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Original Article

Comparative Outcomes of Laparoscopic Versus Open Appendectomy for Acute Appendicitis: A Tertiary Hospital-Based Study

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Abstract

Background: *Acute appendicitis is a leading cause of emergency abdominal surgery worldwide, and in South Asian tertiary hospitals. Laparoscopic appendectomy is widely adopted due to advantages in pain control, earlier feeding and ambulation, shorter hospital stays, and lower wound infection, although operative time and local system factors may influence outcomes. The study aims to compare outcomes between laparoscopic and open appendectomy for acute appendicitis in a tertiary hospital in Bangladesh.*

Methods: *This comparative observational study was conducted at Sir Salimullah Medical College & Mitford Hospital, which enrolled 160 consecutive patients with intraoperatively confirmed acute appendicitis; 80 underwent laparoscopic appendectomy, and 80 underwent open appendectomy based on surgeon preference and feasibility. Baseline assessment included clinical features and timing, WBC, neutrophil percentage, CRP, and imaging, ultrasonography routinely and CT selectively, with comorbidities and ASA class recorded. Standard laparoscopic three-port and conventional open techniques were used, with selective drain placement, conversion, and intraoperative events documented. Outcomes included 24-hour pain score, opioid use, time to oral intake and ambulation, antibiotic duration, length of stay, complications, and 30-day readmission, reoperation, and mortality. Analyses used SPSS v26 with appropriate comparative tests and $p<0.05$ as significant.*

Results: *Baseline characteristics and preoperative clinical, laboratory, and imaging findings were comparable between groups. Laparoscopic appendectomy required longer operative time than open appendectomy (55 ± 18 vs 42 ± 15 minutes, $p<0.001$), with a 6.3% conversion rate. Postoperative recovery favored laparoscopy, including lower 24-hour pain scores (3.6 ± 1.4 vs 4.5 ± 1.6, $p<0.001$), reduced opioid requirement (27.5% vs 50.0%, $p=0.006$), earlier oral intake (11.2 ± 4.6 vs 15.0 ± 5.2 hours, $p<0.001$) and ambulation (13.5 ± 5.3 vs 18.4 ± 6.0 hours, $p<0.001$), shorter antibiotic duration (2.1 ± 1.5 vs 3.0 ± 1.8 days, $p<0.001$), and shorter hospital stay (2.5 ± 1.0 vs 3.4 ± 1.3 days, $p<0.001$). Overall complications were lower with laparoscopy (10.0% vs 22.5%, $p=0.052$), and surgical site infection was significantly reduced (2.5% vs 12.5%, $p=0.032$). Readmission and reoperation rates were low and similar, with no mortality in either group.*

Conclusion: *Laparoscopic appendectomy provided superior early recovery compared with open appendectomy, with less pain and opioid use, earlier feeding and ambulation, shorter antibiotic courses, and reduced hospital stay, despite longer operative time. Morbidity was lower, particularly surgical site infection, while major complications, readmission, reoperation, and mortality were comparable between approaches.*

Keywords: Acute appendicitis, Laparoscopic appendectomy, Open appendectomy, Postoperative outcomes, Surgical site infection.

