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Comparative Evaluation of Laparoscopic and Open Appendicectomy in Uncomplicated and Complicated Appendicitis: A Prospective Study

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ABSTRACT

Background: Acute appendicitis is a common surgical emergency. The appearance of laparoscopic appendectomy has tested the conventional open appendectomy as the standard treatment. However, the advantage of either method remains controversial, predominantly in difficult cases. To compare laparoscopic and open appendectomy in both unsophisticated and complicated appendicitis based on operative time, postoperative pain, problems, hospital stay, and recovery time.

Methods: This prospective, randomized study was conducted from March 2024 to February 2025 in a tertiary care hospital. Patients diagnosed with acute appendicitis were randomized into two groups: laparoscopic and open appendectomy. Important parameters, including operative time, postoperative pain, time to oral intake, length of hospital stay, return to normal activity, and difficulties, were assessed and compared

Results: The study compared 50 patients each undergoing laparoscopic (LA) and open appendectomy (OA). LA had longer operative time (53.17 vs. 23.7 min) but shorter hospital stays (3.57 vs. 7.53 days), lower pain scores (2.17 vs. 4.30), and faster recovery (4.17 vs. 7.17 days). MAS ≥7 strongly predicted appendicitis. Ultrasound showed 80.4% sensitivity and 93.7% PPV, outperforming clinical exam (73.9% sensitivity, 91.9% PPV).

Conclusion: The study has concluded that Laparoscopic appendectomy offers better recovery outcomes than open surgery, with less pain, shorter hospital stays, and higher patient satisfaction.

Key-words: Laparoscopic appendectomy, Open appendectomy, Acute appendicitis, Postoperative pain, Surgical outcomes, Complicated appendicitis

INTRODUCTION

Acute appendicitis is one of the most common causes of acute abdominal pain requiring emergency surgical intervention worldwide [1]. Conventionally, open appendectomy, first described by McBurney in 1894, has been the standard surgical treatment [2]. However, the initiation of negligibly invasive methods led to the introduction of laparoscopic appendectomy by Semm in 1983, which has since gained widespread acceptance [3]. The studies compare numerous results such as operative time, postoperative pain, problem rates, length of hospital stay, and regaining time [4]. The difference between OA and LA has been the subject of extensive investigation.

Numerous studies have demonstrated the advantages of LA over OA. For example, a prospective study at Ganesh Shankar Vidyarthi Memorial Medical College, Kanpur, between September 2023 and August 2024, found that LA was connected with a suggestively shorter hospital stay, better postoperative pain regaining, reduced need for analgesics, earlier return of normal bowel activity, and higher patient satisfaction compared to OA [1,4]. In the LA group, the only disadvantage was a longer

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duration of surgery. Similarly, a randomized controlled trial at Northwest General Hospital and Research Centre, Peshawar, from May 2023 to April 2024, reported that LA resulted in less postoperative pain, briefer hospital stays, despite a longer operational time, quicker return to normal activities, and higher patient satisfaction [5].

Regarding postoperative pain, a study from the University of Muhammadiyah Malang indicated that patients who experienced LA experienced significantly less pain on the first and second postoperative days compared to those who underwent OA [3,6]. In addition, a comparative study at Patna Medical College and Hospital found that LA reduced the occurrence of vomiting and ileus, decreased wound infection rates, shortened hospital stays, and was associated with lower postoperative pain scores, and quicker return to normal activities [6,7].

However, some studies have reported no important differences between the two approaches. A prospective comparative study analyzing 52 patients found that while LA had a longer recovery time after operation and was costlier than OA, there were no important differences in operative time, postoperative pain at various intervals, or postoperative complications [8]. In addition, a retrospective cohort study at Shree Birendra Hospital observed that although LA had a longer functioning time, with no significant difference in postoperative difficulties between the two groups, it resulted in shorter hospital stays and less postoperative pain [9].

