

Long-Term Outcomes and Complications in Laparoscopic Versus Open Appendectomy in Complicated Appendicitis: A Prospective Study

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Received: 01-01-2026 / Revised: 15-02-2026 / Accepted: 21-03-2026

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Conflict of interest: Nil

Abstract

Background: Complicated appendicitis is associated with higher morbidity, and the optimal surgical approach remains debated. This study compared long-term outcomes and complication profiles of laparoscopic versus open appendectomy in adult patients.**Methods:** In this prospective study, 180 patients aged 18–60 years with complicated appendicitis were included. Group A underwent laparoscopic appendectomy (n = 86) and Group B underwent open appendectomy (n = 94). Perioperative variables, postoperative recovery, early complications, and long-term outcomes over 12 months were analyzed. Multivariate logistic regression identified independent predictors of complications.**Results:** Laparoscopic appendectomy had a longer operative time (68.4 ± 14.6 min vs. 54.2 ± 12.1 min; $p < 0.001$) but shorter hospital stay (3.6 ± 1.3 vs. 5.2 ± 1.9 days; $p < 0.001$), lower pain scores (VAS 3.2 ± 0.9 vs. 5.4 ± 1.1 ; $p < 0.001$), and faster return to normal activities (9.1 ± 2.4 vs. 14.3 ± 3.6 days; $p < 0.001$) compared with open surgery. Early postoperative complications were lower in the laparoscopic group (overall 16.3% vs. 45.7%; $p < 0.001$), including surgical site infection (4.7% vs. 19.1%; $p = 0.003$) and postoperative ileus (3.5% vs. 11.7%; $p = 0.04$). Long-term complications at 12 months, including incisional hernia (1.2% vs. 7.4%; $p = 0.04$) and chronic abdominal pain (3.5% vs. 11.7%; $p = 0.03$), were also significantly lower in the laparoscopic group. Logistic regression identified open appendectomy as an independent predictor of overall complications (AOR 4.12; 95% CI 2.08–8.15; $p < 0.001$).**Conclusion:** Laparoscopic appendectomy provided superior short- and long-term outcomes in complicated appendicitis, with reduced morbidity and faster recovery, supporting its use as the preferred surgical approach when expertise is available.**Keywords:** Complicated appendicitis, Laparoscopic appendectomy, Open appendectomy, Postoperative complications, and Long-term outcomes.**DOI:** 10.25258/ijcpr.18.4.119

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Introduction

Acute appendicitis is the most frequent cause of emergency abdominal surgery across all age groups, with an estimated lifetime risk of 7–8% [1]. Despite advances in diagnostic modalities such as ultrasonography and computed tomography, appendicitis continues to pose a significant clinical challenge, particularly when diagnosis is delayed.

Delayed presentation increases the likelihood of disease progression to complicated appendicitis, which accounts for approximately 20–30% of all appendicitis cases [2,3]. Complicated appendicitis is defined by the presence of appendiceal perforation, gangrene, peri-appendiceal abscess, phlegmon, or diffuse peritonitis, and is associated

with substantially higher morbidity and mortality rates [4]. The pathophysiology of complicated appendicitis involves luminal obstruction, ischemia, bacterial overgrowth, and subsequent transmural necrosis leading to perforation. These changes predispose patients to intra-abdominal contamination, systemic inflammatory response, and postoperative septic complications [5]. Consequently, patients with complicated appendicitis experience longer hospital stays, increased antibiotic requirements, and higher rates of postoperative complications compared with those with uncomplicated disease [6].

Open appendectomy (OA), popularized by McBurney in 1894, remained the gold standard surgical treatment for more than a century [7]. While effective, open surgery is associated with larger incisions, increased postoperative pain, higher wound infection rates, and a greater likelihood of long-term complications such as incisional hernia and adhesive small bowel obstruction [8]. The advent of laparoscopic appendectomy (LA), first described by Semm in 1983, marked a paradigm shift toward minimally invasive management of appendicitis [9].

