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Original Article

Association between Body Mass Index and Operative Difficulty in Laparoscopic Cholecystectomy

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ABSTRACT

Background: Symptomatic gallstone disease and related benign gallbladder disease is a condition that is surgically treated with laparoscopic cholecystectomy. But there are several anatomical, inflammatory and patient-related factors which may make them more or less difficult to operate on. Higher BMI may lead to technical difficulties in laparoscopic surgery including port placement, visibility, retraction, dissection and operative time. Objective: To determine the association between body mass index and operative difficulty in patients undergoing laparoscopic cholecystectomy. Methods: This descriptive cross-sectional study was conducted in the Department of Surgery, Lahore General Hospital, Lahore, Pakistan, from June 2025 to January 2026. The number of patients (N) was 75 those who had undergone laparoscopic cholecystectomy for symptomatic gallstone disease were included through non-probability consecutive sampling technique. The BMI was determined by measured height and weight and patients were classified as normal BMI, overweight, and obese. Intraoperative parameters such as port placement difficulty, dense adhesions, difficulty with dissection of Calot's triangle, blood loss, perforation of gall bladder, spillage of bile, requirement of additional port, conversion to open surgery and operative time were used to assess operative difficulty. SPSS software (version 26) was used to analyze data. The data were statistically analysed by chi-square test and one-way ANOVA where appropriate and the significance level set at <0.05. Results: Among 75 patients, the mean age was 43.6 ± 12.8 years, and the majority were female 49 (65.3%). The mean BMI was 27.8 ± 4.6 kg/m². Normal BMI was observed in 21 (28.0%) patients, overweight in 34 (45.3%), and obesity in 20 (26.7%). Operative difficulty increased with BMI. Difficult surgery was recorded in 2 (9.5%) normal-BMI patients, 7 (20.6%) overweight patients, and 7 (35.0%) obese patients, showing a statistically significant association between BMI and operative difficulty ($p = 0.032$). Mean operative time also increased significantly across BMI groups, from 42.8 ± 9.6 minutes in normal-BMI patients to 63.7 ± 14.8 minutes in obese patients ($p < 0.001$). Conclusion: Increased body mass index was significantly associated with greater operative difficulty during laparoscopic cholecystectomy. Obese patients had longer operative time and higher frequencies of difficult port placement, dense adhesions, difficult Calot's triangle dissection, gallbladder perforation, additional port requirement, and conversion to open surgery. BMI should therefore be considered during preoperative assessment and operative planning. Keywords: Body mass index, obesity, laparoscopic cholecystectomy, operative difficulty, gallstones, Calot's triangle.

INTRODUCTION

Gallstone disease is a very frequent condition of the biliary tract and when it occurs it is a common condition for hospitalization and operative treatment. Symptoms include biliary colic, chronic

cholecystitis, acute cholecystitis and gallstone complications. The laparoscopic cholecystectomy is the treatment of choice for symptomatic gallstones due to smaller incisions, less postoperative pain, hospital stay, early mobilization and return to normal activities 1-3.

Laparoscopic cholecystectomy is a very common procedure and in most cases technically easy, but not always. Reasons for increased operative difficulty are acute inflammation, previous attacks of cholecystitis, dense adhesions, thickening of the gallbladder wall, impacted stone at the neck of the gallbladder, unclear anatomy of Calot's triangle, previous abdominal surgery, and the patient's body habitus. These factors may increase the operative time, the need for multiple ports, careful dissection and/or conversion to open surgery 4-6.

Body mass index (BMI) is a key patient-related variable that could potentially affect the technical part of laparoscopic cholecystectomy. The thickened abdomen, a large amount of fat tissue and limited space in the abdomen can make it more difficult for obese patients to insert the trocar and handle the instruments. Around the gallbladder, hepatocystic triangle, and liver bed, fat may be deposited which may not be seen and may make the identification of the cystic duct and cystic artery more difficult. These are the problems that can lead to bleeding, rupturing of the gallbladder, leakage of bile and long surgery 7, 8.

Clinically, there is an association between obesity and operative difficulty, as the prevalence of overweight and obesity is increasing around the world. With increasing number of patients who present obese for laparoscopic cholecystectomy, there is a need to determine factors that can be predictive of the technical difficulty preoperatively. Preoperative identification of high-risk patients may be useful for patient counseling, operating room preparation, selection of appropriate instruments, experienced surgical teams and timely decision-making during surgery 9-11.

