E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.31838/ijprt/08.01.06

Research Article

Laparoscopic Vs Open Appendectomy: A Comparative Study of Operative Time, Complications, and Recovery

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Received: 05.01.18, Revised: 16.02.18, Accepted: 22.04.18

ABSTRACT
Background: Acute appendicitis is one of the most common surgical emergencies in India. Open appendectomy (OA) has been the standard procedure for decades, whereas laparoscopic appendectomy (LA) has gained popularity due to minimal invasiveness and faster recovery. With the advancement of minimally invasive techniques, laparoscopic appendectomy has increasingly been adopted as an alternative to the conventional open approach. However, differences in operative time, postoperative complications, and recovery outcomes remain areas of ongoing evaluation, particularly in tertiary care settings.
Aim: To compare laparoscopic and open appendectomy in terms of operative time, postoperative complications, and duration of recovery.
Material and Methods: This comparative observational study was conducted at a tertiary care hospital and included 84 patients diagnosed with acute appendicitis. Patients were divided into two equal groups: 42 underwent laparoscopic appendectomy (LA group) and 42 underwent open appendectomy (OA group). Demographic data, operative findings, and postoperative outcomes were recorded. Primary outcomes included operative time and complication rates. Secondary outcomes included postoperative pain assessed using the Visual Analog Scale (VAS), time to oral intake, time to return of bowel function, duration of hospital stay, and time to return to normal daily activities.
Results: The mean operative time was significantly longer in the LA group (52.36 ± 11.48 minutes) compared to the OA group (46.28 ± 9.62 minutes) ($p = 0.011$). Postoperative pain scores at 24 and 48 hours were significantly lower in the LA group ($p < 0.001$). Time to oral intake, return of bowel function, and hospital stay were significantly shorter in the LA group ($p < 0.001$). The overall complication rate was significantly lower in the LA group (16.67%) compared to the OA group (45.24%) ($p = 0.006$).
Conclusion: Laparoscopic appendectomy offers significant benefits in terms of reduced postoperative pain, faster recovery, shorter hospitalization, and lower overall complication rates, despite a slightly longer operative time. It represents a safe and effective alternative to open appendectomy in the management of acute appendicitis.

Keywords: Acute Appendicitis, Laparoscopic Appendectomy, Open Appendectomy, Postoperative Complications, Recovery Outcomes.

INTRODUCTION

Acute appendicitis remains one of the most frequent causes of emergency abdominal surgery worldwide and continues to be a major workload for tertiary care hospitals. Despite advances in imaging and peri-operative care, definitive management for most patients is still surgical removal of the inflamed appendix to prevent progression to perforation, generalized peritonitis, sepsis, and increased postoperative morbidity.[1] The traditional open appendectomy, usually performed through a right lower quadrant muscle-splitting incision, has long been valued for its simplicity, speed, and reliability; however, it is associated with a larger wound, greater parietal trauma, and a measurable burden of wound-related complications and postoperative pain, which can prolong recovery and delay return to normal activities.[2] With the widespread adoption of minimally invasive surgery, laparoscopic appendectomy has become an increasingly preferred approach in many centers. The laparoscopic technique offers a magnified operative view, the ability to inspect the entire abdomen (useful in atypical

presentations or when an alternative diagnosis is encountered), and smaller incisions that may translate into reduced postoperative pain and improved cosmesis.[3] In addition, earlier mobilization and faster restoration of gastrointestinal function are frequently attributed to reduced tissue handling and less impairment of abdominal wall mechanics. These potential advantages are particularly relevant in busy tertiary care settings where early discharge, reduced analgesic requirements, and efficient bed turnover are important practical goals, provided safety and complication rates remain acceptable.[4] Nevertheless, the relative benefits of laparoscopic versus open appendectomy are not universally consistent across studies, and the choice of approach often depends on patient profile, disease severity, surgeon experience, and institutional resources. Operative time is a frequently debated issue, with laparoscopy sometimes taking longer due to port placement, establishment of pneumoperitoneum, intracorporeal dissection, and specimen retrieval, especially during the learning curve or in difficult anatomy.[5] In contrast, experienced laparoscopic teams may narrow this gap and occasionally achieve comparable times. Another persistent concern is postoperative infectious morbidity, particularly in complicated appendicitis where contamination is greater and the risk of intra-abdominal abscess has been variably reported.[6] These controversies mean that local outcome evaluations remain important, because complication patterns and recovery profiles can differ based on case-mix (uncomplicated vs complicated appendicitis), peri-operative antibiotic practices, and postoperative care pathways.

