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Comparative Evaluation of Perioperative Outcomes of Laparoscopic Versus Open Appendicectomy in Acute Appendicitis: A Prospective Comparative Study at a Tertiary Care Centre

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Abstract

Background: Acute appendicitis is one of the most common surgical emergencies, with appendicectomy remaining the definitive operative treatment. Although both open and laparoscopic approaches are widely practiced, differences in perioperative morbidity and postoperative recovery remain clinically relevant, particularly in resource-constrained tertiary-care settings. This study aimed to compare perioperative outcomes of laparoscopic appendicectomy (LA) and open appendicectomy (OA) in patients with acute appendicitis.

Methodology: This prospective quasi-experimental study was conducted in the Department of General Surgery at a tertiary-care centre over 18 months. A total of 100 patients aged 18–65 years with acute appendicitis were included, with 50 patients assigned to LA and 50 to OA based on patient preference, surgical expertise and resource availability. Outcomes included operative duration, postoperative pain using the Visual Analogue Scale (VAS) at 24, 48 and 72 hours, postoperative complications, length of hospital stay, return to normal activity and patient satisfaction.

Results: Baseline demographic, clinical and intraoperative characteristics were comparable between groups. Median operative duration was significantly longer with LA than OA (51 vs 41 minutes; p<0.001). However, mean VAS scores were significantly lower after LA at 24 hours (4.80 vs 6.21), 48 hours (3.20 vs 4.71) and 72 hours (1.70 vs 3.20) (all p<0.001). Overall complications occurred in 12% of LA and 28% of OA patients (p=0.046), while individual complications did not differ significantly. Median hospital stay was shorter after LA (3 vs 4 days; p<0.001), and return to normal activity was earlier (7 vs 11 days; p<0.001). Patient satisfaction was significantly higher following LA (median score 4.8 vs 3.6; p<0.001). Three laparoscopic cases (6%) required conversion to open surgery.

Conclusion: Laparoscopic appendicectomy was associated with less postoperative pain, lower overall morbidity, shorter hospitalization, earlier functional recovery and greater patient satisfaction than open appendicectomy, although at the expense of longer operative duration. These findings support LA as an effective approach in appropriately selected patients where laparoscopic expertise and facilities are available.

Keywords: Acute appendicitis; Laparoscopic appendicectomy; Open appendicectomy; Postoperative outcomes; Patient recovery

Introduction

Acute appendicitis is one of the most common causes of acute abdominal pain requiring emergency surgical assessment and remains an important cause of morbidity worldwide. It can occur at any age, although the incidence is highest among adolescents and young adults. The clinical presentation classically includes abdominal pain that may migrate to the right lower quadrant, anorexia, nausea or vomiting, fever, and localized tenderness. However, considerable variation in presentation can occur, making diagnosis challenging in some patients.[1,2] Diagnosis is therefore based on a combination of clinical assessment, laboratory investigations and, when indicated, imaging modalities such as ultrasonography and computed tomography.[2]

The pathogenesis of acute appendicitis is multifactorial. Luminal obstruction by an appendicolith, lymphoid hyperplasia or other causes has traditionally been considered an important initiating mechanism. Obstruction may result in continued mucosal secretion and luminal distension, followed by impairment of lymphatic and venous drainage, bacterial proliferation, progressive inflammation and ischemia. If the inflammatory process progresses, gangrene and perforation may occur, potentially resulting in localized abscess, phlegmon or generalized peritonitis.[1,4] However, contemporary understanding suggests that the natural history of acute appendicitis is more heterogeneous than a simple inevitable progression from uncomplicated inflammation to perforation. Uncomplicated and complicated appendicitis can be differentiated on the basis of clinical, imaging and operative findings, and standardized grading has been proposed to improve disease stratification and guide management.[2–4]

Management of acute appendicitis has evolved considerably over recent decades. Appendicectomy remains the established definitive surgical treatment, although antibiotic-based non-operative management may be considered in carefully selected patients with uncomplicated acute appendicitis after appropriate counselling regarding the possibility of treatment failure or recurrence.[2] When operative treatment is selected, appendicectomy can be performed through either an

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open or laparoscopic approach. Open appendicectomy, traditionally performed through a right lower-quadrant muscle-splitting incision, has been used successfully for more than a century and remains an effective and widely available procedure. In contrast, laparoscopic appendicectomy uses minimally invasive access, most commonly through a three-port technique, and has become increasingly established in contemporary surgical practice.[2]

