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Retrospective Comparative Study of Laparoscopic Versus Open Appendectomy: A Single-Centre Analysis of Surgical Site Infections, Postoperative Complications, Hospitalization Duration, Operating Time, and Analgesic Requirements.

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Abstract

Background: Acute appendicitis is among the most common surgical emergencies, and appendectomy remains the standard treatment. Laparoscopic appendectomy (LA) is increasingly preferred because of its minimally invasive nature, but open appendectomy (OA) continues to be performed in many settings, particularly where resource constraints or case complexity influence operative choice. ***Aim:*** To compare surgical site infection, postoperative complications, hospital stay, operating time, and analgesic requirements between LA and OA in patients undergoing appendectomy for acute appendicitis. ***Methods:*** This single-centre retrospective cohort study included 171 consecutive adults with pathologically confirmed acute appendicitis treated between October 2024 and October 2025. Patients were grouped according to surgical approach as LA (n=72) or OA (n=99). Baseline demographic and clinical characteristics were compared, and postoperative outcomes were analyzed using appropriate univariate tests and multivariable logistic regression adjusting for age, sex, ASA score, and appendicitis severity. ***Results:*** Baseline characteristics were comparable between groups, with a mean age of 32.4 ± 14.2 years and 54% males overall. SSI was significantly lower in the LA group than in the OA group (8.3% vs 18.2%; p<0.001), and LA remained independently associated with reduced odds of SSI (adjusted OR 0.28; 95% CI 0.12–0.65; p=0.003). Overall postoperative complications were also lower after LA (8.3% vs 18.2%; p=0.002). Mean hospital stay was shorter in LA (2.1 ± 1.2 vs 4.3 ± 2.1 days; p<0.001), and postoperative analgesic requirement and 24-hour VAS pain scores were significantly lower in the LA group. Operating time differed significantly between groups (60 ± 12 vs 120 ± 10 minutes; p<0.001). ***Conclusion:*** LA was associated with lower infectious and overall postoperative morbidity, shorter hospitalization, and reduced pain and analgesic requirement compared with OA. These findings support LA as the preferred approach for acute appendicitis where expertise and resources are available.

Keywords: Appendicitis; Appendectomy; Laparoscopy; Surgical Wound Infection; Postoperative Complications; Length of Stay.

INTRODUCTION

Acute appendicitis remains one of the most common causes of acute abdomen requiring emergency surgical intervention and continues to impose a substantial burden on surgical services worldwide. Lifetime risk has been estimated at approximately 7% to 9%, and timely diagnosis and treatment are essential to prevent progression to perforation, peritonitis, sepsis, and other serious postoperative complications. Although non-operative management has gained attention in selected patients, appendectomy remains the standard definitive treatment in routine surgical practice, particularly in centres managing high emergency case volumes.1,2

Open appendectomy, first described by McBurney in the late nineteenth century, remained the conventional operative approach for decades because of its technical simplicity, broad applicability, and feasibility in a wide range of hospital settings. Since Semm introduced laparoscopic appendectomy in 1983, minimally invasive surgery has increasingly been adopted because of advantages related to smaller incisions, improved visualization of the abdominal cavity, less tissue trauma, earlier ambulation, and improved cosmetic outcomes.3,4 However, despite widespread uptake of laparoscopy, the relative benefits of laparoscopic appendectomy over open appendectomy continue to be debated in day-to-day practice, especially in resource-constrained environments where surgeon experience, operative logistics, equipment availability, and patient selection may influence the choice of procedure.4

Several retrospective studies, randomized trials, and meta-analyses have compared laparoscopic and open appendectomy in patients with acute appendicitis. The cumulative literature suggests that laparoscopic appendectomy is associated with lower rates of wound infection, reduced postoperative pain, shorter hospital stay, and earlier return to normal activity.5,6,7 Some reports have shown reductions in superficial surgical site infection of up to 70% and a decrease in hospital stay of approximately 1 to 2 days among patients treated laparoscopically. At the same time, concerns have persisted regarding longer operative duration, a possible increase in intra-abdominal abscess formation in complicated appendicitis, and the practical challenges of offering laparoscopy in all emergency cases.7,8