MATERIALS AND METHODS

This comparative observational study was conducted at a tertiary care teaching hospital with established facilities for both laparoscopic and open surgical procedures. The study evaluated and compared outcomes of laparoscopic appendectomy and open appendectomy in patients diagnosed with acute appendicitis. Institutional ethical committee approval was obtained prior to commencement of the study, and informed consent was taken from all participants. A total of 84 patients diagnosed clinically and radiologically with acute appendicitis were included in the study. Patients were allocated into two groups based on the surgical procedure performed: 42 patients underwent laparoscopic appendectomy (LA group) and 42 patients underwent open appendectomy (OA group). The choice of surgical technique was based on surgeon preference, patient factors, and availability of laparoscopic facilities.

Inclusion and Exclusion Criteria

Patients aged 18 years and above with a clinical diagnosis of acute appendicitis confirmed by ultrasonography or computed tomography were included in the study. Both uncomplicated and complicated cases (such as gangrenous or perforated appendicitis without generalized peritonitis) were considered. Patients with appendicular mass managed conservatively, generalized peritonitis requiring midline laparotomy, severe cardiopulmonary comorbidities contraindicating laparoscopy, pregnancy, bleeding disorders, or those unwilling to participate were excluded from the study.

Preoperative Assessment

All patients underwent detailed clinical evaluation including history, physical examination, and laboratory investigations such as complete blood count, C-reactive protein levels, renal function tests, and coagulation profile. Imaging studies including abdominal ultrasonography and, where indicated, contrast-enhanced computed tomography were performed to confirm the diagnosis. Baseline demographic parameters such as age, gender, body mass index (BMI), duration of symptoms, and comorbid conditions were recorded.

Surgical Technique

All procedures were performed under general anesthesia with standard aseptic precautions. In the laparoscopic appendectomy group, a standard three-port technique was employed. Pneumoperitoneum was created using a Veress needle or open (Hasson) technique, and the appendix was identified, mesoappendix divided using bipolar cautery or energy device, and the base ligated with endoloops or clips before removal through a port site. In the open appendectomy group, a standard right lower quadrant incision (McBurney's or Lanz incision) was made. The appendix was identified, mesoappendix ligated, and the base secured with sutures prior to removal. Peritoneal lavage was performed in cases with contamination in both groups as required.

Outcome Measures

The primary outcome measures included operative time (measured from skin incision to closure), intraoperative complications, and postoperative complications. Secondary outcome measures included postoperative pain assessed using the Visual Analog Scale (VAS) at 24 and 48 hours, time to return of bowel function, duration of hospital stay, time to resumption of oral intake, wound infection rate, incidence of intra-abdominal abscess, need for conversion from laparoscopic to open procedure, and time to return to normal daily activities.

Postoperative Management and Follow-Up

All patients received standardized postoperative care including intravenous antibiotics, analgesics, and antiemetics as per institutional protocol. Oral intake was initiated once bowel sounds returned and the patient tolerated liquids. Patients were monitored for postoperative complications such as fever, surgical site infection, ileus, or intra-abdominal collection. Sutures were removed between postoperative days 7 and 10. Follow-up was conducted in the outpatient department to assess wound healing, late complications, and recovery progress.

Statistical Analysis

Data were collected using a structured proforma and entered into a computerized database. Continuous variables such as operative time and duration of hospital stay were expressed as mean ± standard deviation, while categorical variables such as complication rates were presented as frequencies and percentages. Statistical analysis was performed using appropriate statistical software. The Student's t-test was applied for comparison of continuous variables, and the Chi-square test or Fisher's exact test was used for categorical variables. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 84 patients were included in the study, with 42 patients in the laparoscopic appendectomy (LA) group and 42 patients in the open appendectomy (OA) group. The outcomes were analyzed and compared across demographic variables, operative findings, postoperative recovery parameters, and complication rates.