The relative advantages of laparoscopic and open appendicectomy have been extensively investigated. Evidence synthesized from randomized trials suggests that laparoscopic appendicectomy is associated with less postoperative pain, fewer wound infections, shorter duration of hospitalization and earlier return to normal activities than open appendicectomy.[5],[6] These benefits are clinically relevant because recovery following appendicectomy is determined not only by successful removal of the diseased appendix but also by postoperative pain, wound morbidity, duration of hospitalization and restoration of normal functional activity. Nevertheless, laparoscopic appendicectomy may require a longer operative duration, depends on the availability of laparoscopic equipment and trained personnel, and has historically raised concern regarding intra-abdominal abscess formation in some patient groups.[5],[6] Thus, the relative benefits of the two approaches should be evaluated across multiple perioperative outcomes rather than by any single parameter.

Prospective comparative studies have generally demonstrated favourable postoperative recovery with laparoscopic appendicectomy, although the magnitude of benefit varies across healthcare settings. Pradhan et al. reported that laparoscopic appendicectomy was associated with reduced postoperative morbidity and recovery advantages compared with open surgery, despite a longer operative duration.[7] Similarly, an Indian non-randomized comparative study by Hanspal et al. demonstrated lower postoperative pain, shorter hospitalization and fewer wound infections following laparoscopic appendicectomy.[8] Kehagias et al. also observed a shorter hospital stay and lower wound infection rate with the laparoscopic approach, although operative time was longer.[9] These findings indicate that the choice of surgical approach involves a balance between intraoperative requirements and postoperative recovery.

The occurrence of postoperative complications is particularly important when comparing the two techniques. Surgical-site infection has generally been reported less frequently after laparoscopic appendicectomy, probably because extraction of the appendix through a protected trocar site reduces direct contamination of a larger abdominal incision.[5],[9] However, the relationship between operative approach and intra-abdominal abscess is less straightforward. Earlier randomized evidence suggested an increased risk of intra-abdominal abscess following laparoscopic appendicectomy in adults, whereas more recent studies have not consistently demonstrated such a difference.[5] Mulita et al., in a large retrospective comparison of laparoscopic and open appendicectomy, found no significant difference in postoperative intra-abdominal abscess formation between the approaches.[14] Similarly, a meta-analysis focusing on perforated appendicitis found no statistically significant difference in intra-abdominal abscess formation, while wound infection remained less frequent following laparoscopic surgery.[15] These observations emphasize the importance of assessing

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individual postoperative complications in addition to overall morbidity.

Patient-centred recovery outcomes are also increasingly relevant when evaluating surgical procedures. Reduced postoperative pain, shorter hospitalization and earlier return to normal activity may translate into improved functional recovery and patient experience.[5],[6] Patient satisfaction and quality of life may therefore provide information beyond conventional measures such as operative duration and complication rates. Hussein et al. demonstrated favourable postoperative quality-of-life outcomes following laparoscopic compared with open appendicectomy in their study population, supporting the inclusion of patient-reported outcomes when evaluating the overall impact of the surgical approach.[12]

Despite the growing adoption of laparoscopic appendicectomy, outcomes may vary according to patient characteristics, disease severity, surgeon experience, institutional resources and availability of laparoscopic facilities. Meta-analytic evidence demonstrates overall advantages of laparoscopic appendicectomy, but individual studies continue to show variation in operative duration and specific postoperative outcomes.[5],[13] Furthermore, evidence derived from randomized trials and highly specialized centres may not completely reflect everyday practice in tertiary-care institutions where selection of the operative approach can also be influenced by patient preference, surgeon expertise and resource availability. Comparative evaluation within individual healthcare settings therefore remains clinically relevant.

Against this background, the present study was undertaken to compare laparoscopic and open appendicectomy in adult patients with acute appendicitis at a tertiary-care centre. The study evaluated operative duration, postoperative pain at 24, 48 and 72 hours, postoperative complications, duration of hospital stay, return to normal activity and patient satisfaction. By evaluating both conventional perioperative outcomes and patient-centred measures, the study aimed to provide a comprehensive comparison of the two operative approaches under routine clinical conditions and to determine whether the reported benefits of laparoscopic appendicectomy are reproduced within the local tertiary-care setting.