Over the past three decades, laparoscopic appendectomy has become the preferred approach for uncomplicated appendicitis due to its well-documented advantages, including reduced postoperative pain, improved cosmetic outcomes, shorter length of hospital stay, and earlier return to normal activities [10–12]. Large randomized controlled trials and meta-analyses have consistently shown that laparoscopic appendectomy results in significantly lower surgical site infection rates, reported between 3–7%, compared with 10–20% following open appendectomy [13,14].

Despite these benefits, the application of laparoscopic techniques in complicated appendicitis has historically been controversial. Early studies reported longer operative times and a potentially increased risk of postoperative intra-abdominal abscess formation following laparoscopy, with abscess rates reported as high as 20% in some series [15,16]. These concerns were attributed to pneumoperitoneum-related bacterial dissemination, inadequate peritoneal lavage, and technical difficulties encountered in severely inflamed or distorted anatomy [17].

However, advances in laparoscopic instrumentation, improved surgeon experience, better peri-operative antibiotic protocols, and refined operative techniques have significantly altered outcomes in recent years. Contemporary studies increasingly demonstrate that laparoscopic appendectomy is not only feasible but also advantageous in complicated appendicitis [18]. A comprehensive meta-analysis which included over 6,000 patients, showed a significant reduction in wound infection rates with laparoscopic appendectomy (odds ratio 0.34; $p < 0.001$) and no statistically significant increase in intra-abdominal abscess formation when compared to open surgery [19]. Similarly, national database studies have reported lower rates of postoperative sepsis, reduced need for intensive care, and shorter hospital stays following laparoscopic management of perforated appendicitis [20].

Age and sex have also been identified as important factors influencing outcomes in appendicitis. Older patients and males tend to present with more advanced disease and have higher complication

rates [21]. Nevertheless, multiple studies have demonstrated that the benefits of laparoscopic appendectomy extend across different age groups and both sexes, including elderly patients, in whom reduced surgical trauma is particularly advantageous [22,23].

Long-term outcomes following appendectomy have gained increasing attention in recent years. While early postoperative complications are important, late sequelae such as incisional hernia, chronic abdominal pain, adhesive small bowel obstruction, and reduced quality of life significantly affect patient outcomes and healthcare utilization [24]. Long-term follow-up studies indicate that laparoscopic appendectomy is associated with a markedly lower incidence of incisional hernia (0.5–2%) compared with open appendectomy (4–10%) [25]. Additionally, the risk of adhesive small bowel obstruction is significantly reduced following laparoscopic surgery, reported at <1%, compared to 3–8% after open appendectomy [26,27].

Current international guidelines increasingly support the use of laparoscopic appendectomy in complicated appendicitis when surgical expertise and resources are available [28]. Nevertheless, many existing studies are retrospective, lack standardized definitions of complicated appendicitis, or have limited long-term follow-up. Prospective comparative data evaluating long-term outcomes across different age groups and both sexes remain scarce, particularly in developing healthcare settings.

Therefore, the present prospective study was designed to evaluate and compare the long-term outcomes and complication profiles of laparoscopic versus open appendectomy in adult patients with complicated appendicitis, using a well-defined cohort of 180 patients stratified by age and sex. This study aims to contribute robust evidence to guide surgical decision-making and optimize patient outcomes in complicated appendicitis.

Aim and Objectives

Aim: Compare the long-term outcomes and complications of laparoscopic versus open appendectomy in adult patients with complicated appendicitis.

Objectives:

1. Compared peri-operative outcomes and recovery between the two approaches.
2. Evaluated early (≤ 30 days) and long-term (12 months) post-operative complications.
3. Identified independent predictors of complications using logistic regression.

Materials and Methods

Materials:

Study Site: This study was conducted at Department Of General Surgery, Dr. Kns Memorial Institute of Medical Sciences, Gadia, Barabanki, Up, India, between January 2024 to November 2025. The study was approved by the Institutional Human Ethics Committee, and written informed consent was also obtained from all participants.