Although laparoscopic techniques have improved, BMI is still an important factor in surgical assessment of operative difficulty. While some obese patients are able to have laparoscopic cholecystectomy without complications, others may have a more challenging experience from the poor exposure, difficult retraction, adhesion or unclear biliary anatomy. Thus, it is necessary to obtain local data to assess whether the BMI is a measurable parameter to assess the difficulty of laparoscopic cholecystectomy 12.

The present study was conducted to assess the association between body mass index and operative difficulty in laparoscopic cholecystectomy. The study evaluated BMI categories in relation to operative time, port placement difficulty, adhesions, Calot's triangle dissection, intraoperative complications, need for additional port, conversion to open surgery, and postoperative outcomes.

METHODOLOGY

This descriptive cross-sectional study was conducted in the Department of Surgery, Lahore General Hospital, Lahore, Pakistan. The study was carried out over a period of six months, from June 2025 to January 2026. The objective of the study was to determine the association between body mass index and operative difficulty in patients undergoing laparoscopic cholecystectomy.

The study included a total of 75 patients with symptomatic gallstone disease who were being treated with laparoscopic cholecystectomy. A non-probability sampling consecutive sampling method was used to select the patients. After obtaining informed consent from all patients presenting in the study period who met inclusion criteria, all were included. Each patient was informed of the purpose of the study, operative procedure, potential risks and the confidentiality of data prior to inclusion.

Patients aged 18 years and above, of either gender, who were diagnosed with symptomatic cholelithiasis, chronic cholecystitis or uncomplicated acute cholecystitis, and scheduled for elective or early laparoscopic cholecystectomy were included. Patients with suspected gallbladder malignancy, common bile duct stones and those requiring endoscopic intervention before surgery, as well as empyema of

gallbladder, generalized peritonitis, severe cardiopulmonary disease unfit for general anesthesia, pregnancy and those with incomplete clinical and/or operative records were excluded from the study.

A thorough history and clinical examination were carried out before surgery in all patients. Demographic parameters (age, gender, place of residence and chronic diseases including diabetes mellitus, HTN) were documented. Standard methods were used for measuring height and weight, and calculating body mass index (BMI) as weight in kg/m². Patients were then classified into BMI categories as normal BMI, overweight, and obese. Normal BMI was defined as 18.5–24.9 kg/m², overweight as 25.0–29.9 kg/m², and obesity as BMI ≥30 kg/m².

Patients' routine pre-operative evaluations were performed, including a complete blood count, liver function tests, renal function tests, blood sugar, viral screen, coagulation profile and abdominal ultrasonography. Ultrasound characteristics of gallbladder wall thickness, number of stones, impacted stone at the neck of the gallbladder, pericholecystic fluid and inflammatory characteristic of the gallbladder were noted. Surgery was performed after optimizing patients according to the institutional protocol.

An experienced surgeon, under general anesthesia, performed the laparoscopic cholecystectomy with the standard four-port technique. Laparoscopic ports were inserted and pneumoperitoneum was established, where the gall bladder was seen. In Calot's triangle, dissection was performed for the identification of the cystic duct and cystic artery, and then they were clipped and divided. The gall bladder was dissected free from the liver bed and then removed. Any need for further port placement and/or to open up cholecystectomy was noted.

Operative difficulty was evaluated based on predefined parameters during the operation. These were problems with port placement, excess abdominal wall fat or intraabdominal fat, dense adhesions around the gallbladder, not being able to grab or retract the gallbladder, dissection of Calot's triangle, bleeding during dissection, gallbladder perforation, bile spillage, stone spillage, prolonged operative time, requiring additional port, and conversion to open surgery. Operative time was defined from the time of the first skin incision until closure of the wound.

Operative difficulty was determined based on intraoperative findings, and divided into easy, moderate, and difficult. Easy surgery was defined as surgery in which there was little difficulty finding the anatomy, no adhesions and no significant difficulty during surgery. Moderate was defined as the presence of adhesions, mild dissection or perforation of gall bladder without conversion. Severe adhesions, difficulty in locating Calot's triangle, major bleeding, requirement for more than one port, extended surgery time and conversion to open cholecystectomy were defined as difficult surgery.

In addition, postoperative outcome measures were also documented such as the need for more analgesia after surgery, postoperative infection, length of hospital stay, and early postoperative complications. All the patients were followed while in hospital and treated as per standard post-operative care. The categorization of BMI and the difficulty of the operation was then evaluated.

