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Technical Aspects of Dealing with Difficult Laparoscopic Cholecystectomy in Overweight and Obese Patients

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ABSTRACT

Background: Laparoscopic cholecystectomy (LC) is the preferred surgical approach for gallstone disease; however, obesity presents unique technical challenges, including prolonged operative time, increased conversion rates, and higher postoperative complications. Limited data exist regarding the impact of obesity on LC outcomes in the Pakistani population, necessitating further investigation. **Objective:** This study aimed to evaluate the technical difficulties, intraoperative modifications, and perioperative outcomes of LC in overweight and obese patients compared to normal-weight individuals, with a focus on operative time, conversion rates, and postoperative complications. **Methods:** A quasi-experimental study was conducted at the Department of Surgery, CMH Rawalpindi, from September 2022 to April 2023, involving 300 patients categorized by BMI into normal weight (n=100), overweight (n=120), and obese (n=80). Inclusion criteria encompassed adults undergoing LC for symptomatic cholelithiasis or acute cholecystitis, while exclusions included patients with severe systemic illnesses or prior upper abdominal surgeries. Data on intraoperative challenges, operative time, conversion to open surgery, and postoperative complications were analyzed using SPSS v27. Statistical significance was set at $p<0.05$. **Results:** Obese patients had significantly longer operative times (75 ± 20 min) than normal-weight individuals (60 ± 15 min) ($p<0.01$). Conversion rates were highest in obese patients (10%) compared to normal-weight (2%) ($p<0.05$). Postoperative complications, including wound infections (10% vs. 2%) and bile leaks (3.8% vs. 1%), were significantly more common in obese individuals ($p<0.05$). **Conclusion:** Obesity complicates LC, leading to longer operative times, higher conversion rates, and increased postoperative morbidity. Surgical modifications and perioperative strategies should be tailored to mitigate these risks, ensuring optimal outcomes for obese patients.

INTRODUCTION

Laparoscopic cholecystectomy (LC) has become the gold standard for the management of symptomatic gallstone disease due to its minimally invasive nature, reduced postoperative pain, and shorter hospital stays compared to open surgery. However, performing LC in overweight and obese patients introduces a unique set of technical challenges that can influence operative time, conversion rates, and postoperative complications. Obesity, defined as a body mass index (BMI) of 30 or higher, is associated with increased intra-abdominal fat deposition, which can obscure anatomical landmarks and complicate surgical maneuvers. The growing global prevalence of obesity, which has nearly tripled since 1975, is now a significant health concern, with a rising trend in developing countries, including Pakistan (3). This demographic shift has led to an increased incidence of gallstone disease in obese individuals, necessitating a closer evaluation of the challenges and outcomes associated with performing LC in this population.

Several studies have indicated that obesity prolongs operative time and increases the likelihood of conversion to open surgery due to difficulty in accessing Calot's triangle, excessive intra-abdominal fat, and limited visualization (4). Moreover, obesity has been linked to a higher incidence of postoperative complications, including wound infections, bile leaks, and deep vein thrombosis, which can result in extended hospital stays and increased healthcare costs (5). While extensive research has been conducted on LC in Western populations, there remains a gap in the literature regarding its technical execution and outcomes in obese patients within the Pakistani healthcare context. Given the anatomical and metabolic differences that may exist among different populations, it is imperative to analyze

the specific challenges faced by surgeons in this region and identify optimal strategies for improving surgical outcomes.

Previous studies have emphasized the need for technical modifications in obese patients, such as altered port placement, the use of longer laparoscopic instruments, and modifications in pneumoperitoneum techniques to enhance intraoperative visibility (6). However, there is limited consensus on the most effective surgical approach, and existing guidelines do not provide explicit recommendations tailored to high-BMI patients. Furthermore, while robotic-assisted surgery has been explored as an alternative to conventional laparoscopy, its cost and limited availability in resource-constrained settings remain major barriers to widespread adoption (7-13). Given these challenges, a thorough evaluation of laparoscopic modifications, conversion rates, and postoperative outcomes in overweight and obese patients is crucial to improving surgical techniques and patient safety.

This study aims to address these knowledge gaps by systematically analyzing the intraoperative challenges, surgical modifications, and perioperative outcomes associated with LC in overweight and obese patients in Pakistan. By comparing key operative parameters across different BMI groups, this research seeks to identify the most effective strategies for managing obese patients undergoing LC. The findings will provide valuable insights for optimizing surgical techniques and ensuring better patient outcomes, ultimately contributing to the growing body of evidence on obesity-related challenges in laparoscopic surgery. The study hypothesizes that obesity significantly increases operative complexity, prolongs operative time, and elevates the risk of conversion to open surgery and postoperative complications.

