

# Altering the Surgical Approach of Laparoscopic Cholecystectomy

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## ABSTRACT

**Background:** Laparoscopic cholecystectomy (LC) is the standard treatment for gallbladder diseases. However, rare anatomical variations can complicate the procedure, requiring modifications to the surgical approach.

**Objective:** This study aims to assess the impact of such variations on surgical outcomes and evaluate the effectiveness of laparoscopic techniques when faced with these challenges.

**Methods:** This retrospective study was conducted at Irfan General Hospital during June 2022 to June 2023. A total of 15 patients who experienced unexpected anatomical anomalies during their LC procedures were included in the study. Adult patients aged 18–80 years who underwent laparoscopic cholecystectomy for symptomatic gallstones, chronic cholecystitis, or other gallbladder-related disorders were included in the study. Only patients who presented with rare anatomical findings during surgery, which required changes in the planned surgical approach, were included.

**Results:** 40% of patients had an aberrant cystic artery, 20% had duplicated cystic ducts, and 13% had accessory bile ducts. Severe adhesions were encountered in 27% of cases. Preoperative imaging, including ultrasound, CT, and MRCP, failed to detect the majority of these variations, particularly aberrant cystic arteries and severe adhesions. Surgical modifications were required in 20% of cases, leading to conversion to open surgery, primarily due to severe adhesions and duplicated cystic ducts. The average hospital stay was 2.3 days (range: 1–5).

**Conclusions:** It is concluded that rare anatomical variations can significantly alter the course of laparoscopic cholecystectomy. Despite the limitations of preoperative imaging in detecting these variations, laparoscopic techniques were successfully adapted to manage these challenges in most cases.

**Keywords:** Laparoscopic cholecystectomy, severe Adhesion, Open Surgery, Hospital Stay.

## INTRODUCTION

Laparoscopic cholecystectomy (LC) has become the gold standard for the surgical treatment of gallbladder diseases, including symptomatic cholelithiasis, chronic cholecystitis, and other gallbladder-related disorders. Laparoscopic procedures entered the medical field in the early 1990s to overcome traditional open cholecystectomy through the provision of smaller incisions together with shorter recovery duration and decreased postoperative discomfort<sup>1</sup>. The widespread use of laparoscopic procedures has been generally successful yet doctors face numerous operational challenges caused by unanticipated anatomical differences together with surgical complications and unusual surgical discoveries. Multiple factors arising during surgery might require a change in the initial scheduled procedure to protect patients and enhance their surgical results<sup>2</sup>. Unusual anatomical findings emerge infrequently during laparoscopic cholecystectomy so they become major sources of surgical complication. The three basic anatomic markers for secure LC practice are the cystic duct alongside cystic artery coupled with common bile duct<sup>3</sup>. The deviation of either quantity or form of these bodily elements along with their shape can boost the danger of surgical injuries while possibly leading to incomplete removal of the gallbladder. Surgical procedures require a different approach when patients develop unexpected rare anatomical structures during the operation<sup>4</sup>.

Rare biliary anatomical abnormalities like acquired anomalies together with congenital malformations often force the surgeon to modify their strategy during operation. Dissection of the cystic artery becomes dangerous because it rises from an abnormal position and expands beyond typical dimensions. Patients undergoing laparoscopic cholecystectomy may have two cystic ducts or an accessory bile duct which will manifest as an undiscovered structure during surgery and heightens the danger of accidental tissue damage<sup>5</sup>. The identification of such conditions calls for both instant recognitions combined with thorough evaluation and possible adaptation of surgical approaches. The condition exists as an unusual phenomenon which affects parts of the liver located throughout the gallbladder and omentum the thorax and retroperitoneum<sup>6</sup>. Most instances of this asymptomatic

condition become recognized through perioperative diagnoses or autopsy findings and preoperative computed tomography when clinicians maintain elevated suspicion levels. Current studies show that some ectopic liver instances developed into cases of hepatocellular carcinoma (HCC)<sup>7</sup>. The discovery of abnormal body structures may force surgeons to switch from laparoscopic to open surgical procedures to enhance observation and proper management of relevant anatomical features. The surgeons must perform this conversion occasionally for safety reasons because the risks of continuing with laparoscopic surgery become greater than its potential advantages in scenarios where the risk of bile duct injury or significant bleeding increases to dangerous levels<sup>8</sup>. The surgeon's expertise together with the operational difficulty determines conversion decisions based on patient safety requirements. The laparoscopic procedure becomes complicated by two major factors: severe inflammation and previous surgical adhesions together with acute cholecystitis apart from anatomical difficulties<sup>9</sup>. Medical conditions make it hard to identify customary surgical markers thus compromising the safety of gallbladder and surrounding structure dissection. The surgeon must modify their procedure while taking additional safety measures or performing an open surgical procedure to achieve better control of access during such complicated situations<sup>10</sup>.

**Objective:** This study aims to assess the impact of such variations on surgical outcomes and evaluate the effectiveness of laparoscopic techniques when faced with these challenges.

