RESEARCH PAPER

Outcomes of Laparoscopic Versus Open Appendectomy in Complicated Appendicitis

Dipak Chaulagain [1], Bashir Ullah[2], Kamal Mustafa[3], Syed Asjad Ur Rehman Omer[4], Sidra Abbas[5], Abduraimov Zafarjon[6], Jo'rayev Umarxon Ulug'bek o'g'li[7], Muhammad Siddique khan[8]

[1]Associate Professor Jalal-Abad International University, Manas , Kyrgyzstan
[2]Senior registrar Department of General surgery saidu teaching hospital Saidu sharif swat
[3]Department of general surgery Nishtar hospital multan
[4]Post Graduate Resident Department of General Surgery/ West Surgery Mayo Hospital Lahore
[5]Associate Professor Department of surgery Baqai Medical university Karachi
[6]Department of Human Anatomy Samarkand State Medical University
[7]Assistant Department of Therapeutic sciences Ferg'ona Jamoat Salomatligi Tibbiyot Instituti Uzbekistan
[8]Assistant Professor Department of Surgery Khyber Teaching Hospital Peshawar
siddique.khan@kmc.edu.pk

Corresponding Author
Muhammad Siddique khan
Assistant Professor Department of Surgery Khyber Teaching Hospital Peshawar
siddique.khan@kmc.edu.pk

ABSTRACT
Background: Complicated appendicitis is associated with increased morbidity and postoperative complications. The optimal surgical approach between laparoscopic and open appendectomy remains an area of ongoing debate. Objective: To compare the outcomes of laparoscopic versus open appendectomy in patients with complicated appendicitis. Methods: This cross-sectional analytical study was conducted at Department of General surgery saidu teaching hospital Saidu sharif swat from march 2025 to march 2026 including 180 patients diagnosed with complicated appendicitis. Patients were divided equally into laparoscopic appendectomy (n=90) and open appendectomy (n=90) groups. Results: The mean age was 34.7 ± 11.2 years in the laparoscopic group and 36.1 ± 10.8 years in the open group. Operative time was longer in laparoscopic appendectomy (78.4 ± 18.5 vs. 69.7 ± 16.9 minutes; p=0.002). However, laparoscopic surgery resulted in shorter hospital stay (3.9 ± 1.4 vs. 5.8 ± 2.1 days; p<0.001), earlier oral intake (18.6 ± 6.3 vs. 27.4 ± 8.1 hours; p<0.001), and lower postoperative pain scores (3.8 ± 1.2 vs. 5.9 ± 1.5; p<0.001). Surgical site infection was significantly lower in the laparoscopic group (10.0% vs. 24.4%; p=0.01). Open appendectomy independently predicted postoperative complications (aOR 2.74; p=0.005). Conclusion: Laparoscopic appendectomy provides better postoperative recovery and lower complication rates than open appendectomy in patients with complicated appendicitis despite a slightly longer operative time

Keywords Complicated appendicitis; Laparoscopic appendectomy; Open appendectomy; Postoperative complications; Surgical outcomes
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INTRODUCTION

Acute appendicitis is a frequent surgical emergency worldwide and appendectomy is the main treatment for uncomplicated and complicated appendicitis [1]. Perforated, gangrenous, appendicular abscess and generalized peritonitis are the types of complicated appendicitis and when compared to uncomplicated appendicitis, are associated with higher morbidity, longer hospital stay and increased postoperative complications [3]. Early diagnosis and prompt surgical treatment are crucial to minimize complications. Open appendectomy is the surgical method of choice for complicated appendicitis because of the concerns about intra-abdominal contamination and difficulty of minimally invasive surgery [5]. Open surgery offers direct visualization and facilitates easier handling of severe inflammation or perforation; however, there are larger incisions, more postoperative pain, wound infections, and possibly delayed recovery [7]. In recent decades, laparoscopic surgery has become more common due to improvements in surgical techniques and instrumentation in the field of laparoscopy. Laparoscopic surgery has many benefits: small incisions, less pain after

*Author for Correspondence: siddique.khan@kmc.edu.pk

surgery, quicker recovery, quicker discharge and better cosmetic results [9]. Laparoscopy also provides improved visualization of the abdominal cavity, and enhanced peritoneal lavage for perforation and abscesses [11].