Study Design: This was prospective comparative, randomized study.

Study Subjects: A total of 180 adult patients of rural Barabanki District, UP, (aged 18–60 years) with complicated appendicitis were included. Complicated appendicitis was defined as appendicitis with perforation, gangrene, or appendicular abscess diagnosed clinically and confirmed intra-operatively.

Study Group: Patients were randomly allocated into two groups based on the surgical approach:

- Group A (LAP): Laparoscopic appendectomy (n = 86)
- Group B (Open): Open appendectomy (n = 94)

Both sexes and all adult age groups (18–30, 31–40, 41–50, and 51–60 years) were included.

Inclusion Criteria:

- Age 18–60 years
- Clinical and intra-operative diagnosis of complicated appendicitis
- Willingness to participate and provided written consent form.

Exclusion Criteria:

- Uncomplicated appendicitis
- Pregnancy
- Known bleeding disorders or severe comorbidity precluding surgery
- Previous major abdominal surgery

Methods:

Surgical Procedure: Laparoscopic Appendectomy (LAP): Performed using standard 3-port technique. Peritoneal lavage and removal of appendix were carried out with careful handling of inflamed tissues.

Open Appendectomy (OA): Performed via standard McBurney or Lanz incision. Thorough lavage and removal of the appendix were performed. All surgeries were performed by experienced surgeons

with expertise in both laparoscopic and open appendectomy.

Outcome Measures: Perioperative outcomes: Operative time, intraoperative blood loss, and complications.

Postoperative recovery: Time to oral intake, duration of hospital stay, postoperative pain (VAS score), and return to normal activity.

Early postoperative complications (≤ 30 days): Surgical site infection, intra-abdominal abscess, ileus, sepsis.

Long-term complications (up to 12 months): Incisional hernia, adhesive bowel obstruction, chronic abdominal pain, readmission rates.

Follow-up: Patients were followed prospectively during hospitalization and at outpatient visits at 1, 3, 6, and 12 months postoperatively.

Statistical Analysis: Data were analyzed using SPSS version-26.3. Continuous variables were expressed as mean \pm SD and compared using Student's t-test. Categorical variables were expressed as frequencies and percentages and compared using Chi-square or Fisher's exact test. Multivariate logistic regression was used to identify independent predictors of overall and long-term complications. A p-value < 0.05 was considered statistically significant.

Results

A total of 180 adult patients of rural Barabanki District, UP, (aged 18–60 years, both sexes) with complicated appendicitis were included in this study. This prospective study compared laparoscopic and open appendectomy in adult patients and demonstrated significant differences in peri-operative outcomes, postoperative recovery, complication rates, and long-term morbidity between the two surgical approaches.

Baseline demographic characteristics, including age distribution, sex ratio, and severity of disease (perforation, abscess, and gangrenous appendix), were comparable between the laparoscopic and open appendectomy groups, indicating appropriate group matching and minimizing selection bias. Details are delineated below tables and figures.

Table 1: Baseline Demographic Characteristics of Study Subjects

| Variable | Group A – LAP (n = 86) | Group B – Open (n = 94) | P value |
|---------------------------|------------------------|-------------------------|---------|
| Mean age (years \pm SD) | 38.1 \pm 11.2 | 39.4 \pm 10.8 | 0.52 |
| Male, n (%) | 52 (60.5) | 58 (61.7) | 0.87 |
| Female, n (%) | 34 (39.5) | 36 (38.3) | |
| Age 18–30 yrs | 26 (30.2) | 28 (29.8) | |
| Age 31–40 yrs | 22 (25.6) | 25 (26.6) | |
| Age 41–50 yrs | 21 (24.4) | 23 (24.5) | |
| Age 51–60 yrs | 17 (19.8) | 18 (19.1) | |