Data was entered and analysis was made using SPSS version 26. Descriptive statistics were used to present quantitative data, which included mean and SD data for age, BMI, operative time and hospital stay. Qualitative variables were presented as frequency and percent with regard to gender, BMI category, difficult dissection of Calot's triangle, gall bladder perforation, bile spillage, conversion to open surgery, and postoperative complications. Chi-square test or Fisher's exact test was used to assess the association between BMI category and categorical variables of operative difficulty. Means operative time was compared for different BMI groups by performing one-way ANOVA. The p-value of < 0.05 was regarded as statistically significant.

RESULTS

A total of 75 patients who underwent laparoscopic cholecystectomy were included in the study. There were 20 to 68 years of age with mean age 43.6 ± 12.8 years. Most patients were female, comprising 49 (65.3%), while males were 26 (34.7%). The mean body mass index was 27.8 ± 4.6 kg/m². Normal BMI: 21 patients (28.0%), overweight BMI: 34 patients (45.3%) and obese BMI: 20 patients (26.7%).

Table 1. Baseline characteristics of patients undergoing laparoscopic cholecystectomy

Variable	Frequency / Mean	Percentage
Total patients	75	100.0
Age, years	43.6 ± 12.8	—
Male	26	34.7
Female	49	65.3
Mean BMI, kg/m²	27.8 ± 4.6	—
Normal BMI	21	28.0
Overweight	34	45.3
Obese	20	26.7
Diabetes mellitus	17	22.7
Hypertension	19	25.3
Previous abdominal surgery	11	14.7

Chronic cholecystitis with gallstones (46 [61.3%] patients), acute cholecystitis (18 [24.0%] patients), and symptomatic cholelithiasis without acute inflammation (11 [14.7%] patients) were the most common clinical diagnoses. Twenty-nine (38.7%) patients had ultrasonographic thickening of the gallbladder wall, and 16 (21.3%) patients had an impacted stone at the neck of the gallbladder.

Table 2. Clinical and ultrasound findings

Variable	Frequency	Percentage
Chronic cholecystitis with gallstones	46	61.3
Acute cholecystitis	18	24.0
Symptomatic cholelithiasis	11	14.7
Gallbladder wall thickening	29	38.7
Impacted stone at gallbladder neck	16	21.3
Pericholecystic fluid	9	12.0
Previous attack of cholecystitis	24	32.0

Operative difficulty was determined as easy, moderate or difficult, depending on the findings encountered in the operating room, including difficulty in port placement, dense adhesions, difficult dissection of the Calot's triangle, bleeding, gallbladder perforation and necessity for additional port or conversion. In total, 31 (41.3%) surgeries were easy, 28 (37.3%) were moderately difficult and 16 (21.3%) were difficult. With each successive BMI level, the percentage of difficult cases increased. Only 2 (9.5%) normal BMI patients had a difficult surgery, whereas 7 (20.6%) overweight and 7 (35.0%) obese patients did. This correlation of BMI category to operative difficulty was significant ($p = 0.032$).

Table 3. Association between BMI category and operative difficulty

BMI Category	Easy Surgery	Moderate Difficulty	Difficult Surgery	Total	p-value
Normal BMI	13 (61.9%)	6 (28.6%)	2 (9.5%)	21	
Overweight	13 (38.2%)	14 (41.2%)	7 (20.6%)	34	
Obese	5 (25.0%)	8 (40.0%)	7 (35.0%)	20	
Total	31 (41.3%)	28 (37.3%)	16 (21.3%)	75	0.032

BMI was also associated with an increase in the mean operative time. The mean operating time for the normal BMI patients was 42.8 minutes ± 9.6, for overweight patients 52.4 minutes ± 12.1, and for obese patients 63.7 minutes ± 14.8. There was a statistically significant ($p < 0.001$) difference in operative time between BMI categories.

Table 4. Operative time according to BMI category

BMI Category	Mean Operative Time ± SD, minutes	p-value
Normal BMI	42.8 ± 9.6	
Overweight	52.4 ± 12.1	
Obese	63.7 ± 14.8	
Overall	52.8 ± 14.2	<0.001

Dense adhesions were found in 27 (36.0%) patients, difficult Calot's triangle dissection in 24 (32.0%) patients, gall bladder perforation in 13 (17.3%) patients, and bleeding on dissection in 10 (13.3%) patients. In 8 (10.7%) patients, an additional port had to be used, and in 5 (6.7%) patients, the procedure had to be converted to open cholecystectomy. A higher rate of dense adhesions, dissection of the Calot's triangle, gallbladder perforation, and requirement for an additional port were seen in obese patients when compared with those with normal BMI. Obesity was also associated with higher rate of conversion to open surgery.