Introduction

Acute appendicitis remains one of the most frequent causes of emergency abdominal surgery worldwide, with substantial downstream impact on hospital workload, antibiotic exposure, operative capacity, and preventable morbidity when diagnosis or definitive treatment is delayed[1,2]. Contemporary epidemiologic analyses show that appendicitis continues to impose a large and, in some settings, rising burden across both high-income and low-to-middle income countries (LMICs), reflecting changes in population age structure, urbanization, and access to timely surgical care[3-5]. In South Asia, where referral delays, crowded emergency services, and resource constraints are common, perforation, diffuse peritonitis, and postoperative infectious complications remain clinically consequential outcomes that directly affect length of stay, readmissions, and total cost of care[4,5]. Over the past three decades, laparoscopic appendectomy has increasingly replaced open appendectomy in many health systems, driven by the expectation of reduced surgical site infection, lower postoperative pain, earlier oral intake and ambulation, shorter hospitalization, and faster return to baseline activity[6,7]. Large evidence syntheses and guideline statements generally support laparoscopy as the preferred approach for uncomplicated appendicitis when appropriate expertise and equipment are available, while also acknowledging practical constraints and case-mix considerations, particularly in complicated appendicitis and in settings where operative time, instrument availability, and perioperative monitoring capacity are limiting[6-8]. Notably, comparative literature often demonstrates a trade-off profile: laparoscopic procedures may require longer operative time, yet can still yield superior recovery metrics and lower wound morbidity, which are outcomes of high relevance to high-volume tertiary centers[7-9]. However, the external validity of much of the historical evidence base is frequently challenged in LMIC contexts, where patient presentation is commonly later, disease severity at operation may be higher, and institutional pathways, sterilization capacity, and postoperative surveillance differ from high-income environments[4,6]. Implementation barriers, including training opportunities, maintenance of equipment, and sustainable supply chains for laparoscopic instruments, can further influence real-world outcomes and complication profiles, independent of surgical technique itself[10]. Regional data from Bangladesh are comparatively limited, yet available prospective observations suggest clinically meaningful advantages of laparoscopic appendectomy in pain control, time to feeding, cosmesis, and length of stay, with low wound infection rates reported in laparoscopic cohorts[11,12]. Parallel evidence from other LMIC tertiary hospitals similarly indicates faster recovery endpoints with laparoscopy, although direct costs and affordability may remain important modifiers of access and procedure selection[13,14]. Given these considerations, context-specific comparative outcomes research is needed to inform departmental protocols, patient counseling, perioperative antibiotic strategies, and resource planning within Bangladeshi tertiary hospitals. A focused comparison of laparoscopic versus open appendectomy, using standardized perioperative and postoperative endpoints relevant to acute appendicitis severity, can help clarify whether the expected benefits of laparoscopy in pain, gastrointestinal recovery, and wound morbidity are reproducible under local constraints, and whether any signals of increased intra-abdominal septic complications or conversions materially affect overall safety[6-9]. Therefore, the study aims to compare perioperative characteristics, postoperative recovery, and complication rates between laparoscopic and open appendectomy for acute appendicitis in a tertiary hospital setting in Bangladesh.

Methods

This comparative observational study was conducted in the Department of Surgery of Sir Salimullah Medical College & Mitford Hospital in Bangladesh over the year 2024. Consecutive patients presenting with a clinical diagnosis of acute appendicitis and undergoing appendectomy were enrolled. A total of 160 patients were included, 80 underwent laparoscopic appendectomy

(LA), and 80 underwent open appendectomy (OA). The operative approach was selected based on surgeon preference and feasibility, including patient factors, imaging findings, and operating room resources.

Patients of either sex were eligible if they had suspected acute appendicitis confirmed intraoperatively. Exclusion criteria included appendiceal malignancy, planned interval appendectomy, generalized abdominal pathology requiring an alternative procedure, pregnancy, severe cardiopulmonary instability precluding pneumoperitoneum, and incomplete perioperative records. Preoperative assessment comprised detailed history and examination, documentation of symptom profile and timing, baseline laboratory tests including total leukocyte count, neutrophil percentage, and C-reactive protein, and abdominal ultrasonography as first-line imaging; computed tomography was performed selectively. Anesthesiology risk was graded using the American Society of Anesthesiologists (ASA) classification, and comorbidities were recorded from clinical history and available records.

LA was performed using a standard three-port technique with pneumoperitoneum, appendiceal control by endoloop or intracorporeal ligation, specimen retrieval in a bag, and peritoneal irrigation when contamination was present. OA was performed via a right lower quadrant muscle-splitting incision with ligation of the appendiceal base, peritoneal toilet as required, and wound closure per institutional protocol. Drain placement was decided intraoperatively for perforation, abscess, or moderate to gross contamination. Conversion to open surgery and intraoperative complications were documented.