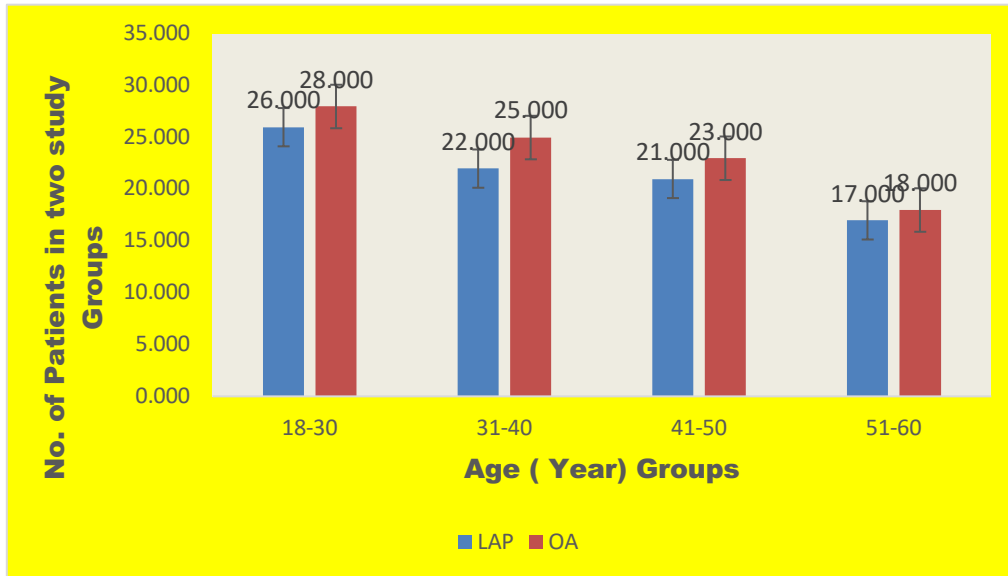


Figure 1: Age wise distribution of study subjects in two groups

This demographic equivalence strengthens the validity of the observed outcome differences.

Table 2: Intraoperative Characteristics

| Parameter | LAP (n = 86) | Open (n = 94) | P value |
|-------------------------------|--------------|---------------|---------|
| Mean operative time (minutes) | 68.4 ± 14.6 | 54.2 ± 12.1 | <0.001 |
| Perforated appendix, n (%) | 48 (55.8) | 51 (54.3) | 0.84 |
| Appendicular abscess, n (%) | 23 (26.7) | 28 (29.8) | 0.64 |
| Gangrenous appendix, n (%) | 15 (17.5) | 15 (15.9) | 0.77 |

*Operative time was significantly longer in the laparoscopic group, while disease severity was similar.

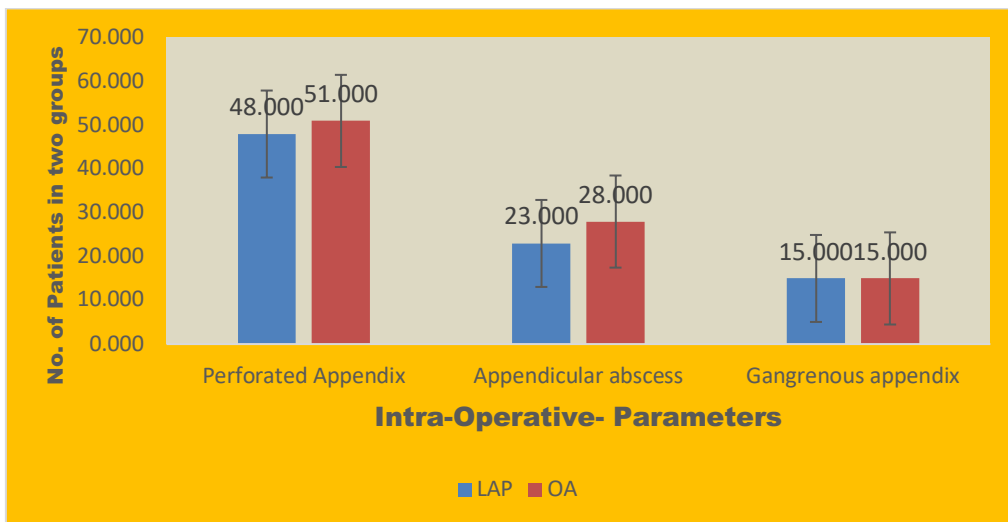


Figure 2: Intraoperative Characteristics

Intra-operatively, laparoscopic appendectomy was associated with a significantly longer operative time compared with open appendectomy. However, this increase in operative duration did not translate into worse postoperative outcomes. On the contrary, patients undergoing laparoscopic surgery demonstrated markedly improved postoperative