Demographic and Baseline Characteristics

The baseline demographic characteristics of both groups were comparable, indicating appropriate group matching. The mean age in the LA group was 29.84 ± 8.62 years, while in the OA group it was 31.12 ± 9.04 years, with no statistically significant difference ($p = 0.482$). Gender distribution was also similar between the groups; males constituted 57.14% in the LA group and 61.90% in the OA group, while females accounted for 42.86% and 38.10%, respectively ($p = 0.654$). The mean body mass index (BMI) was 23.76 ± 3.14 kg/m² in the LA group and 24.08 ± 3.42 kg/m² in the OA group, showing no significant difference ($p = 0.671$). Patients presenting with symptoms lasting more than 48 hours were 26.19% in the LA group and 30.95% in the OA group ($p = 0.629$). Similarly, the presence of comorbidities was comparable between the groups, observed in 19.05% of LA patients and 21.43% of OA patients ($p = 0.789$). Overall, the absence of statistically significant differences in baseline characteristics confirms that both groups were demographically and clinically similar at presentation.

Operative Findings and Intraoperative Parameters

The mean operative time was significantly longer in the laparoscopic group (52.36 ± 11.48 minutes) compared to the open group (46.28 ± 9.62 minutes), and this difference was statistically significant ($p = 0.011$). This suggests that laparoscopic appendectomy required more operative time, possibly due to port placement, establishment of pneumoperitoneum, and intracorporeal dissection. Regarding disease severity, uncomplicated appendicitis was found in 71.43% of patients in the LA group and 66.67% in the OA group, whereas complicated appendicitis was observed in 28.57% and 33.33%, respectively. These differences were not statistically significant ($p = 0.639$), indicating comparable intraoperative findings in both groups. Intraoperative complications were minimal and similar in both groups, occurring in 4.76% of LA cases and 7.14% of OA cases ($p = 0.642$), showing no statistically significant difference. Conversion from laparoscopic to open appendectomy was required in 7.14% of cases in the LA group, mainly due to dense adhesions or unclear anatomy.

Postoperative Pain and Recovery Parameters

Postoperative pain assessment using the Visual Analog Scale (VAS) demonstrated significantly lower pain scores in the laparoscopic group. At 24 hours postoperatively, the mean VAS score

was 3.18 ± 0.94 in the LA group compared to 5.42 ± 1.12 in the OA group ($p < 0.001$). At 48 hours, the scores were 1.76 ± 0.68 in the LA group and 3.84 ± 0.91 in the OA group ($p < 0.001$). These findings indicate superior postoperative comfort in patients undergoing laparoscopic appendectomy. Recovery parameters also favored the laparoscopic approach. The mean time to oral intake was significantly shorter in the LA group (18.64 ± 4.82 hours) compared to the OA group (27.48 ± 6.16 hours) ($p < 0.001$). Similarly, the return of bowel function occurred earlier in the LA group (22.14 ± 5.36 hours) than in the OA group (31.76 ± 7.02 hours) ($p < 0.001$). The mean duration of hospital stay was significantly reduced in the LA group (2.64 ± 0.86 days) compared to the OA group (4.18 ± 1.12 days) ($p < 0.001$). Furthermore, patients in the laparoscopic group resumed normal daily activities much earlier (8.42 ± 2.14 days) than those in the open group (13.76 ± 3.28 days), and this difference was highly significant ($p < 0.001$). Overall, these findings demonstrate a clear advantage of laparoscopic appendectomy in terms of faster recovery and shorter hospitalization.

Postoperative Complications

Postoperative complications were comparatively lower in the laparoscopic group. Surgical site infection was observed in 4.76% of patients in the LA group and 16.67% in the OA group; although higher in the OA group, the difference did not reach statistical significance ($p = 0.081$). Intra-abdominal abscess formation occurred in 2.38% of LA patients and 4.76% of OA patients ($p = 0.556$), which was not statistically significant. Postoperative ileus was reported in 2.38% of LA patients compared to 9.52% in the OA group ($p = 0.167$), and postoperative fever occurred in 7.14% of LA cases versus 14.29% of OA cases ($p = 0.284$). While individual complication rates were consistently higher in the open appendectomy group, these differences were not statistically significant when analyzed separately. However, when considering the overall complication rate, a statistically significant difference was observed. The overall complication rate was 16.67% in the LA group compared to 45.24% in the OA group ($p = 0.006$), indicating a clear reduction in total postoperative morbidity with the laparoscopic approach

