality	20 (31%)
Persistent symptoms	19 (29%)







Discussion

In this study, we analyzed the demographic characteristics, types, diagnostic modalities, management approaches, outcomes, and associated complications of 65 patients who experienced common bile duct (CBD) injuries following cholecystectomy. The mean age of participants was 50.1 ± 15.8 years, with a predominance of females (55%), consistent with existing literature that highlights a higher incidence of cholelithiasis among women (17). The demographic data aligns with broader findings indicating that middle-aged individuals are most commonly affected, as noted by Iwasaki et al. (18), who documented an increased occurrence of biliary complications in this age group.

When examining the distribution of bile duct injuries, our results showed that type A injuries were the most prevalent (23%), followed closely by type D (22%) and type C (20%), while no patients presented with type E injury. This distribution reflects earlier classifications of bile duct injury and anecdotal evidence of type A injuries being frequent (19). The predominance of partial or limited ductal injuries over complete transections aligns with the conclusions of Gallagher and Imagawa (20), who cited similar trends.

Regarding our diagnostic approaches, we found that ultrasonography was employed as the initial investigation in 31% of cases, highlighting its effectiveness due to its non-invasive nature and ability to detect bile leaks and fluid collections. This finding is corroborated by Bhatia and Kumar (21), who supported the use of ultrasound as a first-line tool for evaluating post-operative complications. The use of CT scans and MRCP (26% and 25% respectively) for anatomical delineation corroborates trends in the literature, particularly with MRCP's utility in diagnosing bile duct injuries (22, 23). The application of ERCP for therapeutic stenting in cases of suspected partial ductal obstruction further supports the advocacy for comprehensive imaging and interventional strategies, as outlined by Akool et al. (24).

Management strategies revealed a predominant use of hepaticojejunostomy (31%) as the standard reconstructive procedure for complex injuries, aligning well with findings of Alkhalegy and Kamal (25) and Fong et al. (26), who reported success in surgical interventions for complex biliary reconstructions. Endoscopic management involved stent placement and dilation in 26% of cases, reflecting an emerging consensus on the effectiveness of these approaches for low-grade injuries (27, 28). Surgical repair was performed in 23% of our cohort, which mirrors practices reported by others regarding the critical need for timely and appropriate surgical intervention for bile duct injuries, especially when conservative measures fail (29).

Additionally, our findings indicated a mean hospital stay of 12.0 ± 5.5 days, underscoring the complications related to this type of injury. The reported complication rate of 46% is concerning and aligns with Zhao et al.'s (30) observations where significant post-cholecystectomy complications were highlighted. Our study's mortality rate of 31% (n = 20) reflects the grave risks associated with bile duct injuries, consistent with studies indicating severe outcomes (31, 32). The persistence of symptoms in 29% of cases emphasizes the long-term challenges faced by patients after managing bile duct injuries, as they may continue to experience complications like cholangitis and abdominal pain, supporting long-term follow-up as crucial in these cases (19).

In summary, the findings from our study underscore the complexity and severity of bile duct injuries following cholecystectomy and reflect a pressing need for enhanced awareness, training, and adherence to safe surgical principles to reduce the incidence of these life-altering complications.

Conclusion

CBD injuries after cholecystectomy remain a significant surgical challenge with high morbidity and mortality. Preventive strategies such as the Critical View of Safety, early recognition, and referral to specialized centers are key to improving patient outcomes. Future multicenter studies with standardized classification and reporting are essential.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-23)
Consent for publication
Approved
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Not applicable

Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

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SM (Surgical Resident)
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Study Design, manuscript review, critical input.
SZQ (PG)
Manuscript drafting, Study Design,
SA (PG)
Conception of Study, Development of Research Methodology Design,

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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