recovery profiles. Hospital stay, postoperative pain scores, time to resumption of oral feeding, and return to normal daily activities were all significantly reduced in the laparoscopic group. These findings suggest that the minimally invasive approach mitigates surgical trauma despite longer operative time (tables-2, and figure-2).

Table 3: Early Postoperative Outcomes

| Outcome | LAP (n = 86) | Open (n = 94) | P value |
|----------------------------------|--------------|---------------|---------|
| Mean hospital stay (days) | 3.6 ± 1.3 | 5.2 ± 1.9 | <0.001 |
| Post-op pain score (VAS 24 h) | 3.2 ± 0.9 | 5.4 ± 1.1 | <0.001 |
| Time to oral feeds (days) | 1.4 ± 0.5 | 2.3 ± 0.7 | <0.001 |
| Return to normal activity (days) | 9.1 ± 2.4 | 14.3 ± 3.6 | <0.001 |

Table 4: Early Postoperative Complications (≤30 Days)

| Complication | LAP (n = 86) | Open (n = 94) | P value |
|-------------------------|--------------|---------------|---------|
| Surgical site infection | 4 (4.7%) | 18 (19.1%) | 0.003 |
| Intra-abdominal abscess | 5 (5.8%) | 9 (9.6%) | 0.34 |
| Postoperative ileus | 3 (3.5%) | 11 (11.7%) | 0.04 |
| Sepsis | 2 (2.3%) | 5 (5.3%) | 0.28 |
| Total complications | 14 (16.3%) | 43 (45.7%) | <0.001 |

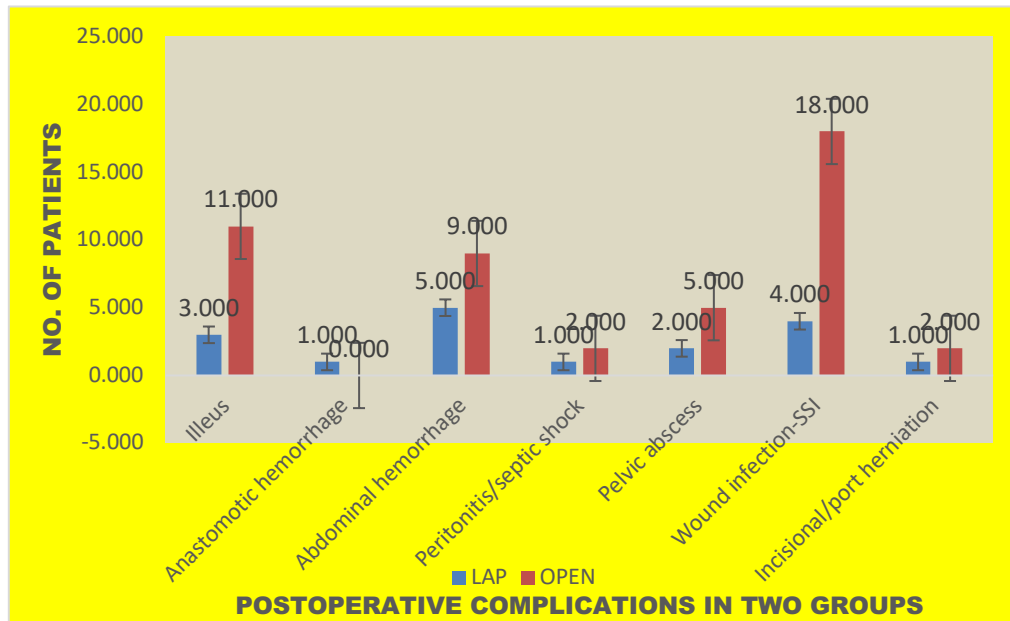


Figure 3: Early Postoperative Complications (≤30 Days)

Early postoperative complications occurred significantly more frequently in the open appendectomy group.