Primary outcomes were postoperative recovery and morbidity, including pain score at 24 hours (0–10 scale), opioid analgesia requirement, time to oral intake, time to ambulation, postoperative antibiotic duration, and length of hospital stay. Secondary outcomes included 30-day readmission, reoperation, mortality, and postoperative complications, including surgical site infection, intra-abdominal abscess, ileus, wound dehiscence, urinary complications, and respiratory events. Patients were followed up to 30 days through inpatient records and post-discharge contact or clinic review. Data were analyzed using SPSS (v-26.0). Continuous variables were compared using Student's t-test or Mann-Whitney U test as appropriate, and categorical variables using chi-square or Fisher's exact test. A two-sided p-value <0.05 was considered statistically significant.

Results

Baseline characteristics were well balanced between the 160 patients in both groups. The majority of participants were aged 18–30 years, with 62.5% in the laparoscopic appendectomy (LA) group and 57.5% in the open appendectomy (OA) group. Mean age was similar between groups (29.8 ± 11.2 years in LA versus 31.1 ± 12.0 years in OA, $p = 0.48$). The proportion of male patients was comparable (57.5% in LA versus 55.0% in OA, $p = 0.873$). Body mass index (BMI) was also similar (24.6 ± 3.2 in LA versus 24.9 ± 3.5 kg/m² in OA, $p = 0.572$). Urban residence was more common in both groups (65.0% in LA versus 60.0% in OA, $p = 0.624$). Comorbidity rates and anesthesia risk were comparable, with any comorbidity present in 17.5% of LA and 22.5% of OA patients ($p = 0.434$), and most patients were classified as ASA class I (67.5% in LA and 62.5% in OA), with no significant difference.

Preoperative symptom profiles were similar between groups. Migratory pain was reported by 52.5% of LA patients and 48.8% of OA patients ($p = 0.752$). Nausea or vomiting was common in both groups (60.0% in LA versus 65.0% in OA, $p = 0.624$), and anorexia was present in approximately three-quarters of patients (75.0% in LA versus 72.5% in OA, $p = 0.857$). More severe clinical signs, such as guarding or rigidity (32.5% in OA versus 22.5% in LA) and

generalized peritonitis (12.5% in OA versus 7.5% in LA), were more frequent in the OA group, although these differences were not statistically significant. Median symptom duration and time from admission to surgery were comparable between groups: 18 (12–30) hours in LA versus 20 (12–36) hours in OA, and 10 (6–16) hours in LA versus 11 (6–18) hours in OA, respectively.

Table 1. Baseline sociodemographic characteristics between the study groups (n=160)

Variable	LA (n=80) n (%)	OA (n=80) n (%)	p-value
Age group (in years)			
<18	6 (7.5)	5 (6.3)	
18–30	50 (62.5)	46 (57.5)	0.81
31–45	18 (22.5)	20 (25.0)	
>45	6 (7.5)	9 (11.3)	
Mean ± SD	29.8 ± 11.2	31.1 ± 12.0	0.48
Sex			
Male	46 (57.5)	44 (55.0)	0.873
Female	34 (42.5)	36 (45.0)	
BMI, kg/m²	24.6 ± 3.2	24.9 ± 3.5	0.572
Residence			
Urban	52 (65.0)	48 (60.0)	0.624
Rural	28 (35.0)	32 (40.0)	
Any comorbidity	14 (17.5)	18 (22.5)	0.434
Diabetes mellitus	6 (7.5)	8 (10.0)	0.781
Hypertension	7 (8.8)	9 (11.3)	0.798
Bronchial asthma/COPD	2 (2.5)	3 (3.8)	1
ASA class			
I	54 (67.5)	50 (62.5)	
II	22 (27.5)	25 (31.3)	0.796
III–IV	4 (5.0)	5 (6.3)	

Laboratory and imaging findings were comparable between groups. Mean white blood cell (WBC) count was elevated in both LA (13.2 ± 3.9 $\times 10^9$/L) and OA (13.6 ± 4.1 $\times 10^9$/L) groups ($p = 0.528$). Neutrophil percentage was similar (78.5 ± 8.4% in LA versus 79.1 ± 8.9% in OA, $p = 0.662$), as were C-reactive protein (CRP) values (34 ± 28 mg/L in LA versus 38 ± 30 mg/L in OA, $p = 0.385$). Ultrasound was the primary imaging modality in both groups (90.0% in LA versus 87.5% in OA), while computed tomography (CT) was used infrequently (7.5% in LA versus 10.0% in OA).

