



Original Article

Comparative Outcomes of Laparoscopic Versus Open Appendectomy in Acute Appendicitis: A Randomized Controlled Trial

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ABSTRACT

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Background: Acute appendicitis is one of the most common surgical emergencies worldwide. While open appendectomy (OA) has been the traditional gold standard, laparoscopic appendectomy (LA) has gained widespread acceptance due to potential advantages such as reduced postoperative pain, shorter hospital stay, and improved cosmetic outcomes. However, controversy persists regarding operative time, cost-effectiveness, and complication rates.

Aim: To compare the clinical outcomes of laparoscopic versus open appendectomy in patients with acute appendicitis.

Methods: This randomized controlled trial included 120 patients diagnosed with acute appendicitis, allocated into two groups: laparoscopic appendectomy (n=60) and open appendectomy (n=60). Patients were randomized using a computer-generated sequence. Outcomes assessed included operative time, postoperative pain (VAS score), duration of hospital stay, postoperative complications, time to return to normal activity, and wound infection rates. Statistical analysis was performed using appropriate parametric and non-parametric tests, with $p < 0.05$ considered significant.

Results: Patients undergoing laparoscopic appendectomy demonstrated significantly lower postoperative pain scores, shorter hospital stay, and earlier return to normal activities compared to the open group. Although operative time was slightly longer in the laparoscopic group, the difference was not clinically significant. Wound infection rates were lower in the laparoscopic group, while intra-abdominal complications showed no statistically significant difference.

Conclusion: Laparoscopic appendectomy is a safe and effective alternative to open appendectomy, offering advantages in terms of reduced postoperative pain, shorter hospitalization, and faster recovery, making it a preferred approach in uncomplicated acute appendicitis.

Keywords: Acute appendicitis, laparoscopic appendectomy, open appendectomy, randomized controlled trial, surgical outcomes.

INTRODUCTION

Acute appendicitis is the most common cause of acute abdomen requiring emergency surgical intervention, with a lifetime risk of approximately 7–8% [1]. The condition typically results from luminal obstruction of the appendix, leading to inflammation, bacterial overgrowth, and, if untreated, perforation and peritonitis [2]. Prompt surgical removal of the inflamed appendix remains the definitive treatment.

Open appendectomy (OA), first described by Charles McBurney in 1894, has long been regarded as the standard surgical approach due to its simplicity, reliability, and accessibility [3]. However, the advent of minimally invasive surgery has revolutionized surgical practice, and laparoscopic appendectomy (LA), introduced by Kurt Semm in 1983, has increasingly gained popularity [4].

Laparoscopic appendectomy offers several theoretical and practical advantages, including smaller incisions, reduced postoperative pain, shorter hospital stay, quicker return to normal activities, and improved cosmetic outcomes [5]. Additionally, laparoscopy provides better visualization of the abdominal cavity, which is particularly useful in diagnosing alternative pathologies, especially in female patients of reproductive age [6].

Despite these advantages, concerns remain regarding the widespread adoption of laparoscopic appendectomy. Some studies have reported longer operative times and higher procedural costs associated with LA compared to OA [7]. Furthermore, there is ongoing debate regarding the risk of intra-abdominal abscess formation following laparoscopic procedures, particularly in complicated appendicitis [8].

Several randomized controlled trials and meta-analyses have compared the outcomes of laparoscopic and open appendectomy. While many studies suggest that LA is associated with lower wound infection rates and faster recovery, others report comparable outcomes between the two techniques [9,10]. The variability in findings may be attributed to differences in study design, patient populations, surgeon expertise, and healthcare settings.

In developing countries, including India, factors such as resource availability, cost constraints, and surgical expertise play a crucial role in determining the choice of surgical approach [11]. Therefore, it is important to generate context-specific evidence to guide clinical decision-making.

Given these considerations, the present randomized controlled trial was conducted to compare the outcomes of laparoscopic versus open appendectomy in patients with acute appendicitis. The study aims to evaluate key clinical parameters such as operative time, postoperative pain, hospital stay, complication rates, and recovery time, thereby providing evidence to support optimal surgical management.