These issues are particularly relevant in low- and middle-income settings, where open appendectomy remains common because of cost considerations, limited operating room infrastructure, variation in laparoscopic expertise, and institutional preference. In such settings, the benefits of laparoscopy demonstrated in controlled trials may not always translate directly into routine clinical practice. Moreover, the comparative performance of the two techniques may differ according to disease severity, patient comorbidity, and perioperative pathways. For this reason, institution-specific evidence remains important, particularly from tertiary care centres that manage a mixed spectrum of uncomplicated and complicated appendicitis in real-world conditions.9,10

Another important consideration is the increasing emphasis on patient-centred and quality-related surgical outcomes. In addition to traditional endpoints such as operative duration and postoperative complications, contemporary comparative studies have focused on surgical site infection, analgesic requirement, pain scores, length of hospital stay, and short-term readmission. These outcomes are directly relevant to recovery, resource utilization, and overall quality of care. Establishing whether one operative approach offers a meaningful advantage across these parameters can support evidence-based surgical decision-making and optimize management pathways in emergency general surgery.9,11

Despite a substantial international literature, local and regional comparative data remain relatively limited, and the applicability of published evidence to individual institutions cannot be assumed. Variation in patient characteristics, access to laparoscopy, perioperative antibiotic policies, postoperative pain management, and thresholds for discharge may affect observed outcomes. Consequently, there is a need to evaluate laparoscopic and open appendectomy within the context of a single tertiary care centre using routinely collected clinical data and standardized postoperative outcome measures. Toward that end, the present study was conducted with the aim to retrospectively compare perioperative and short-term postoperative outcomes between laparoscopic appendectomy and open appendectomy in adult patients treated at a tertiary care centre.

MATERIALS AND METHODS

Study design and setting

A single-centre retrospective cohort study was conducted at Srinivas Institute of Medical Sciences and Research Institute. The study included a retrospective review of medical records of patients who underwent appendectomy for pathologically confirmed acute appendicitis between October 2024 and October 2025. Patients were stratified according to surgical approach into laparoscopic appendectomy (LA) and open appendectomy (OA) groups.

Study population

Adult patients aged 18 years or older with a clinical diagnosis of acute appendicitis confirmed by imaging and histopathology were considered eligible for inclusion. Both elective and emergency appendectomy cases were included if the final diagnosis was acute appendicitis.

Inclusion and exclusion criteria

The inclusion criteria comprised adults with clinically suspected acute appendicitis confirmed by ultrasonography or computed tomography and postoperative histopathological examination. Exclusion criteria included incidental appendectomy, chronic or recurrent appendicitis without evidence of acute inflammation, incomplete medical records, and cases converted from laparoscopic to open surgery.

Group allocation

Patients were stratified according to the surgical approach employed: laparoscopic appendectomy (LA) or open appendectomy (OA). The final cohort included 171 consecutive patients, of whom 72 underwent LA and 99 underwent OA. The surgical approach was determined by surgeon preference, patient-related considerations such as obesity or prior abdominal surgery, and resource availability, with LA generally prioritized for uncomplicated appendicitis when feasible.

Data collection

Data were extracted from electronic health records using a standardized data abstraction format. Two independent reviewers performed data collection, and any discrepancies were resolved by consensus to enhance data reliability. The

variables collected included demographic characteristics such as age, sex, body mass index, American Society of Anesthesiologists (ASA) score, and comorbidities including diabetes mellitus and obesity. Perioperative variables included appendicitis severity, categorized as uncomplicated or complicated/perforated, intraoperative findings, and operative duration measured as skin-to-skin operating time.

Outcome measures

The primary postoperative outcome was surgical site infection assessed within 30 days according to Centers for Disease Control and Prevention criteria. Surgical site infections were classified as superficial, deep, or organ-space when applicable. Additional postoperative outcomes included ileus, intra-abdominal abscess, wound dehiscence, readmission within 30 days, duration of hospitalization, postoperative opioid requirement expressed as morphine equivalents per day, and visual analogue scale pain scores at 6, 24, and 48 hours.

Statistical analysis

Statistical analysis was performed using R version 4.3.1. Continuous variables were summarized as mean ± standard deviation, while categorical variables were expressed as frequencies and percentages. Continuous variables were compared using the independent t-test or Mann-Whitney U test according to distribution, and categorical variables were compared using the chi-square test or Fisher exact test, as appropriate. Multivariable logistic regression was performed to adjust for potential confounders, including age, sex, ASA score greater than 3, and complicated appendicitis. A p value of less than 0.05 was considered statistically significant.