Surgical site infection emerged as the most common complication and was nearly four times more prevalent following open surgery. Rates of postoperative ileus and sepsis were also higher in the open group. Although intra-abdominal abscess

formation was numerically higher in the open appendectomy group, this difference was not statistically significant, supporting the growing body of evidence that laparoscopic surgery does not increase abscess risk in complicated appendicitis when appropriate technique and perioperative care are employed [tables-3, 4 and figure-3).

Table 5: Long-Term Complications (12-Month Follow-up)

| Complication | LAP (n = 86) | Open (n = 94) | P value |
|----------------------------|--------------|---------------|---------|
| Incisional hernia | 1 (1.2%) | 7 (7.4%) | 0.04 |
| Adhesive bowel obstruction | 0 | 4 (4.3%) | 0.04 |
| Chronic abdominal pain | 3 (3.5%) | 11 (11.7%) | 0.03 |
| Readmission within 1 year | 2 (2.3%) | 9 (9.6%) | 0.03 |

Long-term follow-up revealed a clear advantage of laparoscopic appendectomy. Incisional hernia, adhesive small bowel obstruction, chronic abdominal pain, and hospital readmissions within one year were significantly more frequent in the open appendectomy group. These findings

highlight the importance of evaluating long-term outcomes rather than relying solely on early postoperative metrics when comparing surgical approaches (Table-5). Multivariate logistic regression analysis further confirmed these findings. After adjusting for age, sex, and disease

severity, open appendectomy remained an independent predictor of overall postoperative complications, surgical site infection, and long-term morbidity.

Patients undergoing open appendectomy had approximately fourfold higher odds of developing overall postoperative complications, over fivefold increased odds of surgical site infection, and nearly

fourfold higher odds of long-term complications compared with those undergoing laparoscopic appendectomy.

Disease severity variables, particularly appendiceal perforation, also independently increased complication risk, underscoring the importance of early intervention and meticulous surgical technique (Table-6, 7).

Table 6: Overall Outcome Comparison

| Outcome Measure | LAP | Open | P value |
|---------------------------------------|-------|-------|---------|
| Overall complication rate | 17.4% | 49.0% | <0.001 |
| Mean total hospital days | 3.6 | 5.2 | <0.001 |
| Patient satisfaction (good–excellent) | 82.6% | 58.5% | <0.001 |

Table 7: Logistic Regression for Overall Postoperative Complications

| Variable | Adjusted Odds Ratio (AOR) | 95% CI | P value |
|-------------------------|---------------------------|-------------|---------|
| Open appendectomy | 4.12 | 2.08 – 8.15 | <0.001 |
| Age (per year increase) | 1.02 | 0.99 – 1.04 | 0.11 |
| Male sex | 1.18 | 0.62 – 2.24 | 0.61 |
| Perforated appendix | 2.06 | 1.05 – 4.03 | 0.03 |
| Appendicular abscess | 1.88 | 0.92 – 3.84 | 0.08 |

It has also been observed that the patients undergoing open appendectomy had over four times higher odds of developing postoperative complications compared with laparoscopic appendectomy, independent of age, sex, and disease severity.

