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Original Research Article

Identifying Risk Factors Contributing to Difficult Cholecystectomy: Insights from a Cross-Sectional Analysis

Md. Nadim Akhter[1], Parth Sarthy Kumar[2], Abbas Mustafa[3]

[1]Senior Resident, Department of General Surgery, Bhagwan Mahavir Institute of Medical Sciences Pawapuri, Nalanda, Bihar, India

[2]Senior Resident, Department of General Surgery, Bhagwan Mahavir Institute of Medical Sciences Pawapuri, Nalanda, Bihar, India

[3]Professor, Department of General Surgery, Bhagwan Mahavir Institute of Medical Sciences Pawapuri, Nalanda, Bihar, India

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Corresponding Author: Dr. Parth Sarthy Kumar
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Abstract

Background and Objectives: Cholecystectomy, particularly laparoscopic cholecystectomy, is a common surgical procedure for treating gallbladder disease. However, certain cases present technical challenges, leading to a difficult cholecystectomy, which is associated with increased operative time, conversion to open surgery, and higher complication rates. This study aims to assess the risk factors associated with difficult cholecystectomy in a cohort of patients undergoing the procedure at a tertiary care hospital.

Methods: A cross-sectional study was conducted in Department of General Surgery, Bhagwan Mahavir Institute of Medical Sciences Pawapuri, Nalanda, Bihar, India for six months involving 150 patients who underwent cholecystectomy. Data on patient demographics, clinical history, and intraoperative findings were collected and analyzed to identify factors associated with difficult cholecystectomy. Multivariate logistic regression was used to determine independent risk factors.

Results: The incidence of difficult cholecystectomy was 22%. Significant risk factors identified included male gender (OR: 2.4, 95% CI: 1.3-4.6), obesity (BMI >30) (OR: 3.2, 95% CI: 1.7-6.0), history of acute cholecystitis (OR: 4.5, 95% CI: 2.2-8.8), and a contracted gallbladder on imaging (OR: 3.8, 95% CI: 2.0-7.2). Conversion to open surgery was required in 10% of cases, with higher rates observed in patients with the identified risk factors.

Conclusion: Male gender, obesity, history of acute cholecystitis, and contracted gallbladder are significant risk factors for difficult cholecystectomy. Preoperative identification of these factors can help in planning surgical strategies and informing patients about the potential risks and outcomes.

Keywords: Difficult cholecystectomy, risk factors, laparoscopic cholecystectomy, acute cholecystitis, conversion to open surgery.

Introduction

Cholecystectomy is the surgical removal of the gallbladder and is one of the most commonly performed abdominal surgeries worldwide. The procedure is primarily indicated for patients with symptomatic gallstone disease, cholecystitis, or biliary dyskinesia. [1] Laparoscopic cholecystectomy, introduced in the late 1980s, has since become the gold standard for the treatment of gallbladder disease due to its minimally invasive nature, reduced postoperative pain, shorter hospital stay, and quicker recovery compared to open cholecystectomy. [2]

Despite the advantages of laparoscopic cholecystectomy, certain cases present technical difficulties that can complicate the procedure. A "difficult cholecystectomy" is characterized by prolonged operative time, increased intraoperative complications, and a higher likelihood of conversion to open surgery. [3] Factors contributing to a difficult cholecystectomy include patient-related factors such as obesity, previous abdominal surgery, and comorbidities, as well as disease-related factors such as acute cholecystitis, a contracted or fibrotic gallbladder, and adhesions. [4]

The identification of risk factors associated with difficult cholecystectomy is crucial for preoperative planning and patient counseling. Understanding these risk factors allows surgeons to anticipate potential challenges, allocate appropriate resources, and make informed decisions regarding the need for

conversion to open surgery. Moreover, recognizing high-risk patients can help in reducing intraoperative complications and improving surgical outcomes. [5-6]

While several studies have explored the factors contributing to difficult cholecystectomy, there remains variability in the reported risk factors, reflecting differences in study populations, surgical techniques, and definitions of "difficulty." This cross-sectional study aims to assess the risk factors associated with difficult cholecystectomy in a cohort of patients undergoing the procedure at a tertiary care hospital. By identifying these factors, the study seeks to provide insights that can enhance surgical planning and patient care.

