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COMPARISON OF OPEN APPENDECTOMY VERSUS LAPAROSCOPIC APPENDECTOMY IN OBESE PATIENTS: A RANDOMIZED CONTROLLED TRIAL

Original Research

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ABSTRACT

Background: Acute appendicitis is one of the most common surgical emergencies worldwide and appendectomy remains the standard treatment. The rising prevalence of obesity poses additional challenges for surgeons, as obese patients are at greater risk of wound complications, longer hospital stays, and delayed recovery following abdominal surgery. Laparoscopic appendectomy has gained recognition as a preferred approach due to reduced postoperative morbidity, yet its superiority over open appendectomy in obese patients continues to be debated.

Objective: To compare the outcomes of laparoscopic appendectomy (LA) and open appendectomy (OA) in obese patients with acute appendicitis, with emphasis on operative time, postoperative pain, hospital stay, and wound-related complications.

Methods: This randomized controlled trial was conducted in the Department of Surgery over six months. A total of 112 obese patients (BMI >30 kg/m²) with clinically and radiologically confirmed acute appendicitis were enrolled. Participants were randomly allocated into two equal groups: Group L underwent LA (n=56) and Group O underwent OA (n=56). Outcomes included operative time, postoperative pain at 6 hours and at discharge using the Visual Analogue Scale (VAS), hospital stay in days, and wound-related complications. Statistical analysis was performed using SPSS version 25. Independent sample t-tests and Chi-square tests were applied, with stratification by age, gender, and co-morbidities. A p-value of <0.05 was considered statistically significant.

Results: Patients in Group L experienced significantly less postoperative pain at 6 hours (3.1 ± 1.0 vs. 5.6 ± 1.3, $p<0.001$) and at discharge (1.3 ± 0.8 vs. 3.4 ± 1.0, $p<0.001$) compared with Group O. Mean hospital stay was shorter in the laparoscopic group (1.5 ± 0.6 vs. 2.9 ± 1.1 days, $p<0.001$). Wound complications occurred in 8.9% of Group L compared with 33.9% of Group O ($p<0.001$). The mean operative time was longer for LA (56.3 ± 9.8 vs. 49.1 ± 10.5 minutes, $p=0.001$). Stratified analysis confirmed significance across all subgroups.

Conclusion: Laparoscopic appendectomy demonstrated superior outcomes in obese patients with acute appendicitis, with less pain, fewer wound complications, and shorter hospital stay, making it the preferred surgical approach despite a slightly longer operative time.

Keywords: Acute Appendicitis, Laparoscopic Appendectomy, Obesity, Open Appendectomy, Postoperative Complications, Randomized Controlled Trial, Surgical Outcomes.

INTRODUCTION

Acute appendicitis remains the most frequent abdominal surgical emergency worldwide, affecting approximately 96.5 to 100 individuals per 100,000 annually (1). The classical presentation of periumbilical pain migrating to the right iliac fossa, often accompanied by rebound tenderness, fever, nausea, and vomiting, underpins its diagnosis (2). Appendectomy continues to be one of the most commonly performed surgical procedures, carried out either through open appendectomy (OA) or laparoscopic appendectomy (LA), with the latter increasingly recognized as the preferred modality (3). Numerous studies have reported that LA offers benefits such as reduced postoperative pain, shorter hospital stays, faster recovery, and fewer surgical complications compared with OA, establishing it as the gold standard for managing uncomplicated appendicitis in adults (4). The rising prevalence of obesity poses unique challenges in surgical practice, particularly in appendectomy. Obese patients often face greater risks with open procedures due to thicker abdominal walls, wound-related complications, higher postoperative discomfort, and an increased likelihood of pulmonary issues (5). Conversely, some evidence suggests that in certain abdominal surgeries, obese patients may paradoxically experience better outcomes, highlighting the complex relationship between obesity and surgical risk (6). This raises important questions regarding whether obesity independently predisposes patients to greater complications, especially in the context of laparoscopic surgery (7,8). Laparoscopy potentially mitigates several challenges posed by obesity by providing better access, visualization, and smaller incisions, which may reduce the incidence of wound-related complications (9).