Table 8: Logistic Regression for Surgical Site Infection (SSI)

| Variable | Adjusted Odds Ratio (AOR) | 95% CI | P value |
|-------------------|---------------------------|--------------|---------|
| Open appendectomy | 5.21 | 1.76 – 15.41 | 0.003 |
| Age | 1.01 | 0.98 – 1.05 | 0.39 |
| Male sex | 1.24 | 0.51 – 3.02 | 0.63 |
| Perforation | 2.45 | 1.01 – 5.94 | 0.04 |
| Abscess | 2.11 | 0.83 – 5.35 | 0.12 |

The study also revealed that the Open appendectomy was the strongest independent predictor of surgical site infection, increasing the odds of SSI by more than fivefold compared with laparoscopic surgery (Table-8).

Table 9: Logistic Regression for Long-Term Complications (12-Month Follow-up)

| Variable | Adjusted Odds Ratio (AOR) | 95% CI | P value |
|-------------------|---------------------------|-------------|---------|
| Open appendectomy | 3.67 | 1.41 – 9.56 | 0.008 |
| Age | 1.03 | 1.00 – 1.07 | 0.04 |
| Male sex | 1.31 | 0.55 – 3.11 | 0.54 |
| Perforation | 1.94 | 0.83 – 4.52 | 0.12 |
| Abscess | 2.22 | 0.88 – 5.61 | 0.09 |

It has also been observed that the Open appendectomy independently increased the risk of long-term complications (incisional hernia, adhesive bowel obstruction, chronic pain) by nearly 3.7 times compared with laparoscopic appendectomy (Table-9).

Moreover, the multivariate logistic regression analysis demonstrated that open appendectomy was an independent predictor of overall postoperative complications, surgical site infection, and long-term complications. Even after adjusting for age, sex, and disease severity, patients undergoing open appendectomy had significantly higher odds of

adverse outcomes compared with those undergoing laparoscopic appendectomy.

Collectively, these results advocated that the laparoscopic appendectomy provides superior short-term recovery and significantly better long-term outcomes in patients with complicated appendicitis. Although operative time is longer, the benefits in terms of reduced morbidity, faster recovery, and fewer long-term complications outweigh this limitation. The findings support the laparoscopic appendectomy as a safe, effective, and preferable surgical approach for complicated appendicitis in adult rural patients when appropriate expertise is available.

Discussion:

This prospective study evaluated 180 adult patients with complicated appendicitis undergoing either laparoscopic appendectomy (LAP, n = 86) or open appendectomy (OA, n = 94), with emphasis on perioperative outcomes, postoperative recovery, early and long-term complications, and adjusted risk analysis. The findings clearly demonstrated that laparoscopic appendectomy offered superior clinical outcomes compared with open appendectomy, despite a longer operative time.

In this study the both groups were comparable with respect to baseline demographics and disease severity. The mean age was similar between LAP (38.1 ± 11.2 years) and OA (39.4 ± 10.8 years), with a comparable male predominance (60.5% vs. 61.7%). The proportions of perforated appendix (55.8% vs. 54.3%), appendicular abscess (26.7% vs. 29.8%), and gangrenous appendicitis were also similar between groups. This demographic and clinical equivalence strengthens the internal validity of the study and ensured that the observed outcome differences were attributable to the surgical approach rather than confounding variables. Similar baseline comparability has been emphasized as critical in prior appendectomy outcome studies [21,27].

The mean operative time was significantly longer in the laparoscopic group (68.4 ± 14.6 minutes) compared with the open group (54.2 ± 12.1 minutes; $p < 0.001$). This finding was consistent with several randomized trials and meta-analyses reporting increased operative time with laparoscopy, particularly in complicated appendicitis [28–30]. However, multiple authors have demonstrated that operative duration decreases with surgeon experience and institutional learning curves, suggesting that this limitation is largely modifiable [31].

Despite longer operative time, postoperative recovery was significantly better in the LAP group. Mean hospital stay was reduced by nearly two days in the laparoscopic group (3.6 ± 1.3 vs. 5.2 ± 1.9 days; $p < 0.001$). Postoperative pain scores at 24 hours were significantly lower following LAP (VAS 3.2 ± 0.9 vs. 5.4 ± 1.1 ; $p < 0.001$), and patients resumed oral feeding earlier (1.4 vs. 2.3 days; $p < 0.001$). Return to normal activity was also significantly faster in the LAP group (9.1 ± 2.4 vs. 14.3 ± 3.6 days; $p < 0.001$). These findings were consistent with previous studies who reported shorter hospital stay and faster functional recovery following laparoscopic appendectomy [7,8, 32]. Reduced postoperative pain and earlier mobilization following minimally invasive surgery are likely responsible for these advantages.