Despite these advantages, laparoscopic appendectomy in complicated appendicitis is still a topic of debate. Laparoscopy is thought to be associated with an increased risk of development of an intraabdominal abscess because of the pneumoperitoneum and spread of infection [13]. Some also state that MIS causes less wound morbidity and that recovery is quicker without it substantially affecting the morbidity [15]. As a result, laparoscopic and open appendectomy are sometimes interchangeable depending on the surgeons' experience, the patient's condition and the resources available in the institution. Some studies have looked at the laparoscopic and open appendectomy in complicated appendicitis and have reported varying results for operating time, postoperative complications, hospital stay, and recovery [17]. Previous studies have shown that laparoscopic surgery has fewer wound infections and less hospital stay time compared to laparotomy, and other studies revealed that there was no difference in the overall complication rates.

Objective

To compare the outcomes of laparoscopic versus open appendectomy in patients with complicated appendicitis.

Methodology

This was a cross-sectional analytical study conducted at Department of General surgery saidu teaching hospital Saidu sharif swat from march 2025 to march 2026, including 180 patients diagnosed with complicated appendicitis to compare the outcomes of laparoscopic versus open appendectomy. Patients were divided into two groups based on the surgical technique performed. The laparoscopic appendectomy group included 90 patients, while the open appendectomy group included 90 patients. Patients were followed during hospitalization and postoperative recovery to evaluate operative and clinical outcomes.

Inclusion Criteria

Patients aged ≥18 years diagnosed with complicated appendicitis

Patients with perforated, gangrenous, or abscess-associated appendicitis confirmed intraoperatively

Patients undergoing either laparoscopic or open appendectomy

Patients willing to participate and provide informed consent

Exclusion Criteria

Patients with uncomplicated appendicitis

Patients with previous major abdominal surgery

Pregnant females

Patients with severe cardiopulmonary instability unfit for surgery

Patients with incomplete medical records or follow-up data

Data Collection

After obtaining ethical approval, data were collected using a structured proforma. Baseline demographic and clinical variables included age, gender, duration of symptoms, comorbidities, white blood cell count, and imaging findings. Operative details such as operative time, intraoperative findings, need for drain placement, and conversion from laparoscopic to open surgery were recorded. Postoperative outcomes included pain score, duration of hospital stay, time to oral intake, wound infection, intra-abdominal abscess formation, postoperative ileus, and overall recovery. Mortality and readmission rates were also assessed during follow-up.

Statistical Analysis

Data were analyzed using SPSS version 26.0. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequency and percentage. Independent t-tests and chi-square tests were used to compare outcomes between laparoscopic and open appendectomy groups. Logistic regression analysis was performed to identify factors associated with postoperative complications. A p-value ≤0.05 was considered statistically significant.

Results

The baseline demographic and clinical characteristics were comparable between both groups. The mean age was 34.7 ± 11.2 years in the laparoscopic group and 36.1 ± 10.8 years in the open appendectomy group (p=0.39). Male patients predominated in both groups, accounting for 56 (62.2%) and 59 (65.6%) cases, respectively. Duration of symptoms and WBC counts were also similar between groups. Perforated appendicitis was present in 52 (57.8%) laparoscopic cases and 49 (54.4%) open cases, while diabetes mellitus was observed in 18 (20.0%) and 21 (23.3%) patients, respectively, showing no significant baseline differences.

Table 1: Baseline Demographic and Clinical Characteristics of Patients (n = 180)

Variable	Laparoscopic Appendectomy (n=90)	Open Appendectomy (n=90)	p-value
Age (years), mean ± SD	34.7 ± 11.2	36.1 ± 10.8	0.39
Male Gender, n (%)	56 (62.2%)	59 (65.6%)	0.64
Duration of Symptoms (hours), mean ± SD	39.5 ± 12.6	41.3 ± 13.4	0.35
WBC Count ($\times 10^9$/L), mean ± SD	14.8 ± 3.6	15.2 ± 3.9	0.48
Perforated Appendicitis, n (%)	52 (57.8%)	49 (54.4%)	0.65
Diabetes Mellitus, n (%)	18 (20.0%)	21 (23.3%)	0.59