Methodology

This prospective quasi-experimental comparative study was conducted in the Department of General Surgery at a tertiary care centre over a predefined study period. Patients presenting with clinical features suggestive of acute appendicitis and fulfilling the predetermined eligibility criteria were enrolled after obtaining written informed consent. The diagnosis of acute appendicitis was established on the basis of clinical history, physical examination, relevant laboratory investigations and radiological evaluation, as indicated. Patients were allocated to either the laparoscopic appendicectomy group (Group A) or the open appendicectomy group (Group B) according to the allocation method specified in the study protocol. Baseline demographic and clinical characteristics, including age, sex, presenting symptoms, clinical findings and relevant investigations, were recorded using a predesigned study proforma. All patients underwent routine preoperative assessment, appropriate perioperative antibiotic prophylaxis and general anaesthesia. Laparoscopic appendicectomy was performed using the standard laparoscopic technique, whereas open appendicectomy was performed through a conventional right lower-quadrant incision. Intraoperative findings, duration of surgery,

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complications and conversion from laparoscopic to open surgery, whenever required, were documented.

Patients in both groups were subsequently monitored using a standardized postoperative assessment protocol. The principal outcome measures included postoperative recovery, postoperative complications and overall clinical outcome. Operative duration was recorded in minutes according to a predefined start and end point. Postoperative pain was assessed using a standardized visual analogue scale (VAS) at predetermined postoperative intervals. Recovery was evaluated using objective parameters such as time to resumption of oral intake, mobilization, duration of postoperative hospital stay and/or return to routine activity, according to the definitions specified in the study protocol. Postoperative complications were systematically documented, with particular attention to surgical-site infection and other wound-related complications, as well as postoperative fever, ileus, intra-abdominal collection, readmission or reintervention where applicable. Patients were followed for the predetermined postoperative follow-up period to identify early complications and assess recovery.

All collected data were entered into a computerized database and analyzed using appropriate statistical software. Continuous variables, such as age, operative duration, postoperative pain score and duration of hospital stay, were summarized as mean with standard deviation or median with interquartile range depending on the distribution of the data, whereas categorical variables were expressed as frequencies and percentages. Continuous outcomes between the laparoscopic and open appendicectomy groups were compared using an independent-samples *t* test for normally distributed data or the Mann–Whitney U test for non-normally distributed data. Categorical outcomes, including postoperative complications and surgical-site infection, were compared using the Chi-square test or Fisher's exact test, as appropriate. Effect estimates with 95% confidence intervals were reported wherever applicable, and a *p* value <0.05 was considered statistically significant. Ethical approval was obtained from the Institutional Ethics Committee before commencement of the study, and confidentiality of participants' information was maintained throughout the study.

Results

Table 1: Baseline demographic, physiological, and laboratory characteristics of the study groups

Characteristic	**Laparoscopic appendicectomy (n=50)**	**Open appendicectomy (n=50)**	**P value**
Age, years, median (IQR)	29.0 (25.0–36.8)	30.5 (26.0–39.8)	0.560
Sex, n (%)			0.685
Male	28 (56.0)	30 (60.0)	
Female	22 (44.0)	20 (40.0)	
ASA physical status, n (%)			0.914
ASA I	30 (60.0)	28 (56.0)	
ASA II	17 (34.0)	19 (38.0)	
ASA III	3 (6.0)	3 (6.0)	
Heart rate, bpm	92.6 ± 10.8	94.3 ± 11.2	0.444
Systolic BP, mmHg	118.4 ± 10.1	117.6 ± 9.7	0.692

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Diastolic BP, mmHg	74.8 ± 7.5	73.9 ± 8.1	0.562
Temperature, °F	99.1 ± 1.2	99.4 ± 1.3	0.246
Total leukocyte count, /mm³	11,800 ± 2,300	12,100 ± 2,500	0.534
CRP, mg/L	21.4 ± 6.9	22.1 ± 7.3	0.627

A total of 100 patients with acute appendicitis were included in the study, with 50 patients assigned to the laparoscopic appendicectomy group and 50 to the open appendicectomy group. As shown in Table 1, the median age was 29.0 years (IQR: 25.0–36.8) in the laparoscopic group and 30.5 years (IQR: 26.0–39.8) in the open group, with no statistically significant difference between the groups (p=0.560). Males constituted 56.0% and 60.0% of the laparoscopic and open groups, respectively (p=0.685). The distribution of ASA physical status was also comparable between the groups (p=0.914). No statistically significant differences were observed in baseline heart rate, systolic or diastolic blood pressure, body temperature, total leukocyte count, or C-reactive protein levels (all p>0.05), indicating broadly comparable measured baseline characteristics between the two groups.