Comparative studies have demonstrated mixed results. One study found that despite a longer operative time, laparoscopic appendectomy was associated with significantly reduced pain scores, shorter hospital stays, and lower rates of wound infections, seromas, and dehiscence compared with open appendectomy (10,11). In contrast, another study reported no significant difference in hospital stay between the two techniques, though laparoscopic appendectomy demonstrated shorter operative times and fewer complications overall (12,13). These conflicting findings underscore the ongoing debate regarding the optimal surgical approach in obese patients. Given the global rise in obesity and the scarcity of local data addressing outcomes of laparoscopic versus open appendectomy in this subgroup, it is crucial to explore this issue in greater depth. Understanding whether laparoscopic appendectomy offers superior outcomes or whether both approaches yield comparable results will directly inform surgical decision-making, improve patient outcomes, and reduce postoperative morbidity. The objective of this study is therefore to compare the outcomes of open versus laparoscopic appendectomy in obese patients, thereby contributing evidence that can guide optimal surgical practice in this increasingly common clinical scenario.

METHODS

The study was conducted as a randomized controlled trial in the Department of Surgery over a duration of six months. A total of 112 obese adult patients, aged between 20 and 80 years and diagnosed clinically and radiologically with acute appendicitis, were included. Obesity was defined as a body mass index (BMI) greater than 30 kg/m². The sample size of 112 participants, with 56 allocated to each group, was calculated using a statistical power of 90%, a significance level of 7%, and expected wound infection rates of 10.3% in the laparoscopic group versus 34.4% in the open appendectomy group. Patients with a BMI less than 30 kg/m², those with previous abdominal surgeries, abdominal tuberculosis, appendicular mass or abscess, bleeding disorders, chronic liver disease, end-stage renal disease, or pregnancy were excluded. Ethical approval for the study was obtained from the Institutional Review Board prior to commencement, and informed written consent was secured from all participants before enrollment. Each patient underwent a thorough demographic and clinical evaluation, including history taking and detailed physical examination. Laboratory investigations such as complete blood count, urine analysis, renal function tests, liver function tests, and random blood sugar levels were performed. Imaging through ultrasound or computed tomography scans was used when required to exclude complicated appendicitis or other differential abdominal pathologies.

Eligible patients were randomized into two groups using the lottery method. Group L underwent laparoscopic appendectomy via the standard three-port technique, while Group O underwent open appendectomy through a McBurney incision. The primary outcomes recorded included operative time, postoperative pain scores at six hours and at the time of discharge, hospital stay, and wound-related complications such as infection, seroma, and dehiscence. Pain was assessed using a numerical rating scale, and wound complications

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were diagnosed clinically during hospital stay and follow-up. Data were analyzed using SPSS version 25. Quantitative variables such as age, BMI, operative time, pain scores, and hospital stay were expressed as mean ± standard deviation and compared between groups using independent-sample t-tests. Qualitative variables such as gender distribution and wound complications were reported as frequencies and percentages and analyzed using the Chi-square test. Effect modifiers including age, gender, and comorbidities were controlled through stratification, and post-stratification statistical tests were applied to ensure validity. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 112 obese patients diagnosed with acute appendicitis were enrolled and equally randomized into two groups, with 56 undergoing laparoscopic appendectomy and 56 undergoing open appendectomy. Baseline demographic and clinical characteristics were comparable between the two groups. The mean BMI was 32.9 ± 2.8 kg/m² in the laparoscopic group and 33.2 ± 3.1 kg/m² in the open group ($p = 0.48$). The mean Alvarado score was 7.7 ± 1.2 in the laparoscopic group compared with 7.6 ± 1.3 in the open group ($p = 0.68$). Gender distribution was also similar, with 55.4% males and 44.6% females in the laparoscopic group compared with 50% males and 50% females in the open group ($p = 0.57$). The prevalence of diabetes mellitus was 23.2% and 26.8% in the laparoscopic and open groups respectively ($p = 0.66$), while hypertension was observed in 21.4% and 25% of patients respectively ($p = 0.65$). Surgical outcomes demonstrated significant differences between the two approaches. The mean operative time was longer in the laparoscopic group (56.3 ± 9.8 minutes) compared with the open group (49.1 ± 10.5 minutes, $p = 0.001$). However, postoperative pain was significantly reduced in the laparoscopic group. The mean pain score at 6 hours was 3.1 ± 1.0 in the laparoscopic group versus 5.6 ± 1.3 in the open group ($p < 0.001$), while at discharge, pain scores were 1.3 ± 0.8 and 3.4 ± 1.0 respectively ($p < 0.001$). Hospital stay was significantly shorter following laparoscopic appendectomy, with a mean duration of 1.5 ± 0.6 days compared to 2.9 ± 1.1 days in the open group ($p < 0.001$). Wound complications occurred in 8.9% of patients in the laparoscopic group compared with 33.9% in the open group ($p < 0.001$).