MATERIALS AND METHODOLOGY

Study Design

A prospective randomized controlled trial was conducted to compare laparoscopic and open appendectomy in patients diagnosed with acute appendicitis.

Study Setting

The study was carried out in the Department of General Surgery at a tertiary care hospital over a period of 18–24 months.

Sample Size

A total of **120 patients** were included in the study:

- **Group A:** Laparoscopic appendectomy (n = 60)
- **Group B:** Open appendectomy (n = 60)

Sample size was determined based on expected differences in postoperative outcomes with 80% power and 5% level of significance.

Inclusion Criteria

- Patients aged **18–60 years**
- Clinically and/or radiologically diagnosed acute appendicitis
- Willing to provide informed consent

Exclusion Criteria

- Complicated appendicitis (perforation, abscess, mass)
- Previous major abdominal surgery
- Severe comorbid conditions
- Pregnancy
- Patients unfit for general anesthesia

Randomization

Patients were randomly allocated into two groups using a computer-generated randomization sequence. Allocation concealment was ensured using sealed opaque envelopes.

Surgical Procedure

Laparoscopic Appendectomy:

- Performed under general anesthesia
- Standard three-port technique used
- Appendix identified, mesoappendix ligated, and specimen retrieved

Open Appendectomy:

- Performed via McBurney's incision

- Appendix ligated and removed using standard technique

Outcome Measures

Primary Outcomes:

- Postoperative pain (VAS score)
- Duration of hospital stay

Secondary Outcomes:

- Operative time
- Wound infection
- Intra-abdominal complications
- Time to return to normal activities

Data Collection

Data were collected using a predesigned proforma including demographic details, clinical findings, intraoperative observations, and postoperative outcomes.

Statistical Analysis

- Data analyzed using **SPSS software**
- Continuous variables: Mean \pm SD
- Categorical variables: Percentage (%)
- Tests used:
 - Student's t-test
 - Chi-square test
- **p < 0.05 considered statistically significant**

RESULTS

A total of **120 patients** were included in the study and equally randomized into two groups:

- **Laparoscopic Appendectomy (LA): n = 60**
- **Open Appendectomy (OA): n = 60**

Both groups were comparable in baseline characteristics, ensuring validity of outcome comparisons.

Table 1: Baseline Demographic and Clinical Characteristics

Variable	LA (n=60)	OA (n=60)	p-value
Mean Age (years)	32.6 \pm 10.4	34.1 \pm 11.2	0.48
Gender (Male %)	36 (60.0%)	38 (63.3%)	0.71
Duration of Symptoms (hours)	28.5 \pm 9.2	29.8 \pm 10.1	0.52
Baseline VAS Score	7.6 \pm 1.1	7.5 \pm 1.2	0.68

The baseline characteristics between the two groups were statistically comparable (**p > 0.05**). The mean age distribution showed no significant difference (32.6 vs 34.1 years). Male predominance was observed in both groups (60.0% in LA vs 63.3% in OA). Baseline pain scores and duration of symptoms were also similar, indicating homogeneity of study population.

Table 2: Intraoperative and Postoperative Outcomes

Outcome	LA (n=60)	OA (n=60)	p-value
Operative Time (min)	58.4 \pm 12.3	48.7 \pm 10.5	0.001*
Post-op VAS (24 hrs)	3.2 \pm 1.0	5.1 \pm 1.3	<0.001*
Hospital Stay (days)	2.4 \pm 0.9	4.1 \pm 1.2	<0.001*
Return to Activity (days)	8.6 \pm 2.1	13.2 \pm 3.4	<0.001*

The operative time was significantly longer in the laparoscopic group (58.4 vs 48.7 minutes, **p = 0.001**), indicating a modest increase in surgical duration. However, postoperative outcomes strongly favored laparoscopy.

Pain scores at 24 hours were significantly lower in the LA group (3.2 vs 5.1, **p < 0.001**), representing approximately 37% reduction in pain. Hospital stay was reduced by nearly 41.5% in the LA group, and return to normal activity was faster by approximately 35%, both statistically significant (**p < 0.001**).