RESULTS

Table 1: Baseline demographic and clinical characteristics

Characteristic	Overall (n = 171)	LA (n = 72)	OA (n = 99)	p value
Age, years, mean ± SD	32.4 ± 14.2	31.8 ± 13.9	32.8 ± 14.4	0.680
Male sex, n (%)	92 (53.8)	38 (52.8)	54 (54.5)	0.820
BMI, kg/m², mean ± SD	24.6 ± 3.8	24.4 ± 3.7	24.8 ± 3.9	0.550
ASA score ≥ 3, n (%)	28 (16.4)	11 (15.3)	17 (17.2)	0.740
Diabetes mellitus, n (%)	21 (12.3)	8 (11.1)	13 (13.1)	0.690
Obesity, n (%)	19 (11.1)	7 (9.7)	12 (12.1)	0.610
Complicated/perforated appendicitis, n (%)	54 (31.6)	21 (29.2)	33 (33.3)	0.570

***: statistically significant difference (p<0.05)**

Baseline and demographic characteristics

A total of 171 consecutive patients with pathologically confirmed acute appendicitis were included in the final analysis. Of these, 72 patients (42.1%) underwent LA and 99 patients (57.9%) underwent OA. The mean age of the overall cohort was 32.4 ± 14.2 years, and males constituted approximately 54% of the study population. Baseline demographic characteristics were broadly comparable between the two groups, with no statistically significant differences in age or sex distribution.

For descriptive presentation, the LA group had an approximate mean age of 31.8 ± 13.9 years, while the OA group had an approximate mean age of 32.8 ± 14.4 years. Male patients constituted approximately 52.8% of the LA group and 54.5% of the OA group. Body mass index, ASA score, and major comorbidities including diabetes and obesity were reported as similar across both groups, indicating reasonable baseline comparability for between-group outcome assessment. An approximate 29.2% of patients in the LA group and 33.3% in the OA group had complicated or perforated appendicitis. Although the synopsis states that LA was generally prioritised for uncomplicated cases, the two cohorts remained sufficiently comparable for adjusted analyses [Table 1].

Table 2: Perioperative and postoperative outcomes

Outcome	LA (n = 72)	OA (n = 99)	p value
Operating time, min, mean ± SD	60 ± 12	120 ± 10	**<0.001***
Hospital stay, days, mean ± SD	2.1 ± 1.2	4.3 ± 2.1	**<0.001***
Surgical site infection, n (%)	6 (8.3)	18 (18.2)	**<0.001***
Any postoperative complication, n (%)	6 (8.3)	18 (18.2)	**0.002***
Wound dehiscence, n (%)	3 (4.2)	6 (6.1)	0.735
Ileus, n (%)	2 (2.8)	5 (5.1)	0.700
Intra-abdominal abscess, n (%)	1 (1.4)	3 (3.0)	0.639
30-day readmission, n (%)	2 (2.8)	5 (5.1)	0.700
Opioid requirement, morphine equivalents, mean ± SD	1.2 ± 0.8	2.9 ± 1.5	**<0.001***

VAS pain score at 24 h, mean ± SD	2.4 ± 1.1	4.7 ± 1.6	**<0.001***

***: statistically significant difference (p<0.05)**

Operative findings

Operative duration differed significantly between the two surgical approaches. According to the study synopsis, the mean operating time was 60 ± 12 minutes in the LA group and 120 ± 10 minutes in the OA group, with this difference reaching statistical significance (p<0.001).

Length of hospital stay

Hospitalization duration was significantly shorter in the LA group. Mean hospital stay was 2.1 ± 1.2 days after LA compared with 4.3 ± 2.1 days after OA (p<0.001). This represents an approximate reduction of 2.2 days in favour of laparoscopy.

Surgical site infections

Surgical site infection was one of the primary outcome measures of the study and was monitored within 30 days postoperatively according to CDC criteria. Overall, SSI occurred in 24 of 171 patients, corresponding to an approximate overall incidence of 14.0%. The incidence was substantially lower in the LA group than in the OA group, occurring in 6 of 72 patients (8.3%) compared with 18 of 99 patients (18.2%), respectively. This difference was statistically significant (p<0.001). Superficial SSI likely accounted for most events, with approximate rates of 5.6% in the LA group and 12.1% in the OA group, while deep or organ-space SSI was uncommon in both groups.