Table 2: Operative characteristics and intraoperative findings according to assigned surgical approach

Variable	**Laparoscopic appendicectomy (n=50)**	**Open appendicectomy (n=50)**	**P value**
Operative duration, min, median (IQR)	51.0 (42.5–60.8)	41.0 (35.0–48.8)	<0.001
Inflamed appendix, n (%)	26 (52.0)	24 (48.0)	0.689
Gangrenous appendix, n (%)	10 (20.0)	11 (22.0)	0.806
Perforated appendix, n (%)	8 (16.0)	9 (18.0)	0.790
Fecolith present, n (%)	3 (6.0)	3 (6.0)	1.000
Pus/abscess, n (%)	2 (4.0)	3 (6.0)	1.000
Adhesions, n (%)	1 (2.0)	2 (4.0)	1.000
Conversion to open surgery, n (%)	3 (6.0)	—	—

Table 2 summarizes the operative characteristics and intraoperative findings. The median operative duration was significantly longer in the laparoscopic group than in the open group [51.0 (IQR: 42.5–60.8) vs 41.0 (IQR: 35.0–48.8) minutes; p<0.001]. The estimated between-group location shift was 10 minutes (95% CI: 6–14 minutes). The proportions of patients with an inflamed appendix (52.0% vs 48.0%), gangrenous appendix (20.0% vs 22.0%), perforated appendix (16.0% vs 18.0%), fecolith (6.0% vs 6.0%), pus/abscess (4.0% vs 6.0%), and adhesions (2.0% vs 4.0%) did not differ significantly between the laparoscopic and open groups (all p>0.05). Three patients (6.0%) initially assigned to laparoscopic appendicectomy required conversion to an open procedure.

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Table 3: Postoperative pain scores following laparoscopic and open appendicectomy

Postoperative time	Laparoscopic appendicectomy (n=50)	Open appendicectomy (n=50)	Mean difference, LA−OA (95% CI)	P value
VAS at 24 h	4.80 ± 1.10	6.21 ± 1.40	−1.41 (−1.91 to −0.91)	<0.001
VAS at 48 h	3.20 ± 0.99	4.71 ± 1.31	−1.51 (−1.97 to −1.05)	<0.001
VAS at 72 h	1.70 ± 0.80	3.20 ± 1.10	−1.50 (−1.88 to −1.12)	<0.001

Postoperative pain scores at different time points are presented in Table 3. At 24 hours, the mean VAS score was significantly lower following laparoscopic appendicectomy than following open appendicectomy (4.80±1.10 vs 6.21±1.40; mean difference −1.41, 95% CI: −1.91 to −0.91; p<0.001). This difference persisted at 48 hours, with mean VAS scores of 3.20±0.99 and 4.71±1.31, respectively (mean difference −1.51, 95% CI: −1.97 to −1.05; p<0.001). At 72 hours, the corresponding scores were 1.70±0.80 and 3.20±1.10 (mean difference −1.50, 95% CI: −1.88 to −1.12; p<0.001). Thus, significantly lower postoperative pain scores were observed in the laparoscopic group at each assessed postoperative time point.

Table 4: Thirty-day postoperative complications according to surgical approach

Postoperative complication	Laparoscopic appendicectomy (n=50)	Open appendicectomy (n=50)	Absolute risk difference, % (95% CI)	P value
Wound infection	2 (4.0)	7 (14.0)	−10.0 (−22.5 to 1.8)	0.160
Intra-abdominal abscess	1 (2.0)	3 (6.0)	−4.0 (−14.3 to 5.4)	0.617
Paralytic ileus	1 (2.0)	4 (8.0)	−6.0 (−17.0 to 3.8)	0.362
Postoperative fever	4 (8.0)	6 (12.0)	−4.0 (−16.8 to 8.6)	0.505
Reoperation	0 (0)	1 (2.0)	−2.0 (−10.5 to 5.3)	1.000
Any postoperative complication	6 (12.0)	14 (28.0)	−16.0 (−31.1 to −0.2)	0.046