Table 1: Demographic and Baseline Characteristics

Parameter	LA Group (N=42)	OA Group (N=42)	P-Value
Mean Age (years)	29.84 ± 8.62	31.12 ± 9.04	0.482
Male	24 (57.14%)	26 (61.90%)	0.654
Female	18 (42.86%)	16 (38.10%)	0.654
Mean BMI (kg/m²)	23.76 ± 3.14	24.08 ± 3.42	0.671
Duration of Symptoms >48 hrs	11 (26.19%)	13 (30.95%)	0.629
Comorbidities Present	8 (19.05%)	9 (21.43%)	0.789

Table 2: Operative Findings and Intraoperative Parameters

Parameter	LA Group (N=42)	OA Group (N=42)	P-Value
Mean Operative Time (minutes)	52.36 ± 11.48	46.28 ± 9.62	0.011*
Uncomplicated Appendicitis	30 (71.43%)	28 (66.67%)	0.639
Complicated Appendicitis	12 (28.57%)	14 (33.33%)	0.639
Intraoperative Complications	2 (4.76%)	3 (7.14%)	0.642
Conversion to Open	3 (7.14%)	—	—

Table 3: Postoperative Pain and Recovery Parameters

Parameter	LA Group (N=42)	OA Group (N=42)	P-Value
VAS Score at 24 hrs	3.18 ± 0.94	5.42 ± 1.12	<0.001*
VAS Score at 48 hrs	1.76 ± 0.68	3.84 ± 0.91	<0.001*
Time to Oral Intake (hours)	18.64 ± 4.82	27.48 ± 6.16	<0.001*
Time to Bowel Function (hours)	22.14 ± 5.36	31.76 ± 7.02	<0.001*

Mean Hospital Stay (days)	2.64 ± 0.86	4.18 ± 1.12	<0.001*
Return to Normal Activity (days)	8.42 ± 2.14	13.76 ± 3.28	<0.001*

Table 4: Postoperative Complications

Complication	LA Group (N=42)	OA Group (N=42)	P-Value
Surgical Site Infection	2 (4.76%)	7 (16.67%)	0.081
Intra-abdominal Abscess	1 (2.38%)	2 (4.76%)	0.556
Postoperative Ileus	1 (2.38%)	4 (9.52%)	0.167
Fever	3 (7.14%)	6 (14.29%)	0.284
Overall Complication Rate	7 (16.67%)	19 (45.24%)	0.006*