MATERIAL AND METHODS

This quasi-experimental study was conducted at the Department of Surgery, Combined Military Hospital (CMH), Rawalpindi, over a period of eight months, from September 2022 to April 2023, following approval from the Institutional Review Board. The study aimed to evaluate the technical challenges associated with laparoscopic cholecystectomy (LC) in overweight and obese patients and compare their perioperative outcomes with those of normal-weight individuals. Participants were recruited through consecutive sampling from patients presenting with symptomatic gallstone disease, confirmed through ultrasonography. Inclusion criteria encompassed adults aged 18 years and older diagnosed with symptomatic cholelithiasis, biliary dyskinesia, or acute cholecystitis with preoperative American Society of Anesthesiologists (ASA) classification I or II (14-19). Patients were excluded if they had a BMI <18.5 kg/m² or >45 kg/m², common bile duct stones, cholangitis, jaundice, coagulopathies, advanced cardiopulmonary disease, previous upper quadrant abdominal surgeries, active malignancies, or required open surgery due to other medical conditions. Informed consent was obtained from all participants, ensuring they understood the study's purpose, risks, and benefits, while maintaining strict patient confidentiality (20-23).

Data collection was performed through a structured review of electronic medical records, including demographic details, clinical presentations, intraoperative parameters, and postoperative outcomes. The primary outcome was operative time, defined as the time from skin incision to skin closure. Secondary outcomes included conversion to open cholecystectomy, intraoperative challenges (difficulty in establishing pneumoperitoneum, need for additional ports or longer instruments), and postoperative complications such as wound infections, bile leaks, and intra-abdominal collections. Additional data collected included hospital stay duration and the frequency of readmissions. Intraoperative assessments were standardized, with experienced surgeons documenting procedural challenges, anatomical variations, and the use of modified techniques such as adjusted port placement and patient positioning. All surgeries followed a standardized four-port laparoscopic technique, with pneumoperitoneum established either via a Veress needle or an open (Hasson) technique based on surgeon preference and patient factors (24-27).

The study adhered to ethical principles outlined in the Declaration of Helsinki, with formal approval granted by the Institutional Ethical Review Board of CMH Rawalpindi. Ethical approval details, including reference number, were documented in compliance with institutional guidelines. Patient confidentiality was maintained by anonymizing data during collection and analysis, ensuring that only authorized personnel had access to identifiable information. Given the observational nature of the study, no additional risks were imposed on participants beyond routine clinical care, and all patients received standard perioperative management.

Statistical analyses were performed using SPSS version 27 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Group comparisons were conducted using one-way ANOVA for continuous variables and the chi-square test for categorical variables. A p-value of <0.05 was considered statistically significant. Missing data were handled through multiple imputation methods where necessary. Potential confounding variables, such as age and gender distribution, were analyzed to assess their impact on the primary outcomes. Sensitivity analyses were conducted to evaluate the robustness of findings across different

BMI categories. The methodological approach ensured completeness and reproducibility while providing a comprehensive assessment of the technical challenges associated with LC in overweight and obese patients.

RESULTS

The study analyzed a total of 300 patients who underwent laparoscopic cholecystectomy (LC), categorized into three groups based on their body mass index (BMI): normal weight (n=100), overweight (n=120), and obese (n=80). The mean age of the participants was 45 ± 12 years, with a comparable age distribution across the three groups. A slight female predominance was observed, with 60% of the total study population being female, distributed as 60% in the normal weight group, 58.3% in the overweight group, and 62.5% in the obese group. Similarly, the proportion of male patients was consistent across groups, accounting for 40% of the total cohort (Table 1).

Table 1

Demographic and Clinical Characteristics of Patients (n=300)

Variables	Normal Weight (n=100)	Overweight (n=120)	Obese (n=80)	Total (n=300)
Mean Age (years)	44 ± 11	45 ± 12	46 ± 13	45 ± 12
Male	40 (40%)	50 (41.7%)	30 (37.5%)	120 (40%)
Female	60 (60%)	70 (58.3%)	50 (62.5%)	180 (60%)

Table 2

Intraoperative Findings

Intraoperative Parameter	Normal Weight (n=100)	Overweight (n=120)	Obese (n=80)	p-value
Difficulty in establishing pneumoperitoneum	5 (5%)	12 (10%)	15 (18.8%)	<0.05
Need for additional/longer instruments (%)	3 (3%)	10 (8.3%)	20 (25%)	<0.01
Mean Operative Time (minutes)	60 ± 15	68 ± 18	75 ± 20	<0.01

Table 3

Conversion to Open Surgery

Conversion Reasons	Normal Weight (n=100)	Overweight (n=120)	Obese (n=80)	Total (n=300)	p-value
Total Conversion to Open Surgery (%)	2 (2%)	5 (4.2%)	8 (10%)	15 (5%)	<0.05
Unclear anatomy due to fat	(%) 1 (1%)	3 (2.5%)	5 (6.3%)	-	-
Dense adhesions (%)	1 (1%)	2 (1.7%)	3 (3.8%)	-	-