The distribution of postoperative complications within 30 days is presented in Table 4. Wound infection occurred in 2 patients (4.0%) in the laparoscopic group compared with 7 patients (14.0%) in the open group; however, this difference did not reach statistical significance (p=0.160). Intra-abdominal abscess occurred in 1 (2.0%) versus 3 (6.0%) patients (p=0.617), paralytic ileus in 1 (2.0%) versus 4 (8.0%) patients (p=0.362), and postoperative fever in 4 (8.0%) versus 6 (12.0%) patients (p=0.505) in the laparoscopic and open groups, respectively. One patient (2.0%) in the open group required reoperation, whereas no reoperation was recorded in the laparoscopic group (p=1.000). Although none of the individual complications differed significantly between groups, the composite incidence of any postoperative complication was significantly lower in the laparoscopic group, occurring in 6 (12.0%) patients compared with 14 (28.0%) patients in the open group (p=0.046). This represented an absolute risk difference of −16.0 percentage points (95% CI: −31.1 to −0.2).

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Table 5: Postoperative recovery and patient-reported outcomes according to surgical approach

Outcome	Laparoscopic appendicectomy (n=50)	Open appendicectomy (n=50)	Hodges–Lehmann difference, LA−OA (95% CI)	P value
Hospital stay, days, median (IQR)	3.0 (2.0–3.0)	4.0 (3.0–5.0)	−1 day (−1 to −1)	<0.001
Return to normal activity, days, median (IQR)	7.0 (6.0–8.0)	11.0 (9.0–13.0)	−3 days (−5 to −3)	<0.001
Satisfaction score, median (IQR)	4.8 (4.5–5.0)	3.6 (3.5–4.5)	+0.5 (+0.4 to +1.2)	<0.001
Satisfaction category, n (%)				0.002
Highly satisfied	38 (76.0)	22 (44.0)	—	
Moderately satisfied	11 (22.0)	20 (40.0)	—	
Not satisfied	1 (2.0)	8 (16.0)	—	

The distribution of postoperative complications within 30 days is presented in Table 4. Wound infection occurred in 2 patients (4.0%) in the laparoscopic group compared with 7 patients (14.0%) in the open group; however, this difference did not reach statistical significance (p=0.160). Intra-abdominal abscess occurred in 1 (2.0%) versus 3 (6.0%) patients (p=0.617), paralytic ileus in 1 (2.0%) versus 4 (8.0%) patients (p=0.362), and postoperative fever in 4 (8.0%) versus 6 (12.0%) patients (p=0.505) in the laparoscopic and open groups, respectively. One patient (2.0%) in the open group required reoperation, whereas no reoperation was recorded in the laparoscopic group (p=1.000). Although none of the individual complications differed significantly between groups, the composite incidence of any postoperative complication was significantly lower in the laparoscopic group, occurring in 6 (12.0%) patients compared with 14 (28.0%) patients in the open group (p=0.046). This represented an absolute risk difference of −16.0 percentage points (95% CI: −31.1 to −0.2).

Discussion

The present quasi-experimental study compared perioperative outcomes of laparoscopic appendicectomy (LA) and open appendicectomy (OA) in 100 patients with acute appendicitis, with 50 patients in each group. The principal findings were that LA was associated with significantly less postoperative pain, a lower overall complication rate, shorter hospital stay, earlier return to normal activity and greater patient satisfaction, although it required a significantly longer operative time. The two groups were broadly comparable with respect to baseline demographic and clinical characteristics and intraoperative appendiceal findings. These findings are generally consistent with previous comparative studies and systematic reviews demonstrating improved early postoperative recovery following laparoscopic appendicectomy.[5–10,13]

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Operative Duration

In the present study, operative duration was significantly longer with LA, with a median duration of 51 minutes compared with 41 minutes for OA ($p<0.001$), representing an estimated difference of approximately 10 minutes. This finding is consistent with several previous studies. Pradhan et al. reported a mean operative duration of 42.82±10.84 minutes for LA compared with 37.99±9.81 minutes for OA.[7] Similarly, longer laparoscopic operative times have been reported in randomized and prospective comparative studies.[9,10] A systematic review of randomized trials also demonstrated that laparoscopic appendicectomy generally required greater operative time than the open approach.[5]

The longer operative duration associated with LA may be related to establishment of pneumoperitoneum, trocar placement, laparoscopic exploration, intracorporeal dissection and secure retrieval of the appendix. Operative duration is also influenced by surgeon experience, severity of appendicitis, adhesions and institutional familiarity with laparoscopic surgery. Consequently, the additional operative time observed in the present study should be interpreted together with the postoperative recovery advantages associated with LA.