## METHODOLOGY

This retrospective study was conducted at Irfan General Hospital during June 2022 to June 2023. A total of 15 patients who experienced unexpected anatomical anomalies during their LC procedures were included in the study. Adult patients aged 18–80 years who underwent laparoscopic cholecystectomy for symptomatic gallstones, chronic cholecystitis, or other gallbladder-related disorders were included in the study. Only patients who presented with rare anatomical findings during surgery, which required changes in the planned surgical approach, were included. Patients with contraindications to surgery, such as severe

cardiovascular or respiratory conditions, and those who underwent open cholecystectomy from the outset were excluded.

**Data Collection:** Data were obtained retrospectively from the hospital's medical records, which included demographic details, clinical presentation, and relevant surgical information. Specifically, patient demographics such as age, sex, and medical history were collected. Clinical presentation data, including symptoms that led to the decision for surgery, were also recorded. Preoperative imaging, such as ultrasound, CT scans, and MRCP, was reviewed to assess the biliary anatomy and identify any potential variations. Intraoperative findings, especially the rare anatomical anomalies, were documented in detail. The surgical modifications required to address these anomalies were also noted, including whether the procedure was converted from laparoscopic to open surgery. Postoperative data, including complications, recovery times, and length of hospital stay, were gathered to assess the impact of these findings on the overall outcome. All surgeries were initially planned as laparoscopic cholecystectomies performed using the standard four-port technique.

**Statistical Analysis:** Data were analyzed using SPSS v21. Descriptive statistics were used to summarize the patient demographics, preoperative characteristics, and surgical outcomes. Continuous variables, such as age and length of hospital stay, were reported as means with standard deviations, while categorical variables such as gender, comorbidities, and the presence of specific anatomical anomalies were presented as frequencies and percentages.

## RESULTS

A total of 15 patients who underwent laparoscopic cholecystectomy for gallbladder disease were included in this

Table 2: Preoperative Imaging Detection Accuracy

Anatomical Variation	Detected by Ultrasound	Detected by CT	Detected by MRCP	Undetected by Any Imaging	Total Patients
Aberrant Cystic Artery	0 (0%)	1 (16.7%)	0 (0%)	5 (83.3%)	6
Duplicated Cystic Duct	0 (0%)	0 (0%)	1 (33.3%)	2 (66.7%)	3
Accessory Bile Ducts	0 (0%)	0 (0%)	2 (100%)	0 (0%)	2
Severe Adhesions	0 (0%)	0 (0%)	0 (0%)	4 (100%)	4

40% of patients had an aberrant cystic artery, with half of those having an origin from the right hepatic artery. Duplicated cystic ducts were found in 20% of cases, and accessory bile ducts were identified in 13% of patients. Severe adhesions were encountered in 27% of cases. In response to these findings, 80% of surgeries were completed with a modified laparoscopic technique, while 20% required conversion to open surgery, primarily due to severe adhesions (13%) and duplicated cystic ducts (7%).

Table 3: Intraoperative Anatomical Findings

Anatomical Variation	Number of Patients	Percentage (%)
Aberrant Cystic Artery	6	40%
- Right Hepatic Artery Origin	3	50%
Duplicated Cystic Duct	3	20%
Accessory Bile Ducts	2	13%
Severe Adhesions	4	27%
Modification		
Laparoscopic Cholecystectomy (modified technique)	12	80%
Conversion to Open Surgery	3	20%
- Due to Severe Adhesions	2	13%
- Due to Duplicated Cystic Ducts	1	7%

The average length of hospital stay was 2.3 days, with a range from 1 to 5 days. Postoperative complications occurred in 13% of patients, with one patient experiencing a mild wound infection (6.7%) and another having transient jaundice (6.7%). The remaining 86.7% of patients had no complications. At the 1-month

study. The patient cohort consisted of 9 females (60%) and 6 males (40%). The mean age of the patients was 48.7 years (range: 28–74 years). The majority of patients (80%) presented with symptomatic cholelithiasis, while 20% were diagnosed with chronic cholecystitis. The most common comorbidities included hypertension (40%), diabetes mellitus (26%), and hyperlipidemia (33%).

Table 1: Patient Demographics

Characteristic	Value
Total Patients	15
Gender	
- Female	9 (60%)
- Male	6 (40%)
Mean Age (years)	48.7±9.81
Comorbidities	
- Hypertension	6 (40%)
- Diabetes Mellitus	4 (26%)
- Hyperlipidemia	5 (33%)
Presenting Condition	
- Symptomatic Cholelithiasis	12 (80%)
- Chronic Cholecystitis	3 (20%)

Aberrant cystic arteries were detected by CT in only 16.7% of cases, while the majority (83.3%) were undetected by any imaging. Duplicated cystic ducts were only detected by MRCP in one-third of cases, with the remaining two-thirds undetected. Accessory bile ducts were successfully identified by MRCP in all cases. Severe adhesions, however, were not detected by any imaging modality and were only discovered intraoperatively in all 4 patients.

follow-up, all patients had achieved full recovery, highlighting the overall success and safety of the procedures performed.