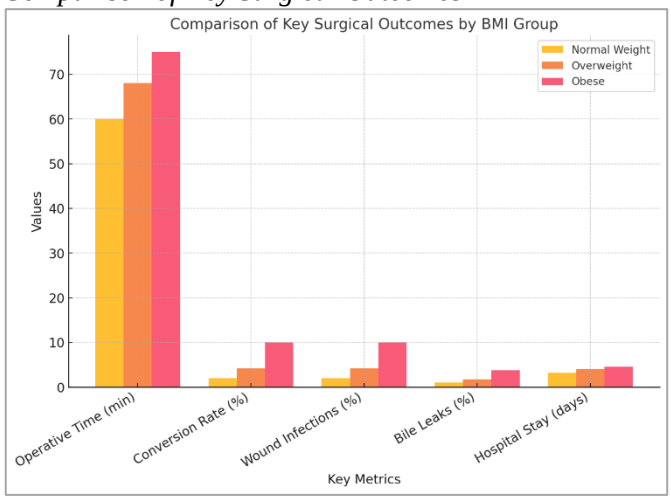
Table 4

Postoperative Complications

Complication	Normal Weight (n=100)	Overweight (n=120)	Obese (n=80)	Total (n=300)	p-value
Wound Infections (%)	2 (2%)	5 (4.2%)	8 (10%)	15 (5%)	<0.05
Bile Leaks (%)	1 (1%)	2 (1.7%)	3 (3.8%)	6 (2%)	<0.05
Mean Hospital Stay (days)	3.2 ± 0.8	4.0 ± 1.0	4.5 ± 1.2	3.9 ± 1.0	<0.01

Figure 1

Comparison of Key Surgical Outcomes



Intraoperative findings demonstrated a significant association between obesity and technical challenges during LC. Difficulty in establishing pneumoperitoneum was observed in 18.8% of obese patients, compared to 10% in overweight and only 5% in normal-weight individuals ($p<0.05$). The requirement for additional or longer laparoscopic instruments also increased with BMI, being necessary in 25% of obese cases, compared to 8.3% in overweight and only 3% in normal-weight patients ($p<0.01$). Consequently, the mean operative time was significantly longer in obese patients, averaging 75 ± 20 minutes, whereas overweight and normal-weight patients had shorter mean durations of 68 ± 18 minutes and 60 ± 15 minutes, respectively ($p<0.01$) (Table 2). These findings suggest that obesity contributes to procedural complexity, necessitating increased operative time and the use of specialized surgical modifications.

The rate of conversion to open cholecystectomy was also found to be significantly higher among obese patients. A total of 15 patients (5%) required conversion to open surgery, with the highest rate observed in the obese group (10%), followed by overweight (4.2%) and normal-weight (2%) patients ($p<0.05$). The primary reasons for conversion included unclear anatomy due to excessive intra-abdominal fat, which accounted for 6.3% of conversions in the obese group, compared to 2.5% in overweight and 1% in normal-weight patients. Dense adhesions were another common cause, affecting 3.8%

of obese patients, 1.7% of overweight patients, and 1% of normal-weight individuals (Table 3). These findings indicate that obesity not only prolongs operative time but also increases the likelihood of conversion to open surgery due to the challenges associated with intra-abdominal fat deposition and difficult anatomical visualization.

Postoperative complications were more prevalent in obese patients, with wound infections occurring in 10% of obese cases, compared to 4.2% in overweight and only 2% in normal-weight individuals ($p<0.05$). Bile leaks followed a similar pattern, with an incidence of 3.8% in obese patients, 1.7% in overweight, and 1% in normal-weight individuals ($p<0.05$). Additionally, hospital stay duration was significantly longer in obese patients, averaging 4.5 ± 1.2 days, compared to 4.0 ± 1.0 days in overweight and 3.2 ± 0.8 days in normal-weight individuals ($p<0.01$) (Table 4). These findings highlight that obesity is associated with an increased risk of postoperative complications, requiring extended hospitalization and meticulous postoperative care.

Overall, the results of this study demonstrate that obesity significantly impacts the technical execution and outcomes of laparoscopic cholecystectomy. Increased BMI is correlated with greater intraoperative difficulty, prolonged operative time, higher conversion rates, and increased postoperative morbidity. These findings emphasize the need for tailored surgical strategies and perioperative management plans to mitigate complications and improve outcomes in overweight and obese patients undergoing LC.