Three patients initially assigned to the laparoscopic group required conversion to open appendicectomy, giving a conversion rate of 6%. Conversion is an important practical consideration and may be required because of difficult anatomy, dense adhesions, advanced inflammation, bleeding or inability to safely complete the procedure laparoscopically. Pradhan et al. reported conversion in approximately 2.8% of laparoscopic cases.[7] Variation in conversion rates between studies is expected because of differences in patient selection, disease severity and surgeon experience.

Postoperative Pain

A major finding of the present study was the consistently lower postoperative pain following LA. Mean VAS scores at 24 hours were 4.80±1.10 following LA and 6.21±1.40 following OA, with a mean difference of −1.41 (95% CI −1.91 to −0.91; $p<0.001$). At 48 hours, the corresponding scores were 3.20±0.99 and 4.71±1.31 ($p<0.001$), while at 72 hours they were 1.70±0.80 and 3.20±1.10 ($p<0.001$). Thus, the analgesic advantage of LA was evident throughout the first 72 postoperative hours.

This finding is strongly supported by previous evidence. Hanspal et al. reported lower postoperative pain after laparoscopic appendicectomy, with mean VAS scores of approximately 2.93 in the laparoscopic group compared with 4.62 in the open group.[8] The Cochrane review by Jaschinski et al., which included 85 randomized studies involving 9,765 participants, found that pain on the first postoperative day in adults was lower after LA by approximately 0.75 cm on a 10-cm VAS.[5] Other randomized and comparative studies have similarly demonstrated reduced postoperative pain following the laparoscopic approach.[6,9,10]

The lower pain scores following LA are biologically plausible because the procedure avoids the relatively larger muscle-splitting right lower-quadrant incision required for conventional OA. Reduced abdominal-wall trauma may facilitate earlier mobilization and contribute to subsequent improvements in functional recovery and duration of hospitalization.

Postoperative Complications

The overall postoperative complication rate in the present study was 12% following LA compared with

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28% following OA, and this difference was statistically significant (p=0.046). The absolute risk difference was −16 percentage points (95% CI −31.1 to −0.2). This suggests an overall reduction in early postoperative morbidity associated with the laparoscopic approach, although interpretation of individual complications requires caution because of the relatively small number of events.

Wound infection occurred in 2 patients (4%) following LA compared with 7 patients (14%) following OA. Although this represented a clinically notable numerical reduction, the difference did not reach statistical significance (p=0.160). Similar trends have been demonstrated in previous studies. Hanspal et al. reported wound infection rates of approximately 3.4% following LA and 13.2% following OA.[8] Kehagias et al. likewise observed fewer wound infections after laparoscopic surgery.[9] More importantly, the Cochrane review found a significantly lower likelihood of wound infection after LA, with a Peto odds ratio of 0.42 (95% CI 0.35–0.51).[5] A later meta-analysis also supported a reduction in wound-related complications with the laparoscopic approach.[13]

The lower incidence of wound infection following LA may be related to smaller incisions and reduced direct exposure of the abdominal wall to the inflamed or contaminated appendix during specimen removal. Nevertheless, because the difference in wound infection in the present study was not statistically significant, the present results should be described as showing a numerical reduction rather than definitive evidence of a reduction in this individual complication.

Intra-abdominal abscess occurred in 1 patient (2%) in the LA group and 3 patients (6%) in the OA group (p=0.617). Earlier randomized evidence raised concern that intra-abdominal abscess might occur more frequently following laparoscopic appendicectomy. The Cochrane review reported an increased incidence of intra-abdominal abscess in adults following LA, with a Peto odds ratio of 1.65 (95% CI 1.12–2.43).[5] However, more recent evidence has not consistently demonstrated this association. Mulita et al., in a large retrospective comparison, found no significant difference in intra-abdominal abscess formation between laparoscopic and open appendicectomy.[14] Furthermore, the meta-analysis by Gu and Hua focusing on perforated appendicitis found no statistically significant difference in intra-abdominal abscess formation between the approaches, while wound infection was lower following laparoscopic surgery.[15] The present findings therefore support the view that the risk of intra-abdominal abscess after LA may not necessarily be increased, although the small number of abscesses in this study prevents a definitive conclusion.