Table 5. Intraoperative findings according to BMI category

Operative Finding	Normal BMI n=21	Overweight n=34	Obese n=20	p-value
Difficulty in port placement	2 (9.5%)	6 (17.6%)	8 (40.0%)	0.018
Dense adhesions	4 (19.0%)	12 (35.3%)	11 (55.0%)	0.030
Difficult Calot's triangle dissection	3 (14.3%)	11 (32.4%)	10 (50.0%)	0.025
Bleeding during dissection	1 (4.8%)	4 (11.8%)	5 (25.0%)	0.047
Gallbladder perforation	2 (9.5%)	5 (14.7%)	6 (30.0%)	0.049
Bile spillage	1 (4.8%)	5 (14.7%)	5 (25.0%)	0.062
Need for additional port	1 (4.8%)	3 (8.8%)	4 (20.0%)	0.041
Conversion to open surgery	0 (0.0%)	2 (5.9%)	3 (15.0%)	0.039

Postop complications seen in 9 (12.0%) patients. Infection of the surgical site was seen in 5 (6.7%) of patients and prolonged stay in hospital for more than two days in 14 (18.7%) patients. The postoperative complications rate was comparatively high in obese patients compared to normal weight and overweight patients and the hospital stay was longer. The mean hospital stay was 1.7 ± 0.6 days in normal BMI patients, 2.1 ± 0.8 days in overweight patients and 2.8 ± 1.1 days in obese patients; this was statistically significant ($p = 0.002$).

Table 6. Postoperative outcomes according to BMI category

Outcome	Normal BMI n=21	Overweight n=34	Obese n=20	p-value
Surgical site infection	0 (0.0%)	2 (5.9%)	3 (15.0%)	0.041
Postoperative pain requiring additional analgesia	3 (14.3%)	8 (23.5%)	8 (40.0%)	0.045
Hospital stay >2 days	1 (4.8%)	5 (14.7%)	8 (40.0%)	0.006
Mean hospital stay, days	1.7 ± 0.6	2.1 ± 0.8	2.8 ± 1.1	0.002

Overall, there was a strong correlation between BMI and the difficulty of laparo-cholecystectomy. The average operative time was longer and the average number of adhesions larger in obese patients than in those with a normal BMI, and the conversion rate and time in the hospital were higher in obese patients than in those with normal BMI.

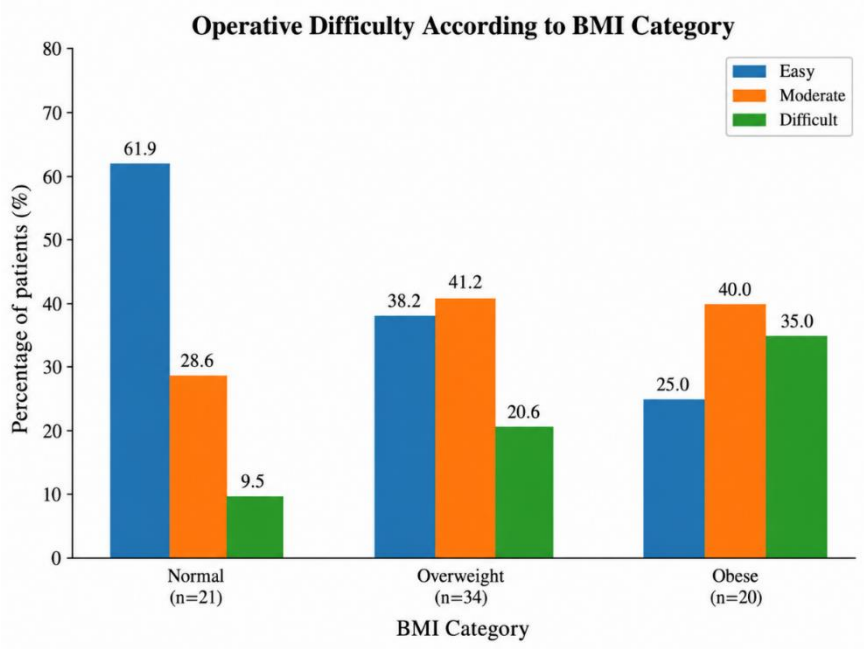

Figure 1. Operative difficulty according to BMI category among patients undergoing laparoscopic cholecystectomy.

The figure shows that the proportion of easy laparoscopic cholecystectomy decreased with increasing BMI, while moderate and difficult operative cases were more common among overweight and obese patients. Difficult surgery was observed in 9.5% of normal-BMI patients, 20.6% of overweight patients, and 35.0% of obese patients, indicating a positive association between higher BMI and operative difficulty.