Mean operative duration was higher in the laparoscopic group (78.4 ± 18.5 minutes) compared with the open group (69.7 ± 16.9 minutes; p=0.002). However, laparoscopic patients had shorter hospital stay (3.9 ± 1.4 vs. 5.8 ± 2.1

days; p<0.001), earlier oral intake (18.6 ± 6.3 vs. 27.4 ± 8.1 hours; p<0.001), and lower postoperative pain scores (3.8 ± 1.2 vs. 5.9 ± 1.5; p<0.001). Drain placement was also less frequent in laparoscopic surgery (31.1% vs. 45.6%; p=0.04).

Table 2: Operative and Postoperative Outcomes Between Groups (n = 180)

Variable	Laparoscopic Appendectomy (n=90)	Open Appendectomy (n=90)	p-value
Operative Time (minutes), mean ± SD	78.4 ± 18.5	69.7 ± 16.9	0.002
Hospital Stay (days), mean ± SD	3.9 ± 1.4	5.8 ± 2.1	<0.001
Time to Oral Intake (hours), mean ± SD	18.6 ± 6.3	27.4 ± 8.1	<0.001
Postoperative Pain Score, mean ± SD	3.8 ± 1.2	5.9 ± 1.5	<0.001
Drain Placement Required, n (%)	28 (31.1%)	41 (45.6%)	0.04

Surgical site infection occurred in 9 (10.0%) laparoscopic cases compared with 22 (24.4%) open cases (p=0.01). Postoperative ileus was also less frequent after laparoscopic surgery, affecting 8 (8.9%) patients versus 17 (18.9%) in the open group (p=0.05).

Table 3: Postoperative Complications in Both Groups (n = 180)

Complication	Laparoscopic Appendectomy (n=90)	Open Appendectomy (n=90)	p-value
Surgical Site Infection, n (%)	9 (10.0%)	22 (24.4%)	0.01
Intra-Abdominal Abscess, n (%)	7 (7.8%)	5 (5.6%)	0.55
Postoperative Ileus, n (%)	8 (8.9%)	17 (18.9%)	0.05
Readmission, n (%)	4 (4.4%)	9 (10.0%)	0.15
Mortality, n (%)	1 (1.1%)	2 (2.2%)	0.56

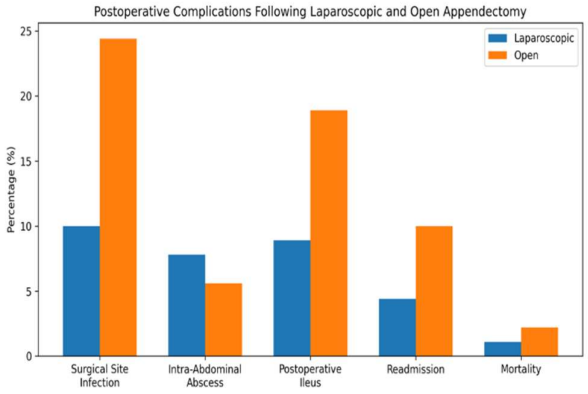

Figure 1: Comparison of Postoperative Complications Between Laparoscopic and Open Appendectomy Groups in Patients With Complicated Appendicitis

Logistic regression analysis identified open appendectomy as a significant predictor of postoperative complications, with an adjusted OR of 2.74 (95% CI: 1.34–5.61; p=0.005). Other significant predictors included perforated appendicitis (aOR 2.89; p=0.003), hospital stay >5 days (aOR 3.11; p=0.002), diabetes mellitus (aOR 2.21; p=0.03), and operative time >80 minutes (aOR 1.96; p=0.04). **Table 4: Logistic Regression Analysis for Predictors of Postoperative Complications (n = 180)**

Variable	Adjusted OR (95% CI)	p-value
Open Appendectomy	2.74 (1.34–5.61)	0.005
Diabetes Mellitus	2.21 (1.07–4.54)	0.03
Operative Time >80 minutes	1.96 (1.01–3.82)	0.04
Perforated Appendicitis	2.89 (1.42–5.88)	0.003
Hospital Stay >5 days	3.11 (1.51–6.39)	0.002