Stratified analysis for age, gender, and comorbidities confirmed that significant differences in wound complications and hospital stay between the two surgical approaches remained consistent across subgroups ($p < 0.05$). These findings support that laparoscopic appendectomy, despite requiring a slightly longer operative time, was associated with less pain, shorter hospitalization, and fewer wound-related complications in obese patients when compared to open appendectomy. When outcomes were further examined in relation to comorbid conditions, consistent trends were observed. Among diabetic patients, laparoscopic appendectomy was associated with fewer wound complications (15.4%) compared with open appendectomy (40.0%), along with a shorter hospital stay (1.8 ± 0.5 vs. 3.2 ± 1.0 days). Similarly, in hypertensive patients, wound complications were lower in the laparoscopic group (16.7%) compared with the open group (42.9%), and mean hospital stay remained shorter (1.7 ± 0.6 vs. 3.1 ± 1.1 days). Pain scores at 6 hours and at discharge followed the same overall trend in both diabetic and hypertensive subgroups, with significantly lower scores in the laparoscopic group. These findings indicate that the advantages of laparoscopic appendectomy over open appendectomy persisted even in higher-risk subgroups with comorbidities. However, postoperative outcomes beyond discharge, such as time to return to daily activities or long-term complications, were not assessed, limiting the broader evaluation of recovery profiles between the two techniques.

Table 1: Demographic and Clinical Characteristics (n=112)

Variable	Group L (n=56)	Group O (n=56)	p-value
Gender			0.57
Male	31 (55.4%)	28 (50%)	
Female	25 (44.6%)	28 (50%)	
BMI (kg/m²), Mean ± SD	32.9 ± 2.8	33.2 ± 3.1	0.48
Alvarado Score, Mean ± SD	7.7 ± 1.2	7.6 ± 1.3	0.68
Diabetes Mellitus (%)	13 (23.2%)	15 (26.8%)	0.66
Hypertension (%)	12 (21.4%)	14 (25%)	0.65

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Table 2: Surgical Outcomes and Postoperative Complications

Outcome Variables	Group L (n=56)	Group O (n=56)	p-value
Operative Time (min), Mean ± SD	56.3 ± 9.8	49.1 ± 10.5	0.001
Pain Score at 6 hrs (VAS)	3.1 ± 1.0	5.6 ± 1.3	<0.001
Pain Score at Discharge (VAS)	1.3 ± 0.8	3.4 ± 1.0	<0.001
Hospital Stay (days), Mean ± SD	1.5 ± 0.6	2.9 ± 1.1	<0.001
Wound Complications (n, %)	5 (8.9%)	19 (33.9%)	<0.001

Table 3: Subgroup Outcomes by Comorbidities

Variable	Group L (n=56)	Group O (n=56)	p-value
Diabetic Patients			
Wound Complications, n (%)	2 (15.4%)	6 (40.0%)	0.04
Hospital Stay (days), Mean ± SD	1.8 ± 0.5	3.2 ± 1.0	<0.01
Pain Score at 6 hrs (VAS), Mean ± SD	3.4 ± 0.9	5.7 ± 1.2	<0.001
Pain Score at Discharge (VAS), Mean ± SD	1.5 ± 0.6	3.5 ± 1.0	<0.001
Hypertensive Patients			
Wound Complications, n (%)	2 (16.7%)	6 (42.9%)	0.05
Hospital Stay (days), Mean ± SD	1.7 ± 0.6	3.1 ± 1.1	<0.01
Pain Score at 6 hrs (VAS), Mean ± SD	3.2 ± 1.0	5.6 ± 1.3	<0.001
Pain Score at Discharge (VAS), Mean ± SD	1.4 ± 0.7	3.3 ± 0.9	<0.001