Early postoperative complications occurred significantly more frequently following open appendectomy. Surgical site infection (SSI) was the most common complication and was nearly four times higher in the OA group (19.1%) compared with the LAP group (4.7%; $p = 0.003$). Postoperative ileus was also significantly more common following open surgery (11.7% vs. 3.5%; $p = 0.04$). These findings align closely with previous studies demonstrating lower wound infection rates and faster bowel recovery following laparoscopic appendectomy [4,19–22, 29].

Intra-abdominal abscess formation was numerically higher in the open group (9.6%) compared with the laparoscopic group (5.8%), though this difference did not reach statistical significance ($p = 0.34$). Early studies suggested increased abscess rates after laparoscopy in complicated appendicitis [23], but more recent meta-analyses have shown no significant difference when modern techniques and antibiotic protocols are used [14,15]. The present study findings support the latter view.

Long-term follow-up at 12 months revealed significantly fewer late complications following laparoscopic appendectomy. Incisional hernia occurred in only 1.2% of LAP patients compared with 7.4% in OA patients ($p = 0.04$). Adhesive small bowel obstruction occurred exclusively in the open group (4.3%; $p = 0.04$). Chronic abdominal pain (3.5% vs. 11.7%; $p = 0.03$) and readmission within one year (2.3% vs. 9.6%; $p = 0.03$) were also significantly higher following open surgery.

The present study results were consistent with long-term observational studies demonstrating reduced adhesion formation and incisional hernia rates after laparoscopic surgery due to minimal peritoneal trauma and smaller incisions [16–19]. Multivariate logistic regression further confirmed the superiority of laparoscopic appendectomy. After adjustment for age, sex, perforation, and abscess, open appendectomy remained an independent predictor of adverse outcomes. Patients undergoing open appendectomy had over fourfold higher odds of overall postoperative complications (AOR 4.12; 95% CI 2.08–8.15; $p < 0.001$), more than fivefold higher odds of surgical site infection (AOR 5.21; 95% CI 1.76–15.41; $p = 0.003$), and nearly fourfold higher odds of long-term complications (AOR 3.67; 95% CI 1.41–9.56; $p = 0.008$).

These findings mirror adjusted analyses from large national databases, which similarly reported higher morbidity and infection rates following open appendectomy for complicated appendicitis [20,21, 32]. Appendiceal perforation also independently increased complication risk, highlighting the importance of early diagnosis and timely intervention.

Some earlier studies reported no advantage or even increased abscess rates with laparoscopic appendectomy in complicated appendicitis [33,34].

These discrepancies may be explained by older surgical techniques, limited laparoscopic expertise, and inconsistent definitions of complicated appendicitis. Contemporary studies, including ours, reflect modern surgical practice and demonstrate improved outcomes with laparoscopy.

Current international guidelines increasingly recommend laparoscopic appendectomy for complicated appendicitis when adequate expertise is available [23]. The present study provides strong prospective evidence supporting these recommendations, particularly with respect to long-term outcomes that are often under-reported.

Strengths and Limitations

The strengths of this study include its prospective design, adequate sample size, balanced group characteristics, inclusion of long-term follow-up, and multivariate adjustment. Limitations include its single-center nature which may introduce selection bias. Nevertheless, the consistency of findings with high-quality published literature supports their reliability.

Conclusion:

Laparoscopic appendectomy provides better short-term recovery and significantly fewer early and long-term complications compared with open appendectomy in patients with complicated appendicitis. Despite longer operative time, its overall clinical benefits support laparoscopic appendectomy as the preferred surgical approach when expertise is available.

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