Paralytic ileus occurred in 2% of LA patients compared with 8% of OA patients, postoperative fever in 8% compared with 12%, and reoperation in 0% compared with 2%, respectively. None of these individual differences reached statistical significance. These results should therefore be interpreted cautiously and not as evidence of superiority for any individual rare complication.

Duration of Hospital Stay

Hospital stay was significantly shorter following LA. The median duration of hospitalization was 3 days (IQR 2–3) in the laparoscopic group compared with 4 days (IQR 3–5) in the open group (p<0.001), representing an estimated reduction of approximately one day.

This finding closely agrees with the available literature. The Cochrane review reported that hospitalization was

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approximately 0.96 days shorter after LA than after OA.[5] Hanspal et al. similarly reported mean hospital stays of 4.34±1.37 days following LA and 5.09±1.71 days following OA.[8] Kehagias et al. also demonstrated shorter hospitalization after laparoscopic appendicectomy.[9] Meta-analytic evidence has consistently identified shorter postoperative hospitalization as one of the principal recovery advantages of the laparoscopic approach.[6,13]

The shorter hospital stay observed after LA may reflect the combined effects of reduced postoperative pain, smaller wounds, earlier mobilization and fewer wound-related problems. From a healthcare perspective, even a one-day reduction in hospitalization may be relevant in high-volume tertiary-care centres because it may improve bed utilization and reduce indirect resource requirements, although the present study did not perform a formal cost-effectiveness analysis.

Return to Normal Activity

Patients undergoing LA returned to normal activity substantially earlier than those undergoing OA. The median time was 7 days (IQR 6–8) following LA compared with 11 days (IQR 9–13) following OA ($p<0.001$), with an estimated difference of approximately 3 days.

This finding is consistent with the Cochrane review, which reported that adult patients undergoing LA returned to normal activity approximately 4.97 days earlier than those undergoing OA.[5] Systematic reviews and individual comparative studies have likewise demonstrated faster functional recovery following laparoscopic appendicectomy.[6–9,13] The earlier return to normal activity observed in the present study is therefore consistent with the broader evidence supporting faster postoperative recovery following minimally invasive surgery.

Earlier functional recovery is particularly important in a predominantly young and economically active population, as acute appendicitis commonly affects adolescents and young adults. A reduction of several days before resumption of normal activity may have meaningful implications for patients and their families, although socioeconomic outcomes and time to return to employment were not separately evaluated in the present study.

Patient Satisfaction

Patient satisfaction was significantly greater following LA. The median satisfaction score was 4.8 (IQR 4.5–5.0) in the laparoscopic group compared with 3.6 (IQR 3.5–4.5) in the open group ($p<0.001$). Furthermore, 76% of patients undergoing LA were highly satisfied compared with 44% undergoing OA, while dissatisfaction was reported by 2% and 16%, respectively. The overall distribution of satisfaction categories differed significantly between the groups ($p=0.002$).

Patient satisfaction is influenced by several factors, including pain, wound appearance, duration of hospitalization, speed of functional recovery and expectations regarding treatment. The greater satisfaction observed following LA in the present study is therefore consistent with its favourable results for pain, hospital stay and return to normal activity. Patient-centred outcomes reported in previous studies also suggest potential advantages following laparoscopic surgery. Hussein et al. demonstrated favourable postoperative quality-of-life outcomes after laparoscopic compared with open appendicectomy in their study population.[12] However, quality-of-life measurements and

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satisfaction scores are not interchangeable; therefore, direct numerical comparison with the satisfaction scale used in the present study is inappropriate.

Overall Interpretation

Taken together, the findings of the present study demonstrate a consistent pattern. Laparoscopic appendicectomy required approximately 10 minutes longer than open surgery but was associated with substantially less postoperative pain, a one-day shorter median hospital stay, approximately 3 days earlier return to normal activity and greater patient satisfaction. The overall complication rate was also significantly lower after LA. Individual complications such as wound infection, intra-abdominal abscess, paralytic ileus, postoperative fever and reoperation generally occurred less frequently in the laparoscopic group, but these differences were not statistically significant individually.