Table 2. Preoperative clinical presentation and timing parameters in both groups

Variable	LA (n=80) n (%)/Median (IQR)	OA (n=80) n (%)/Median (IQR)	p-value
Migratory pain	42 (52.5)	39 (48.8)	0.752
Fever	28 (35.0)	33 (41.3)	0.515
Nausea/Vomiting	48 (60.0)	52 (65.0)	0.624
Anorexia	60 (75.0)	58 (72.5)	0.857
Rebound tenderness	30 (37.5)	36 (45.0)	0.422
Guarding/rigidity	18 (22.5)	26 (32.5)	0.215
Generalized peritonitis	6 (7.5)	10 (12.5)	0.43
Symptom duration (hours)	18 (12–30)	20 (12–36)	0.41
Admission to surgery (hours)	10 (6–16)	11 (6–18)	0.48

Table 3. Preoperative laboratory indices and imaging utilization among the groups

Variable	LA (n=80) n (%)/Mean ± SD	OA (n=80) n (%)/Mean ± SD	p-value
WBC ($\times 10^9$/L)	13.2 ± 3.9	13.6 ± 4.1	0.528
Neutrophil (%)	78.5 ± 8.4	79.1 ± 8.9	0.662
CRP (mg/L)	34 ± 28	38 ± 30	0.385
Imaging performed			
USG	72 (90.0)	70 (87.5)	
CT	6 (7.5)	8 (10.0)	0.855
None	2 (2.5)	2 (2.5)	

Laparoscopic procedures required a longer operative time (55 ± 18 minutes in LA versus 42 ± 15 minutes in OA, $p < 0.001$), although intraoperative findings were generally similar. Simple inflamed appendicitis was the most common diagnosis (47.5% in LA versus 37.5% in OA), while perforated appendicitis was more frequent in the OA group (15.0% versus 7.5%). However, the overall distribution of intraoperative diagnoses did not differ significantly. Drain usage was lower in the LA group (17.5% versus 30.0%, $p = 0.095$). Conversion from laparoscopy to open surgery occurred in 6.3% of LA cases. Intraoperative complications were rare in both groups (1.3% in LA versus 2.5% in OA).

Table 4. Intraoperative characteristics and operative findings in the groups

Variable	LA (n=80) n (%)/Mean ± SD	OA (n=80) n (%)/Mean ± SD	p-value
Operative time (minutes)	55 ± 18	42 ± 15	<0.001
Intraoperative diagnosis			
Simple inflamed	38 (47.5)	30 (37.5)	
Suppurative	24 (30.0)	22 (27.5)	
Gangrenous	8 (10.0)	10 (12.5)	0.455
Perforated	6 (7.5)	12 (15.0)	
Abscess/mass	4 (5.0)	6 (7.5)	
Peritoneal contamination (moderate to gross)	12 (15.0)	18 (22.5)	0.233
Drain used	14 (17.5)	24 (30.0)	0.095
Conversion to open	5 (6.3)	Not applicable	-
Intraoperative complications	1 (1.3)	2 (2.5)	1

Postoperative recovery outcomes were more favorable in the LA group across several measures. Pain scores at 24 hours were lower in LA patients (3.6 ± 1.4) compared to OA patients (4.5 ± 1.6, $p < 0.001$), and opioid requirements were reduced (27.5% in LA versus 50.0% in OA, $p = 0.006$). LA patients resumed oral intake and ambulation earlier (11.2 ± 4.6 versus 15.0 ± 5.2 hours, and 13.5 ± 5.3 versus 18.4 ± 6.0 hours, respectively; both $p < 0.001$). The duration of postoperative antibiotics was shorter (2.1 ± 1.5 days in LA versus 3.0 ± 1.8 days in OA, $p < 0.001$), as was hospital stay (2.5 ± 1.0 days in LA versus 3.4 ± 1.3 days in OA, $p < 0.001$). Rates of readmission (3.8% in LA versus 7.5% in OA), reoperation (1.3% in LA versus 2.5% in OA), and mortality were low and similar between groups, with no deaths reported.