DISCUSSION

The technical challenges associated with laparoscopic cholecystectomy (LC) in overweight and obese patients present significant implications for surgical outcomes. This study demonstrated that obesity is strongly correlated with prolonged operative times, increased intraoperative complexity, higher conversion rates to open surgery, and an elevated risk of postoperative complications. These findings align with existing literature that emphasizes the impact of obesity on minimally invasive surgical procedures. Prior studies have similarly reported increased operative time in obese patients due to factors such as excessive intra-abdominal fat, difficulty in establishing pneumoperitoneum, and impaired visualization of Calot's triangle (4). The mean operative duration in this study was significantly longer in obese patients (75 ± 20 minutes) compared to normal-weight individuals (60 ± 15 minutes), reinforcing the notion that obesity necessitates additional intraoperative adjustments to overcome anatomical challenges (26-29).

One of the key intraoperative challenges encountered in this study was difficulty in establishing pneumoperitoneum, which was observed in 18.8% of obese patients, compared to 10% in overweight and 5% in normal-weight individuals. This is consistent with previous reports that suggest the presence of excessive subcutaneous and visceral fat complicates trocar insertion and gas insufflation, thereby prolonging the initial steps of the procedure (6). Furthermore, the necessity for additional or longer laparoscopic instruments was significantly greater in the obese cohort (25%) compared to normal-weight patients (3%), supporting prior recommendations that specialized instruments are often required to enhance maneuverability in patients with high BMI (7). These findings underscore the need for meticulous preoperative planning, including the selection of appropriate instrumentation and alternative port placement strategies to optimize surgical efficiency (30-33).

The increased conversion rate to open cholecystectomy observed in this study (10% in obese patients versus 2% in normal-weight individuals) further corroborates findings from earlier research indicating a positive correlation between BMI and conversion risk. Prior studies have suggested that obesity predisposes patients to unclear anatomical landmarks due to excessive intra-abdominal fat and dense adhesions, which may compromise surgical safety and necessitate conversion to an open procedure (8). Similarly, our findings revealed that unclear anatomy due to fat was a primary reason for conversion in 6.3% of obese patients, compared to only 1% of normal-weight individuals, reinforcing the notion that obesity contributes to anatomic distortion and increased surgical difficulty. Although robotic-assisted LC has been proposed as a potential alternative to mitigate these challenges, its widespread application remains limited due to cost constraints and accessibility issues, particularly in resource-limited settings (7).

Postoperative complications were significantly more prevalent in obese patients, with wound infections (10%) and bile leaks (3.8%) occurring at higher rates compared to normal-weight individuals (2% and 1%, respectively). These results are in agreement with previous studies indicating that obesity is an independent risk factor for surgical site infections due to impaired wound healing, increased tension on incisions, and reduced tissue perfusion (9). Furthermore, the prolonged hospital stay observed in obese patients (4.5 ± 1.2 days) compared to normal-weight individuals (3.2 ± 0.8 days) highlights the broader clinical implications of obesity in surgical recovery. Delayed wound healing and increased susceptibility to infections may prolong hospitalization and healthcare costs, further reinforcing the need for targeted perioperative interventions in this patient population (34).

Despite the robust findings of this study, certain limitations must be acknowledged. The retrospective nature of data collection, while allowing for a comprehensive analysis of real-world clinical outcomes,

may introduce inherent selection biases. Additionally, the study was conducted in a single tertiary care center, which may limit the generalizability of results to other healthcare settings with varying patient demographics and surgical expertise. Although the sample size was adequate for statistical comparisons, the relatively small proportion of obese patients (n=80) may limit the power of subgroup analyses. Future studies should aim to validate these findings in multicenter prospective trials with larger and more diverse populations to enhance external validity. Moreover, investigating the role of preoperative weight management strategies, such as dietary modifications and prehabilitation programs, in optimizing surgical outcomes in obese patients undergoing LC could provide valuable insights into reducing perioperative risks.

The findings of this study reinforce the need for a tailored surgical approach in overweight and obese patients undergoing LC. Surgeons must anticipate technical challenges associated with obesity and implement appropriate modifications, including optimized port placement, the use of longer instruments, and alternative patient positioning to improve visualization and accessibility. Additionally, given the higher rates of postoperative complications, enhanced perioperative care strategies, such as prophylactic antibiotic administration, strict glycemic control, and early mobilization protocols, should be emphasized to mitigate adverse outcomes. From a broader perspective, these results highlight the importance of incorporating BMI-based risk stratification into preoperative planning to better inform surgical decision-making and improve patient counseling (32-34).

CONCLUSION

In conclusion, this study provides compelling evidence that obesity significantly complicates laparoscopic cholecystectomy, leading to longer operative times, higher conversion rates, and increased postoperative morbidity. These findings are consistent with prior literature and emphasize the need for strategic intraoperative modifications and enhanced perioperative care to optimize outcomes in this high-risk patient population. Further research exploring advanced surgical techniques, including robotic-assisted approaches and alternative insufflation methods, may offer promising avenues to enhance the safety and efficacy of LC in obese individuals.

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