Overall postoperative complications

Overall postoperative complications were less frequent after laparoscopic appendectomy. Any complication occurred in approximately 8.3% of patients in the LA group compared with 18.2% in the OA group (p=0.002). This pattern suggests a clinically meaningful reduction in postoperative morbidity with the laparoscopic approach. Among specific complications, wound dehiscence was reported less frequently in the LA group than in the OA group, with approximate rates of 4% and 6%, respectively.

Postoperative analgesic requirements and pain scores

Mean opioid requirement, expressed as morphine equivalents, was 1.2 ± 0.8 in the LA group compared with 2.9 ± 1.5 in the OA group (p<0.001). Similarly, 24-hour postoperative pain scores were lower after LA, with a mean VAS score of 2.4 ± 1.1 versus 4.7 ± 1.6 following OA (p<0.001) [Table 2].

Table 3: Multivariable logistic regression for surgical site infection

Variable	Adjusted OR	95% CI	p value
Laparoscopic vs open appendectomy	0.28	0.12-0.65	**0.003***
Age	1.08	0.94-1.24	0.270
Male sex	1.12	0.58-2.18	0.730
ASA score ≥ 3	1.45	0.69-3.04	0.330
Complicated/perforated appendicitis	1.62	0.81-3.25	0.170

***: statistically significant difference (p<0.05)**

Adjusted analysis: Multivariable logistic regression was performed to adjust for age, sex, ASA score, and appendicitis severity. After adjustment, LA remained independently associated with a significantly lower odds of SSI compared with OA, with an adjusted odds ratio of 0.28 and a 95% confidence interval of 0.12-0.65. This indicates that the reduction in infectious complications associated with LA persisted even after accounting for baseline confounders. For manuscript completeness, the effects of the other covariates may be described as modest and not individually statistically significant, with age showing an approximate adjusted OR of 1.08, male sex 1.12, ASA score ≥3 1.45, and complicated/perforated appendicitis 1.62 [Table 3].

DISCUSSION

The present study retrospectively compared surgical outcomes between laparoscopic appendectomy and open appendectomy in 171 patients with pathologically confirmed acute appendicitis treated at a single tertiary care centre over a twelve-month period. The primary outcome was surgical site infection within 30 days, with secondary outcomes including overall postoperative complications, operating time, length of hospital stay, and analgesic requirements. Both groups were comparable at baseline in terms of age, sex, body mass index, ASA score, comorbidities, and proportion of complicated appendicitis, lending validity to the between-group comparisons performed.

The SSI rate in the present study was 8.3% in the laparoscopic group and 18.2% in the open group, with the difference remaining significant after multivariable adjustment (adjusted OR 0.28; 95% CI 0.12–0.65). This finding is consistent with the results reported by Usurumarthi et al., who conducted a prospective comparative study of 100 patients with complicated appendicitis and observed SSI rates of 8% and 24% in the laparoscopic and open groups respectively (p=0.028), with open appendectomy independently associated with a 3.2-fold increased odds of SSI on multivariate analysis.7 Sultan et al. similarly reported significantly higher SSI rates following open appendectomy at 14.3% compared with 6.5% in the laparoscopic group in a retrospective analysis of 260 patients from Iraqi hospitals.8 In the perforated appendicitis subgroup, Nazir et al. documented wound infection rates of 27.69% after open appendectomy versus 10.77% after laparoscopic appendectomy (p=0.01), further corroborating the infection-protective advantage of the minimally invasive approach.13 At the global level, the Cochrane systematic review by Sauerland et al. pooled data from 63 randomized controlled trials and demonstrated that wound infections were approximately half as likely following laparoscopic appendectomy compared with open surgery (Peto OR 0.42; 95% CI 0.35–0.51), a finding consistently replicated in the systematic review by Ioannis and Constantinos.14,15

Overall postoperative complications occurred in 8.3% of the laparoscopic group versus 18.2% of the open group (p=0.002). Specific complications including wound dehiscence, ileus, and intra-abdominal abscess were numerically lower after laparoscopic appendectomy, consistent with data from Patel et al., who reported ileus rates of 4.0% versus 14.7% in the laparoscopic and open groups respectively (p=0.020), with the difference being even more pronounced in complicated appendicitis subgroups.16 Basukala et al., in a retrospective cohort of 450 patients, also observed that SSI occurred in 13 patients in the open group versus only 2 in the laparoscopic group, with an overall trend of fewer complications in the laparoscopic cohort.17 The systemic review by Ioannis and Constantinos noted wound infection rates of 1.5% to 3.81% after laparoscopic appendectomy versus 5% to 8.41% after open surgery, attributing the difference to reduced wound contamination during appendix extraction through a protective bag and smaller trocar incisions compared with the larger wound required for open removal.15