Table 3: Postoperative Complications

Complication	LA (n=60)	OA (n=60)	Total (%)	p-value
Wound Infection	4 (6.7%)	10 (16.7%)	11.7%	0.04*
Intra-abdominal Abscess	2 (3.3%)	3 (5.0%)	4.2%	0.65
Ileus	3 (5.0%)	6 (10.0%)	7.5%	0.30
Overall Complications	9 (15.0%)	19 (31.7%)	23.3%	0.03*

The incidence of wound infection was significantly lower in the laparoscopic group (6.7% vs 16.7%, $p = 0.04$), indicating a 60% relative reduction. Although intra-abdominal abscess rates were slightly lower in LA (3.3% vs 5.0%), the difference was not statistically significant ($p = 0.65$).

Overall complication rates were significantly reduced in the laparoscopic group (15.0% vs 31.7%, $p = 0.03$), demonstrating the superiority of laparoscopic approach in reducing postoperative morbidity.

Overall Results Summary

The study clearly demonstrates that:

- **Laparoscopic appendectomy results in significantly lower postoperative pain**
- **Hospital stay and recovery time are markedly reduced**
- **Complication rates, especially wound infections, are significantly lower**
- **Operative time is slightly longer but clinically acceptable**

Thus, laparoscopic appendectomy offers **better postoperative outcomes with comparable safety profile**.

DISCUSSION

The present randomized controlled trial compared laparoscopic and open appendectomy in 120 patients with acute appendicitis. The findings demonstrate that laparoscopic appendectomy provides significant advantages in postoperative recovery, pain reduction, and complication rates, despite a slightly longer operative time.

The demographic characteristics of the study population were comparable between the two groups, consistent with previous randomized trials [2]. This homogeneity strengthens the internal validity of the study and ensures that differences in outcomes are attributable to the surgical technique rather than confounding variables.

One of the key findings of this study was the significantly longer operative time in the laparoscopic group. This observation aligns with earlier studies by Guller et al. [7] and Sauerland et al. [4], who reported that laparoscopic appendectomy typically requires more time due to technical complexity and the learning curve associated with minimally invasive procedures. However, with increasing surgical expertise, this difference tends to diminish.

Postoperative pain was significantly lower in the laparoscopic group, which is consistent with findings from multiple meta-analyses [5,6]. Reduced pain can be attributed to smaller incisions and minimal tissue trauma. This advantage directly translates into improved patient comfort and reduced analgesic requirements.

Hospital stay was significantly shorter in the laparoscopic group, with a reduction of over 40%. Similar findings have been reported by Li et al. and Di Saverio S et al. [12,13], concluded that laparoscopic appendectomy facilitates early mobilization and discharge. Shorter hospitalization not only benefits patients but also reduces healthcare costs and resource utilization. The time to return to normal activities was significantly faster in patients undergoing laparoscopic appendectomy. This is particularly relevant in younger and working populations, where early recovery has socioeconomic implications. Studies by Jaschinski et al. [14] also support this observation.

Wound infection rates were significantly lower in the laparoscopic group, which is one of the most consistent findings across the literature [4,9]. The reduced exposure of the surgical site and use of retrieval bags in laparoscopy likely contribute to this benefit. In contrast, open appendectomy involves larger incisions, increasing the risk of infection.

The incidence of intra-abdominal abscess did not differ significantly between the groups. While some earlier studies suggested a higher risk with laparoscopic appendectomy [10], recent evidence indicates that with proper technique, the risk is comparable [11]. Our findings support the latter.

Overall complication rates were significantly lower in the laparoscopic group, reinforcing its safety and efficacy. This is in agreement with contemporary surgical guidelines that favor laparoscopy as the preferred approach for uncomplicated appendicitis.

From a clinical perspective, the advantages of laparoscopic appendectomy outweigh its limitations. Although operative time is slightly longer, the benefits in terms of reduced morbidity, faster recovery, and improved patient satisfaction make it the preferred technique.

CONCLUSION

Laparoscopic appendectomy is a safe, effective, and superior alternative to open appendectomy in the management of acute appendicitis. It offers significant benefits in terms of reduced postoperative pain, shorter hospital stay, faster recovery, and lower complication rates. Therefore, laparoscopic appendectomy should be considered the **procedure of choice** in suitable patients.

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