These findings are broadly consistent with randomized, observational and meta-analytic evidence demonstrating that the principal advantages of laparoscopic appendicectomy relate to postoperative recovery and wound morbidity.[5],[6],[13] The results also agree with prospective comparative studies from settings more similar to the present study.[7–10],[16] Nevertheless, the benefits should be interpreted in the context of the longer operative duration, requirement for laparoscopic equipment and trained personnel, possibility of conversion to open surgery and institutional resource availability.

Limitations

The present findings should be interpreted in light of several limitations. First, this was a single-centre study with a relatively small sample size of 100 patients. The study therefore had limited statistical power for uncommon complications such as intra-abdominal abscess, reoperation and paralytic ileus. This may explain why clinically relevant numerical differences in several individual complications did not reach statistical significance.

Second, allocation to laparoscopic or open appendicectomy was not randomized. The operative approach was influenced by patient preference, surgeon expertise and availability of facilities. Although the two groups were broadly comparable in measured baseline and intraoperative characteristics, residual confounding from unmeasured factors cannot be excluded. Consequently, the observed associations should not be interpreted as definitive causal effects of the operative technique.

Third, three patients assigned to LA required conversion to open surgery. Conversion is an inherent component of laparoscopic surgical practice and may reflect greater technical difficulty or disease severity. Fourth, follow-up was limited to 30 days; therefore, long-term outcomes such as incisional hernia, chronic postoperative pain, long-term cosmetic satisfaction and quality of life could not be evaluated. Finally, return to normal activity and patient satisfaction were partly subjective patient-reported outcomes and may have been influenced by individual expectations and social circumstances.

Despite these limitations, the prospective collection of data, comparable group sizes, assessment of multiple clinically relevant outcomes and inclusion of both objective and patient-centred recovery measures strengthen the study. The findings provide useful real-world evidence regarding the comparative outcomes of laparoscopic and open appendicectomy in a tertiary-care setting.

Overall, the present study supports the association of laparoscopic appendicectomy with improved early

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postoperative recovery compared with open appendicectomy, at the expense of a modest increase in operative duration. Larger multicentre randomized or appropriately adjusted prospective studies with longer follow-up and formal assessment of cost-effectiveness and quality of life would further clarify the comparative effectiveness of the two approaches.

Conclusion

Laparoscopic appendicectomy was associated with better early postoperative outcomes than open appendicectomy in patients with acute appendicitis. Although the laparoscopic approach required a significantly longer operative time, patients experienced significantly lower postoperative pain at 24, 48 and 72 hours, a lower overall postoperative complication rate, shorter hospital stay, earlier return to normal activity, and higher patient satisfaction. Individual complications, including wound infection, intra-abdominal abscess and paralytic ileus, were numerically less frequent following laparoscopic surgery but did not differ significantly between groups. Overall, these findings suggest that laparoscopic appendicectomy provides important short-term recovery benefits when appropriate expertise and facilities are available.

Limitations

The study has several limitations. It was a single-centre study with a relatively small sample of 100 patients, limiting the statistical power to detect differences in uncommon postoperative complications. The quasi-experimental, non-randomized design introduces the possibility of selection bias and residual confounding despite broadly comparable measured baseline characteristics. Allocation was influenced by patient preference and availability of surgical expertise, and three laparoscopic cases required conversion to open surgery. Furthermore, follow-up was limited to 30 days; therefore, long-term outcomes such as incisional hernia, chronic pain and long-term quality of life could not be evaluated. Patient satisfaction and return to normal activity also included subjective patient-reported components.

Recommendations

Laparoscopic appendicectomy may be considered an effective operative approach for appropriately selected patients with acute appendicitis in centres where laparoscopic equipment and trained surgical personnel are available. The additional operative time should be balanced against its observed advantages in postoperative pain and recovery. Future studies should preferably employ multicentre randomized or well-adjusted prospective designs with larger sample sizes, standardized definitions of postoperative complications and longer follow-up. Further evaluation of cost-effectiveness, quality of life and long-term patient-reported outcomes would also help define the comparative value of laparoscopic and open appendicectomy in resource-constrained tertiary-care settings.

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