DISCUSSION

The present study evaluated the association between body mass index and operative difficulty in patients undergoing laparoscopic cholecystectomy. In this study, the proportion of operative difficulty increased gradually from normal BMI patients to overweight and obese patients. Difficult surgery was observed in only 9.5% of patients with normal BMI, while it increased to 20.6% among overweight patients and 35.0% among obese patients. This finding suggests that raised BMI is an important factor that may increase the technical difficulty of laparoscopic cholecystectomy 13, 14.

There are several anatomical and technical reasons for the greater difficulty in performing operations in obese patients. Fat in the abdominal wall can be a problem for placing a port and can also limit the movement of laparoscopic instruments. Furthermore, with more intra-abdominal fat the operative field becomes more restricted and exposure of the gall bladder and Calot's triangle becomes more difficult. In the present study, difficulty in port placement, dense adhesions and difficult dissection of Calot's triangle were more prevalent among obese patients than their normal BMI counterparts. These results suggest a correlation between obesity and ease of entry into the abdominal cavity, as well as an influence on the dissection part of surgery 15-17.

There was also a significant difference between the different BMIs in terms of operative time. In patients with a normal BMI, the mean operative time was 42.8 ± 9.6 minutes, whereas in overweight patients, it was 52.4 ± 12.1 minutes, and in obese patients, 63.7 ± 14.8 minutes. This rise may be attributed to slow insertion of the port, the lack of recognition of the port, the difficulty of gallbladder retraction, and careful dissection in the patient with excess fat around the hepatocystic triangle. More surgical precautions to prevent bleeding, bile duct injury and gallbladder perforation may also be the reason for longer operative time in obese patients.

Patients with higher BMI also had a higher rate of intra operative complications. Higher rates of these factors were found in obese patients: dense adhesions, dissection of the Calot's triangle was difficult, bleeding during dissection, gallbladder perforation, requirement of additional port, and conversion to open surgery. While laparoscopic cholecystectomy is still a safe and effective procedure in obese patients, these findings demonstrate that obesity can add to the technical demands on the operating surgeon. Key points that help to minimize operative risk include proper planning prior to surgery, positioning the patient appropriately, positioning the port appropriately, using longer instruments as needed, and identifying difficult anatomy early 18.

Conversion to open cholecystectomy was observed in 6.7% of the total patients and was more common in obese patients. The conversion should NOT be viewed as a failure of the laparoscopic procedure, but as a safe choice when the anatomy is not well known, or when there are a number of complications like bleeding or severe adhesions. Surgeons should have a low threshold to add more ports or convert to laparoscopy when it is not safe in patients with high BMI. The use of this method will decrease the chances of damaging the bile ducts or causing other complications 19.

There was also a relationship between BMI and postoperative outcomes. Patients who were obese had an increased incidence of postoperative pain necessitating supplemental analgesia, surgical site infection, and length of hospital stay greater than 2 days. Additionally, hospital length of stay was significantly longer for obese patients. This might be attributed to the higher BMI that leads to more operative time, handling of tissue, technical difficulty and a higher risk of wound related complications. Thus, BMI

should not only be viewed as a pre-operative patient factor, but also as one that may affect the difficulty of the procedure and the recovery period 20.

The results of this study emphasize the significance of the pre-laparoscopic cholecystectomy BMI assessment. Early recognition of overweight and obese patients prior to surgery will allow the surgical team to be prepared for possible technical issues, ensure proper instrument selection, inform patients of risks associated with surgery and facilitate peri-operative planning. There were, however, certain limitations of the study. Sample size was relatively small and the study took place for a short duration. Other factors that may affect the operative difficulty are acute inflammation, prior history of cholecystitis, gallbladder wall thickness, surgeon experience and previous abdominal surgery. Thus, larger multicenter analyses are suggested to assess the independent association of BMI with the difficulty of surgery.

CONCLUSION

This study concluded that increased body mass index is significantly associated with greater operative difficulty in laparoscopic cholecystectomy. Obese patients had higher frequencies of difficult port placement, dense adhesions, difficult Calot's triangle dissection, bleeding during surgery, gallbladder perforation, need for additional port, conversion to open surgery, longer operative time, and prolonged hospital stay. Although laparoscopic cholecystectomy can be safely performed in overweight and obese patients, raised BMI should be considered an important predictor of technical difficulty. Careful preoperative assessment, proper operative planning, experienced surgical technique, and timely decision-making during surgery can help reduce complications and improve patient outcomes.

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