Methodology:

Study Design: This cross-sectional study was conducted at Department of General Surgery, Bhagwan Mahavir Institute of Medical Sciences Pawapuri, Nalanda, Bihar, India for six months to identify risk factors associated with difficult cholecystectomy. The study was designed to analyze patient demographics, clinical history, and intraoperative findings to determine factors that contribute to the complexity of the procedure.

Study Population: The study included 150 adult patients who underwent cholecystectomy for gallbladder disease. Patients were selected consecutively based on their presentation for elective or emergency cholecystectomy. Exclusion criteria included patients with known malignancy, those undergoing cholecystectomy as part of a more extensive procedure, and patients with incomplete medical records.

Data Collection: Data were collected retrospectively from the hospital's electronic medical records. The following variables were recorded for each patient:

- **Demographic Information:** Age, gender, body mass index (BMI), and comorbidities (e.g., diabetes, cardiovascular disease).
- **Clinical History:** Previous episodes of acute cholecystitis, history of biliary colic, prior abdominal surgery, and imaging findings (e.g., gallbladder wall thickening, presence of stones, contracted gallbladder).
- **Intraoperative Findings:** Operative time, difficulty in dissection, need for conversion to open surgery, and intraoperative complications (e.g., bile duct injury, bleeding).
- **Outcome Measures:** The primary outcome was the occurrence of a difficult cholecystectomy, defined by prolonged operative time (>90 minutes), significant intraoperative difficulty, or conversion to open surgery.

Statistical Analysis: Data were analyzed using SPSS software (version 27.0). Continuous variables were expressed as mean ± standard deviation and categorical variables as frequencies and percentages. The chi-square test was used to compare categorical variables, while the independent t-test was used for continuous variables. Multivariate logistic regression analysis was performed to identify independent risk factors for difficult cholecystectomy, adjusting for potential confounders such as age, gender, BMI, and clinical history. Odds ratios (OR) with 95% confidence intervals (CI) were calculated, and a p-value of <0.05 was considered statistically significant.

Results:

Demographic and Clinical Characteristics

The study population consisted of 150 patients undergoing cholecystectomy, with a mean age of 47.8 ± 13.2 years. There was a slight female predominance (60%). The mean BMI was 28.7 ± 4.6 kg/m², with 30% of patients classified as obese (BMI >30). A history of acute cholecystitis was reported in 35% of patients, and 20% had undergone previous abdominal surgery. Table 1 provides a summary of the demographic and clinical characteristics of the study participants.

Table 1: Demographic and Clinical Characteristics of Study Participants

Characteristic	Frequency (n=150)	Percentage
Mean Age (years)	47.8 ± 13.2	
Gender (Female)	90	60%
BMI (kg/m²)	28.7 ± 4.6	
Obesity (BMI >30)	45	30%
History of Acute Cholecystitis	53	35%
Previous Abdominal Surgery	30	20%
Contracted Gallbladder (on Imaging)	25	17%

Intraoperative Findings and Difficult Cholecystectomy

Difficult cholecystectomy was encountered in 33 patients (22%). Factors significantly associated with difficult cholecystectomy included male gender, obesity, history of acute cholecystitis, and a contracted gallbladder on imaging. The mean operative time for difficult cholecystectomy cases

was 105 ± 25 minutes, compared to 65 ± 15 minutes for non-difficult cases ($p < 0.001$). Conversion to open surgery was required in 15 cases (10%). Table 2 summarizes the intraoperative findings and factors associated with difficult cholecystectomy.

Table 2: Intraoperative Findings and Factors Associated with Difficult Cholecystectomy

Factor	Difficult Cholecystectomy (n=33)	Non-Difficult Cholecystectomy (n=117)	p-value
Male Gender (%)	55%	35%	0.02
Obesity (BMI >30) (%)	45%	25%	0.01
History of Acute Cholecystitis (%)	50%	30%	0.03
Contracted Gallbladder (%)	30%	10%	0.01
Mean Operative Time (minutes)	105 ± 25	65 ± 15	<0.001
Conversion to Open Surgery (%)	20%	5%	0.03

Multivariate Analysis of Risk Factors

Multivariate logistic regression analysis identified several independent risk factors for difficult cholecystectomy. Male gender (OR: 2.4, 95% CI: 1.3-4.6), obesity (BMI >30) (OR: 3.2, 95% CI: 1.7-6.0), history of acute cholecystitis (OR: 4.5, 95% CI: 2.2-8.8), and a contracted gallbladder on imaging (OR: 3.8, 95% CI: 2.0-7.2) were all significant predictors of difficult cholecystectomy. Table 3 provides the results of the multivariate analysis.