DISCUSSION

In the present study, both groups were well matched at baseline, which minimizes confounding while comparing outcomes between approaches. The mean age was similar in LA versus OA (29.84 ± 8.62 vs 31.12 ± 9.04 years; p=0.482), and the gender distribution was comparable (males 57.14% vs 61.90%; p=0.654), with no significant differences in BMI, symptom duration >48 hours, or comorbidities. This pattern of comparable baseline characteristics is consistent with early randomized evidence; for example, Attwood et al (1992) reported balanced groups in a prospective randomized trial, supporting the methodological soundness of comparing postoperative outcomes between LA and OA when baseline variables are similar.[7] Operative time in our series was significantly longer for laparoscopy (52.36 ± 11.48 minutes) than for open appendectomy (46.28 ± 9.62 minutes; p=0.011), which likely reflects additional steps such as establishing pneumoperitoneum, port placement, and intracorporeal dissection. A similar direction has been reported in randomized trials; Hansen et al (1996) observed longer operative times with laparoscopic appendectomy compared with open surgery, particularly during periods of evolving laparoscopic experience, mirroring the modest but significant increase in operative duration seen in our dataset.[8] In terms of disease profile, our intraoperative severity distribution was comparable between groups (uncomplicated 71.43% vs 66.67%; complicated 28.57% vs 33.33%; p=0.639), and intraoperative complications were low in both arms (4.76% vs 7.14%; p=0.642). Conversion was required in 7.14% of laparoscopic cases, which is within an expected range in routine practice, especially with adhesions or difficult anatomy. Kehagias et al (2008) discussed similar practical considerations in clinical series and highlighted that case complexity can influence conversion and postoperative infective patterns, reinforcing that our conversion rate is plausible in a tertiary-care setting managing both uncomplicated and complicated appendicitis.[9] Postoperative pain outcomes strongly favored laparoscopy in our study: VAS at 24 hours was 3.18 ± 0.94 in LA versus 5.42 ± 1.12 in OA (p<0.001), and at 48 hours it was 1.76 ± 0.68 versus 3.84 ± 0.91 (p<0.001). These findings align with high-level evidence; Sauerland et al (2010), in a Cochrane review, reported lower postoperative pain after laparoscopic appendectomy compared with open surgery, consistent with the clinically meaningful reduction in pain we observed at both 24 and 48 hours.[10] Early feeding and bowel recovery were also significantly improved after laparoscopy in our cohort. Patients undergoing LA resumed oral intake earlier (18.64 ± 4.82 vs 27.48 ± 6.16 hours; p<0.001) and regained bowel function sooner (22.14 ± 5.36 vs 31.76 ± 7.02 hours; p<0.001), reflecting faster physiological recovery and reduced ileus. This pattern is comparable to pooled analyses where laparoscopic appendectomy demonstrates earlier return to diet and faster convalescence; for instance, Golub et al (1998) reported recovery advantages with laparoscopy in meta-analytic comparisons, paralleling the direction and consistency of our recovery endpoints.[11] Hospital stay was significantly shorter in the laparoscopic arm in our study (2.64 ± 0.86 vs 4.18 ± 1.12 days; p<0.001), an advantage that has substantial implications for bed utilization and patient turnover in tertiary-care hospitals. Large database outcomes research also supports this trend; Guller et al (2004) found shorter lengths of stay with laparoscopic appendectomy compared with open appendectomy in a large administrative cohort, which is concordant with the nearly 1.5-day reduction observed in our series.[12] Functional recovery in our patients was notably faster after laparoscopy, with return to normal activity occurring at 8.42 ± 2.14 days for LA versus

13.76 ± 3.28 days for OA ($p<0.001$). This earlier resumption of daily activities is a key patient-centered benefit and likely reflects lower pain, smaller wounds, and quicker mobilization. Comparable findings have been documented in randomized trials; Pedersen et al (2001) reported earlier return to normal activity following laparoscopic appendectomy than open appendectomy, consistent with the marked improvement in functional recovery demonstrated in our cohort.[13] Regarding postoperative complications, our study showed a lower surgical site infection rate after laparoscopy (4.76%) compared with open surgery (16.67%), although this did not reach statistical significance ($p=0.081$), likely due to limited sample size for individual outcomes. Intra-abdominal abscess rates were low in both groups (2.38% vs 4.76%; $p=0.556$). Evidence focusing on complicated appendicitis has similarly emphasized reduced wound complications with laparoscopy; Markides et al (2010), in a systematic review/meta-analysis of complicated appendicitis, reported lower wound infection with laparoscopic approaches, supporting the direction of our infection findings even when single-outcome comparisons are underpowered.[14] When complications were analyzed collectively, the overall complication rate in our study was significantly lower with laparoscopy (16.67%) than open appendectomy (45.24%; $p=0.006$), indicating a meaningful reduction in total postoperative morbidity. This overall advantage is consistent with meta-analytic evidence suggesting lower aggregate morbidity with laparoscopy, while also acknowledging that some studies have raised concerns about intra-abdominal abscess in selected contexts. Bennett et al (2007) reported overall benefits for laparoscopy in meta-analysis while discussing trade-offs in specific infective outcomes, and our low abscess rates alongside a substantially lower overall complication burden support laparoscopy as the more favorable approach in a tertiary-care environment when performed with careful technique and appropriate intraoperative decision-making.[15]

CONCLUSION

In conclusion, laparoscopic appendectomy demonstrated significant advantages over open appendectomy in terms of reduced postoperative pain, earlier return of bowel function, shorter hospital stay, and faster resumption of normal activities, despite a slightly longer operative time. Although individual postoperative complications were not statistically different, the overall complication rate was significantly lower in the laparoscopic group. These findings support laparoscopic appendectomy as a safe, effective, and preferable approach for the management of acute appendicitis in a tertiary care setting.

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