Table 4: Postoperative Outcomes

Outcome	Number of Patients	Percentage (%)
Length of Hospital Stay (Mean)	2.3 days (Range: 1–5)	
Postoperative Complications	2	13%
- Mild Wound Infection	1	6.7%
- Transient Jaundice	1	6.7%
No Complications	13	86.7%
Recovery Time (Follow-up at 1 month)	Full Recovery in all patients	100%

## DISCUSSION

Laparoscopic cholecystectomy (LC) is widely regarded as the gold standard for the treatment of gallbladder diseases, particularly symptomatic cholelithiasis and chronic cholecystitis. Its success is attributed to its minimally invasive nature, resulting in shorter recovery times, reduced pain, and a lower incidence of complications compared to open surgery. The surgical procedure becomes challenging since confronting unexpected anatomical abnormalities leads to difficulties during dissection which ultimately raises the possibility of patient injuries<sup>11</sup>. These findings show that surgical team members must modify their procedures because they discovered unusual anatomical features throughout laparoscopic cholecystectomies in 15 individual patients<sup>12</sup>. Patients' surgical plan benefits significantly from preoperative imaging tools including ultrasound along with CT scans and MRCP

because these technologies reveal anatomical variations that impact the surgical procedure path. The study employed current imaging technology yet discovered that anomalies requiring surgical procedure modifications existed in only 33% of patients<sup>13</sup>. Ultrasound failed to identify any of the rare anatomical variations with its use in every patient because it proves inadequate for deeper and complex anatomical structure examination. The diagnostic procedures of CT and MRCP produced better results compared to other tests while MRCP specifically detected all accessory bile duct cases<sup>14</sup>. Preoperative tests did not reveal important findings such as aberrant cystic arteries and duplicated cystic ducts leading to necessary intraoperative modifications. Earlier analyses confirm that preoperative imaging shows its worth by revealing anatomy but cannot always confirm rarities in anatomical variations. The aberrant cystic artery was the most frequently observed abnormal structure in 40% of subjects undergoing this study. Multiple studies identify the cystic artery as one of the most common variations in cholecystectomy patients because it affects 20 to 30 percent of patients<sup>15</sup>. An aberrant cystic artery originating from the right hepatic artery needed special caution during dissection since this condition appeared in three patients (50%). All patients received successful laparoscopic management of anomalous arteries during the study period while avoiding severe hemorrhage complications. During laparoscopic dissection patients should maintain strong attention since any damages to odd arterial vessels have the potential to trigger substantial bleeding along with additional complications<sup>16</sup>. Patients with duplicated cystic ducts which occur in twenty percent of cases represented a complex situation to manage. The procedure required open surgery for managing a complicated patient anatomy and prevented bile duct injury from developing. The existence of duplicated cystic duct is a rare anatomical variation seen in 2% of laparoscopic cholecystectomy patients since it proves difficult to handle during surgical dissection<sup>17</sup>. Early recognition of such surgical variations during the procedure is vital because it protects patients from developing biliary leakage or injury therefore surgeons must stay adaptable during operations. The main reasons for conversions to open surgery encompassed severe adhesions which comprised 13% while complicated biliary anatomy made up 7% during the 20% total procedures in this cohort<sup>18</sup>. Studies throughout the literature show that laparoscopic cholecystectomy usually results in conversion between 5% to 20% of surgical cases. Conversion to open surgery occurs only infrequently but remains essential to save patients from severe dangers such as bile duct injury as well as major bleeding. The two adhesion-related conversions proved difficult to manage because the patients presented with morphed anatomical features that prohibited safe laparoscopic surgery<sup>19</sup>. Surgical demands during operations necessitate immediate decision-making abilities since the healthcare provider made the open surgery conversion right when it became necessary. The patients experienced positive postoperative results including a short hospitalization of 2.3 days combined with a limited occurrence of complications (13%). Both patients who had complications finished their recovery without requiring further medical treatments after recovering from their mild wound infection and short jaundice period<sup>20</sup>. Research evidence about LC procedures shows comparable complication rates despite encountering this rare condition. The successful postoperative recovery combined with minimal complications demonstrates the security and performance excellence of laparoscopic procedures when dealing with unknown intraoperative complications. Bearing in mind the significance of preoperative imaging tests the current study reveals its inability to identify rarer cases of anatomical deviation. Prior to surgery surgeons need to understand that some variations such as aberrant cystic arteries and duplicated cystic ducts cannot be

consistently identified through preoperative tests. The necessity for surgeons to demonstrate intensive intraoperative perception and flexibility along with surgical approach readiness emerges as a result of unexpected findings during operations.

## CONCLUSION

It is concluded that rare anatomical variations encountered during laparoscopic cholecystectomy can significantly influence the surgical approach, often requiring modifications to the standard technique in order to ensure optimal patient outcomes. Despite the use of preoperative imaging techniques such as ultrasound, CT scans, and MRCP, many of these variations, including aberrant cystic arteries, duplicated cystic ducts, and accessory bile ducts, went undetected prior to surgery.

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