Table 5. Postoperative recovery outcomes and early clinical course after laparoscopic versus open appendectomy

Outcome	LA (n=80) n (%)/Mean ± SD	OA (n=80) n (%)/Mean ± SD	p-value
Pain score at 24 hours (0–10)	3.6 ± 1.4	4.5 ± 1.6	<0.001
Opioid analgesia required	22 (27.5)	40 (50.0)	0.006
Time to oral intake (hours)	11.2 ± 4.6	15.0 ± 5.2	<0.001
Time to ambulation (hours)	13.5 ± 5.3	18.4 ± 6.0	<0.001
Post-op antibiotic duration (days)	2.1 ± 1.5	3.0 ± 1.8	<0.001
Length of hospital stay (days)	2.5 ± 1.0	3.4 ± 1.3	<0.001
Readmission within 30 days	3 (3.8)	6 (7.5)	0.495
Reoperation	1 (1.3)	2 (2.5)	1
Mortality	0 (0.0)	0 (0.0)	-

Complication rates were generally lower in the LA group. Overall complications occurred in 10.0% of LA patients compared to 22.5% of OA patients, a difference that approached but did not reach statistical significance (p = 0.052). Surgical site infection was significantly less frequent in the LA group (2.5% versus 12.5%, p = 0.032). Other complications, including intra-abdominal abscess, postoperative ileus, urinary complications, and respiratory complications, were rare and did not differ significantly between groups.

Table 6. Postoperative complications comparing the laparoscopic versus open appendectomy groups

Complication	LA (n=80) n (%)/Mean ± SD	OA (n=80) n (%)/Mean ± SD	p-value
Any complication (overall)	8 (10.0)	18 (22.5)	0.052
Surgical site infection (SSI)	2 (2.5)	10 (12.5)	0.032
Intra-abdominal abscess	2 (2.5)	4 (5.0)	0.681
Postoperative ileus	2 (2.5)	5 (6.3)	0.443
Wound dehiscence	0 (0.0)	1 (1.3)	1
Urinary retention/UTI	1 (1.3)	2 (2.5)	1
Respiratory complications	1 (1.3)	1 (1.3)	1

Discussion

Baseline demographics, comorbidity burden, ASA class, symptom profile, and inflammatory markers were broadly comparable between groups in this tertiary hospital cohort, enabling a fair comparison of perioperative outcomes. The primary finding was that laparoscopic appendectomy (LA) resulted in faster postoperative recovery and fewer wound-related complications, despite a longer mean operative time. LA was associated with increased operative duration (55±18 vs 42±15 minutes, p<0.001), but demonstrated lower 24-hour pain scores (3.6±1.4 vs 4.5±1.6, p<0.001), reduced opioid requirements (27.5% vs 50.0%, p=0.006), earlier oral intake (11.2±4.6 vs 15.0±5.2 hours, p<0.001), earlier ambulation (13.5±5.3 vs 18.4±6.0 hours, p<0.001), shorter antibiotic exposure (2.1±1.5 vs 3.0 ± 1.8 days, p<0.001), and reduced length of stay (2.5±1.0 vs 3.4 ± 1.3 days, p<0.001). Overall complication rates were lower with LA (10.0% vs 22.5%), approaching statistical significance (p=0.052), and surgical site infection (SSI) was significantly reduced (2.5% vs 12.5%, p=0.032). The increased operative time associated with LA is consistent with previous prospective comparative studies and randomized trials, in which additional steps such as port placement, intra-abdominal assessment, and specimen extraction typically prolong operative duration, particularly during the early phase of a unit's learning curve[15,16]. In this study, conversion to open surgery occurred in 6.3% of LA cases, a rate comparable to contemporary reports and considered clinically acceptable in mixed-severity appendicitis, where factors such as adhesions, perforation, or inadequate visualization may