Discussion

This study showed that there were no differences in outcome between laparoscopic and open appendectomy for complicated appendicitis, but that laparoscopic appendectomy led to faster postoperative recovery and a reduced incidence of complications despite a longer operating time. The results corroborate the trend towards the use of less invasive surgical treatment for complicated appendicitis [18]. There were no statistically significant differences between the two groups with regard to gender distribution, age, duration of symptoms, count of leukocytes, or diabetes mellitus or perforated appendicitis. This similarity suggests that differences in outcome after surgery were not due to differences among patients, but were due to the surgery itself. Another study had similar baseline factors in the laparoscopic and open appendectomy groups allowing reliable comparison of surgical outcomes

[19]. Laparoscopic appendectomy group had significantly longer operative time (78.4 ± 18.5 minutes) than open group (69.7 ± 16.9 minutes, p=0.002). This longer duration may be due to the technical difficulty of laparoscopic surgery in complicated appendicitis particularly in cases of dense adhesions, perforation or the presence of an abscess. Despite the longer operating time, however, laparoscopic surgery led to reduced hospital stay, earlier oral feeding, and less postoperative pain. One study also showed that laparoscopic appendectomy took longer time for surgery, but resulted in faster postoperative recovery and less postoperative pain [20]. The laparoscopic group (3.9 ± 1.4 days) had significantly shorter hospital stay than the open group (5.8 ± 2.1 days; p<0.001). Minimally invasive surgery may have been a factor in the shorter hospital stay, as may have been early recovery and mobilization after surgery. The early return to oral feed in laparoscopy patients further indicates the fast restoration of bowel function and the diminished surgical stress response. Another study reported significantly reduced hospitalisation and hospital stay for patients who had laparoscopy for complicated appendicitis [21].

Smaller incisions and a decrease in tissue trauma probably accounted for the significantly lower postoperative pain scores in the laparoscopic group (3.8 ± 1.2 vs. 5.9 ± 1.5; p<0.001). Reduced pain can enhance patient satisfaction, aid in early ambulation and reduce need for analgesics. A prior study showed that laparoscopic surgery had significantly less postoperative pain and better functional recovery [22]. Surgical site infection was significantly less in the laparoscopic group (10.0% vs. 24.4%; p=0.01) in regard to postoperative complications. Laparoscopy involves smaller incisions, and minimises wound exposure, which may have a lower risk of contamination of the wound. There was also a reduced risk of postoperative ileus with laparoscopic surgery. The odds of intra-abdominal abscess formation was slightly higher in the laparoscopic group but was not statistically significant. In another study, the wounds of patients undergoing laparoscopic appendectomy were shown to be less likely to become infected, while the rates of intra-abdominal abscess were found to be similar between the two procedures. Open appendectomy was the only independent predictor of postoperative complications, as identified by the regression analysis, with aOR of 2.74 (p=0.005).

Limitations

This study has several limitations. Being a single-center cross-sectional study, the findings may not be generalizable to all healthcare settings. The sample size was relatively limited, which may affect the strength of subgroup analyses and rare postoperative outcomes. Variations in surgeon expertise, operative technique, and perioperative management were not fully controlled and could have influenced surgical outcomes. Additionally, the follow-up period was relatively short, limiting assessment of long-term complications and recovery. Selection bias may also have been present due to non-random allocation of patients to laparoscopic or open appendectomy groups.

Conclusion

It is concluded that laparoscopic appendectomy is a safe and effective surgical approach for complicated appendicitis and is associated with better postoperative recovery compared to open appendectomy. Although laparoscopic surgery required a longer operative time, it resulted in shorter hospital stay, earlier oral intake, lower postoperative pain scores, and fewer surgical site infections. Open appendectomy, perforated appendicitis, diabetes mellitus, prolonged operative time, and extended hospital stay were significant predictors of postoperative complications. Therefore, laparoscopic appendectomy may be considered the preferred approach in appropriately selected patients with complicated appendicitis when surgical expertise and facilities are available..

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