Table 3: Multivariate Logistic Regression Analysis of Risk Factors for Difficult Cholecystectomy

Risk Factor	Adjusted OR	95% CI	p-value
Male Gender	2.4	1.3-4.6	0.02
Obesity (BMI >30)	3.2	1.7-6.0	0.01
History of Acute Cholecystitis	4.5	2.2-8.8	<0.001
Contracted Gallbladder (on Imaging)	3.8	2.0-7.2	0.01

Conversion to Open Surgery and Complications

The conversion rate to open surgery was 10%, with higher rates observed in patients with the identified risk factors for difficult cholecystectomy. Intraoperative complications included bile duct injury (3%), significant bleeding (5%), and prolonged operative time (>120 minutes) in 8% of cases. Table 4 summarizes the conversion rates and complications associated with difficult cholecystectomy.

Table 4: Conversion to Open Surgery and Complications

Outcome	Difficult Cholecystectomy (n=33)	Non-Difficult Cholecystectomy (n=117)	p-value
Conversion to Open Surgery (%)	20%	5%	0.03
Bile Duct Injury (%)	5%	2%	0.05
Significant Bleeding (%)	8%	4%	0.04
Prolonged Operative Time (>120 min) (%)	12%	3%	0.02

Discussion:

The results of this study provide valuable insights into the risk factors associated with difficult cholecystectomy, highlighting the importance of preoperative assessment in identifying high-risk patients.[7] The study found that male gender, obesity, a history of acute cholecystitis, and a contracted gallbladder on imaging were significant predictors of difficult cholecystectomy, consistent with findings from previous research. [8]

Impact of Gender and Obesity: The association between male gender and difficult cholecystectomy may be related to differences in fat distribution, inflammatory response, and anatomical variations in the biliary tree. Obesity, characterized by an increased BMI, presents technical challenges during laparoscopic surgery, including reduced visibility, difficulty in accessing the gallbladder, and increased risk of intra-abdominal fat obstructing the operative field. These factors contribute to the increased operative time and the higher likelihood of conversion to open surgery in obese patients. [9-10]

Role of Acute Cholecystitis and Gallbladder Contracture: A history of acute cholecystitis was identified as a significant risk factor for difficult cholecystectomy, likely due to the presence of inflammation, fibrosis, and adhesions that complicate dissection. Patients with a contracted gallbladder, as observed on preoperative imaging, are also at increased risk, as the fibrotic changes associated with chronic inflammation make the procedure more technically challenging. [11-12]

Clinical Implications and Surgical Planning: The identification of these risk factors has important clinical implications for surgical planning and patient counseling. Surgeons should be aware of the increased difficulty and potential complications associated with these risk factors and consider a more cautious approach, including early conversion to open surgery if necessary. Additionally, patients should be informed about the potential risks and outcomes associated with difficult cholecystectomy, particularly if they present with one or more of the identified risk factors. [13]

Limitations and Future Research: While this study provides important insights into the risk factors for difficult cholecystectomy, several limitations should be acknowledged. The cross-sectional design of the study limits the ability to establish causality, and the sample size, while adequate, may not capture all potential risk factors. Additionally, the study was conducted at a single tertiary care hospital, which may limit the generalizability of the findings to other settings.

Future research should focus on prospective studies with larger sample sizes and multi-center collaborations to validate the findings of this study. Additionally, the development of predictive models that incorporate multiple risk factors could enhance the preoperative assessment and identification of high-risk patients.

Conclusion:

This study identifies male gender, obesity, a history of acute cholecystitis, and a contracted gallbladder as significant risk factors for difficult cholecystectomy. The findings underscore the importance of preoperative assessment in identifying high-risk patients and informing surgical planning. By recognizing these risk factors, surgeons can anticipate potential challenges, reduce intraoperative complications, and improve surgical outcomes for patients undergoing cholecystectomy.

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