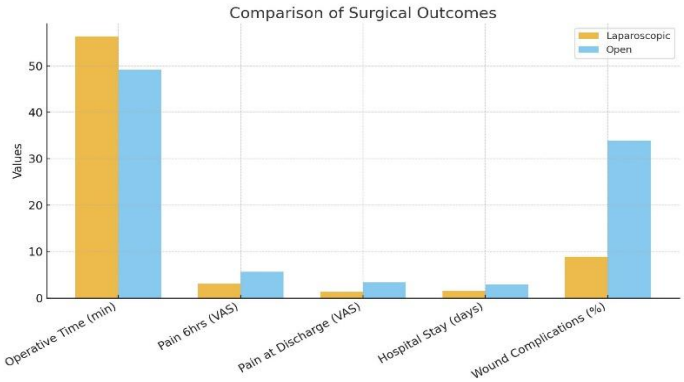

Figure 2 Comparison of Surgical Outcomes

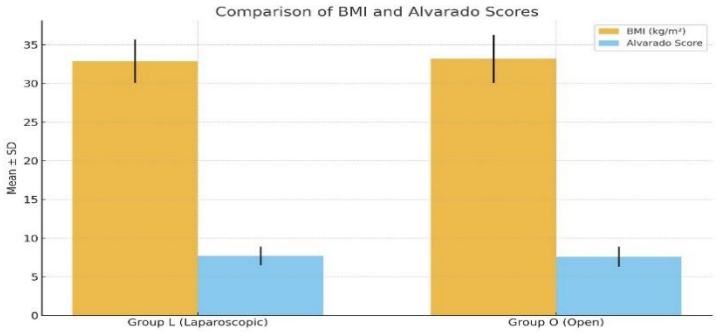

Figure 2 Comparison of BMI and Alvarado Scores

DISCUSSION

The present study demonstrated that laparoscopic appendectomy in obese patients resulted in significantly reduced postoperative pain, shorter hospital stay, and fewer wound-related complications compared with the open approach, although operative time was longer in

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the laparoscopic group. These findings are consistent with earlier reports indicating that laparoscopic appendectomy offers superior short-term outcomes and reduced morbidity in obese individuals undergoing surgery for acute appendicitis (14). The persistence of these benefits across subgroups, even after stratification for age, gender, and co-morbidities such as diabetes mellitus and hypertension, highlights the reliability of the results and reinforces the role of laparoscopy as a safer alternative in this high-risk population. Previous research has consistently emphasized the advantages of laparoscopic appendectomy in terms of improved perioperative and postoperative outcomes. One study described reduced hospital stay, earlier initiation of oral intake, and decreased analgesic requirements in the laparoscopic group, with comparable complication rates to the open approach (15,16). Another investigation concluded that, among obese patients, laparoscopy was superior with respect to complications, operative time, and perioperative safety, though the length of hospital stay was similar across both approaches (17). A pooled analysis further corroborated that laparoscopic appendectomy is associated with shorter hospital stay and complication rates comparable to open appendectomy (18). The present findings add to this body of evidence by specifically analyzing obese patients in a local setting where limited data are available. The clinical implications of these results are important. Obese patients represent a growing proportion of surgical candidates worldwide, and the selection of a surgical approach directly influences recovery and complication risk. The reduced wound-related morbidity observed with laparoscopy is of particular significance, as wound infection, seroma, and dehiscence remain common challenges in obese patients undergoing abdominal surgery (19-21). The shorter hospital stay also offers advantages in terms of resource utilization and patient satisfaction. Despite a modestly increased operative time, the overall balance of benefits favors the laparoscopic technique, especially in the context of enhanced recovery protocols.

This study had several strengths, including its randomized design, adequate sample size, and subgroup analyses stratified by effect modifiers, which improved the robustness of the findings. The use of standardized outcome measures and objective statistical comparisons further strengthened the reliability of the results. However, certain limitations must be acknowledged. The follow-up was limited to the immediate postoperative period, and long-term outcomes such as return to normal activities, chronic pain, or incisional hernia formation were not assessed. The exclusion of patients with complicated appendicitis, previous abdominal surgeries, or multiple comorbidities, while necessary for uniformity, reduced the generalizability of the findings to all obese patients presenting with appendicitis. Additionally, the study was conducted in a single center, which may limit external validity. Future studies should incorporate multicenter designs with larger sample sizes to improve generalizability. Extended follow-up is required to evaluate long-term recovery, quality of life, and late complications such as adhesions or incisional hernias. Cost-effectiveness analysis and patient-reported outcome measures may also provide further insight into the broader advantages of laparoscopic appendectomy in obese patients. In summary, the findings of this study support laparoscopic appendectomy as the preferred surgical approach for obese patients with acute appendicitis, offering clear benefits in terms of reduced morbidity and faster recovery, despite a slightly longer operative time. These results align with global evidence and emphasize the role of laparoscopy in improving surgical outcomes in an increasingly obese patient population.

CONCLUSION

Laparoscopic appendectomy emerged as a more favorable surgical option for obese patients with acute appendicitis, demonstrating clear benefits in terms of reduced postoperative pain, shorter hospital stay, and fewer wound-related complications when compared with the open technique. Despite requiring slightly longer operative time, its overall clinical advantages establish it as the preferred approach in this high-risk group. These findings underscore the importance of adopting laparoscopic surgery as the standard of care for obese individuals, offering improved recovery, lower morbidity, and better patient outcomes in routine surgical practice.

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AUTHOR CONTRIBUTION

Author	Contribution
Muzammil Ramzan*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Muttahhar Asim	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Shahid Mehmood Khan	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Osama Iqbal	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Muhammad Bilal Sikandar Nagra	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Syed Aliraza Nasir	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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