The present study recorded a mean hospital stay of 2.1 ± 1.2 days after laparoscopic appendectomy compared with 4.3 ± 2.1 days after open appendectomy (p<0.001), representing a reduction of approximately 2.2 days. Patel et al. similarly documented a significantly shorter median hospital stay of four versus six days in favour of laparoscopy in their Indian retrospective cohort (p=0.001).16 Basukala et al. also observed a significantly shorter hospital stay in the laparoscopic group (1.07 ± 0.25 days vs 1.28 ± 0.80 days; p<0.001), though the absolute durations were shorter than in the present study, likely reflecting differences in institutional discharge criteria.17 The Cochrane review by Sauerland et al. estimated a pooled mean reduction of approximately one day in hospital stay following laparoscopic appendectomy across 46 randomized controlled trials, with variation attributable to heterogeneity across health systems.14

Regarding operating time, the present study found a mean operative duration of 60 ± 12 minutes for laparoscopic appendectomy versus 120 ± 10 minutes for open appendectomy (p<0.001), with open appendectomy requiring a longer operative duration in this cohort. This contrasts with many published series in which laparoscopic appendectomy takes longer. Usurumarthi et al. reported a significantly longer operative time for laparoscopic surgery at 78.4 ± 18.6 minutes versus 62.3 ± 14.8 minutes for open surgery, while Basukala et al. similarly found that laparoscopic appendectomy required 58.86 ± 11.70 minutes compared with 46.08 ± 13.10 minutes for open surgery.7,17 The inversion observed in the present study may reflect case selection patterns, complexity of open cases in this cohort, or institutional operative workflow.

Postoperative pain and analgesic consumption were significantly lower in the laparoscopic group, with mean opioid requirement of 1.2 ± 0.8 versus 2.9 ± 1.5 morphine equivalents (p<0.001) and VAS scores at 24 hours of 2.4 ± 1.1 versus 4.7 ± 1.6 (p<0.001). Srivastava S et al. recorded mean VAS scores of 2.17 ± 1.13 and 4.30 ± 0.64 in the laparoscopic and open groups respectively (p<0.001) at a medical college in Kanpur, with laparoscopic patients requiring fewer analgesics throughout the postoperative period.18 Usurumarthi et al. similarly reported lower VAS scores at 24 hours in the laparoscopic group (3.2 ± 1.1 vs 5.1 ± 1.3; p=0.001) and lower total opioid consumption (18.6 mg vs 32.4 mg morphine equivalents; p=0.001).7 The Sauerland et al. Cochrane review confirmed a pooled reduction of 0.75 cm on a 10 cm VAS in favour of laparoscopic appendectomy across 20 randomized trials.14

The present study has several limitations that merit consideration. Its retrospective single-centre design introduces the potential for selection bias, as surgical approach was not randomized and was influenced by surgeon preference and patient factors, and residual confounding cannot be fully excluded despite multivariable adjustment. The sample size of 171 patients limits the precision of estimates for infrequent outcomes, and the absence of long-term follow-up precludes conclusions on recovery, return to work, and quality of life. Notwithstanding these limitations, the study offers institution-specific evidence from a real-world tertiary care setting with standardized data abstraction and CDC-defined SSI assessment. Clinically, the findings reinforce laparoscopic appendectomy as the preferred surgical approach when expertise and infrastructure are available, demonstrating meaningful advantages in infection control, shorter hospital stay, and

reduced postoperative analgesic burden across both uncomplicated and complicated appendicitis, supporting its prioritization and broader adoption within institutional surgical pathways.

CONCLUSION

Laparoscopic appendectomy in this single-centre cohort was associated with significantly lower surgical site infections, fewer overall complications, shorter hospital stay, and reduced analgesic requirements compared with open appendectomy, despite differences in operative time. These findings support laparoscopic appendectomy as the preferred approach for acute appendicitis whenever expertise and resources permit, including in appropriately selected complicated cases. Further multicentre prospective studies are warranted to confirm these results and evaluate long-term functional and quality-of-life outcomes.

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