necessitate conversion to ensure patient safety[17]. The observed recovery benefits, including reduced pain, lower opioid use, and earlier return of function, are consistent with the broader literature. Both prospective studies and meta-analyses have reported decreased analgesic requirements and faster functional recovery following LA, likely due to smaller incisions, reduced abdominal wall trauma, and enhanced early mobilization[15,18]. Systematic reviews comparing laparoscopic and open approaches also demonstrate shorter hospitalization and earlier resumption of normal activities with LA, underscoring the clinical significance of the reduced hospital stay observed in this cohort (approximately 0.9 days shorter)[7]. In high-volume tertiary centers, even modest reductions in length of stay can result in substantial improvements in bed availability and patient throughput. Wound outcomes represented a significant distinction in this study, with SSI rates reduced fivefold in the LA group (2.5% vs 12.5%). This finding is consistent with previous studies and umbrella reviews, which generally report a lower risk of wound infection following LA compared to open appendectomy (OA)[18,19]. Mechanistically, factors such as smaller incisions, reduced tissue exposure, and controlled specimen extraction likely contribute to this reduction. Technique-specific practices, including the routine use of a retrieval bag, have also been evaluated, with some evidence indicating reduced contamination risk, although cost considerations may influence their adoption[20]. In Bangladesh, where postoperative wound infection leads to prolonged dressings, increased antibiotic use, and delayed return to work, the observed reduction in SSI has significant implications for both patients and the healthcare system. Intra-abdominal abscess (IAA) remains a subject of debate following LA, particularly in cases of complicated appendicitis. In this cohort, IAA rates were low and not significantly different between groups (2.5% LA vs 5.0% OA). Recent evidence indicates that, when cases are appropriately stratified, and procedures are performed with sound technique, LA does not increase the risk of IAA and may offer advantages even in complicated cases[21-23]. Large cohort studies identify complicated appendicitis as the primary risk factor for IAA after LA, rather than the laparoscopic approach itself, highlighting the importance of case severity and effective source control[24]. Pediatric meta-analyses similarly suggest that LA is safe in complicated appendicitis, with outcome differences often attributable to heterogeneity in disease severity and perioperative protocols rather than the surgical approach[25,26]. Adjunctive intraoperative strategies are also relevant; recent meta-analyses indicate no clear benefit of routine peritoneal lavage over suction or aspiration alone in preventing infectious complications, supporting a selective rather than routine lavage strategy[27]. The current findings, including lower (though not statistically significant) drain use with LA (17.5% vs 30.0%, p=0.095), are consistent with a growing preference for selective drain placement based on contamination and source control. Timing variables were similar between groups in this cohort (median admission-to-surgery interval: 10 vs 11 hours), which is clinically important because delays from symptom onset to appendectomy are associated with increased morbidity and prolonged length of stay[28]. The comparable timing likely minimized confounding from delay-related complication risk, thereby allowing the observed differences to more accurately reflect the impact of operative approach and subsequent recovery pathways.

Limitations of the study

Key limitations include the single-center, non-randomized design, with procedure choice influenced by surgeon preference and case feasibility, so selection bias and residual confounding are possible. Some recovery outcomes, such as pain scores and time to oral intake or ambulation, are partly subjective and may vary with postoperative care protocols. In addition, follow-up was limited; long-term outcomes such as incisional hernia, adhesive obstruction, and patient-reported quality of life were not assessed.

Conclusion

In this tertiary hospital cohort, laparoscopic appendectomy was associated with better early postoperative recovery than open appendectomy, with lower 24-hour pain scores, reduced opioid requirement, earlier oral intake and ambulation, shorter antibiotic duration, and a shorter hospital stay, despite a longer operative time. Postoperative morbidity also favored laparoscopy, particularly with a significantly lower surgical site infection rate, while serious complications, readmission, reoperation, and mortality were low and comparable between groups. These findings support laparoscopic appendectomy as the preferred approach for acute appendicitis in similar settings when appropriate expertise and resources are available.

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