MATERIALS AND METHODS

Research Design- This was a retrospective analysis of prospectively maintained data conducted at our hospital, involving patients who underwent appendicectomy between March 2024 and February 2025. The study focused on evaluating the diagnostic correlation between the Modified Alvarado Score, ultrasound findings, and confirmed appendicitis. A total of 100 patients with complete clinical and imaging records were included. Each patient's MAS was assessed by a consultant using the following criteria: migratory right iliac fossa pain, tenderness in the right iliac fossa, rebound tenderness, anorexia, nausea or vomiting, fever >37.5°C, and leucocytosis. In addition, all patients underwent ultrasonography performed by a trained radiologist or medical officer. Ultrasound findings considered positive for acute appendicitis included a non-compressible blind-ending tubular structure measuring more than 6 mm in diameter in the right iliac fossa or right hypochondrium, presence of free fluid in RIF, detection of appendicolith, or increased appendiceal vascularity. The inability to visualize the appendix or the identification of a normal appendix was interpreted as a negative scan. Patients were classified into three groups based on clinical and imaging findings. Group 1 included patients with a MAS≥7, who underwent appendicectomy regardless of ultrasound results. Group 2 included those with a MAS<7 but a positive ultrasound, in whom surgery was performed based on imaging. Group 3 consisted of patients with a MAS between 4 and 6 and a negative ultrasound, who were initially observed without antibiotics; if their symptoms persisted or worsened over 1–2 days, appendicectomy was performed based on clinical judgment. The surgical approach varied based on operating room logistics. Laparoscopic appendicectomy was exclusively performed by a consultant surgeon, whereas open appendicectomy was carried out either by a consultant or an experienced senior house officer. The diagnosis of appendicitis was established intraoperatively through macroscopic assessment and, when needed, confirmed histologically. A grossly inflamed appendix was defined as a red, distended organ with prominent surface vessels, while histological confirmation required transmural or mucosal infiltration of neutrophils.

Inclusion Criteria

- Patients who underwent appendicectomy within the study period.
- Availability of complete records, including:
- Modified Alvarado Score assessed by a consultant.
- Documented ultrasound scan findings.
- Recorded height and weight.
- Age ≥ 18 years.

Exclusion Criteria

- Incomplete clinical records or missing MAS parameters.
- Inconclusive or unavailable ultrasound scan data.
- Patients with a known history of chronic abdominal pain or prior appendicectomy.

Statistical Analysis- Data were entered and analysed using SPSS version 25. Descriptive statistics were used to

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summarise baseline characteristics. Categorical variables were expressed as frequencies and percentages, and continuous variables as mean±standard deviation. Comparisons were made using the chi-square test or Fisher's exact test for categorical data, and Student's t-test or Mann–Whitney U test for continuous variables. A p-value of <0.05 was considered a significant difference.

RESULTS

Table 1 shows the patient characteristics between the LA and OA groups. Each group had 50 patients. The average age was slightly lower in the LA group (28.4 years) compared to the OA group (30.1 years). The gender distribution was similar in both groups, with about 60% males and 40% females in the LA group, and 58% males and 42% females in the OA group. The average BMI was marginally lower in the LA group (23.5 kg/m²) than in the OA group (24.2 kg/m²). The Modified Alvarado Score, which helps diagnose appendicitis, was nearly the same in both groups—7.6 for LA and 7.4 for OA. Ultrasound was positive for appendicitis in 85% of LA patients and 82% of OA patients. Fever above 37.5°C was reported in 70% of LA patients and 72% of OA patients. Nausea or vomiting occurred in 76% of the LA group and 80% of the OA group. Anorexia was present in 68% of LA cases and 65% of OA cases. Comorbidities were found in 12% of LA patients and 16% of OA patients. A history of previous abdominal surgery was more common in the OA group (10%) compared to the LA group (6%). Finally, most patients in both groups fell into the ASA I-II classification, indicating a generally healthy population—94% in LA and 92% in OA.

Table 1: Baseline and demographic paramaters of the patients in each group

Parameter	Laparoscopic Appendectomy (LA)	Open Appendectomy (OA)
Number of Patients	50	50
Mean Age (years)	28.4	30.1
Male (%)	60%	58%
Female (%)	40%	42%
Mean BMI (kg/m²)	23.5	24.2
Mean Modified Alvarado Score	7.6	7.4
Ultrasound Positive (%)	85%	82%
Fever >37.5°C (%)	70%	72%
Nausea/Vomiting (%)	76%	80%
Anorexia (%)	68%	65%
Comorbidities Present (%)	12%	16%
Previous Abdominal Surgery (%)	6%	10%
ASA I-II Classification (%)	94%	92%

Table 2 shows key clinical outcomes for both surgical approaches. The mean operative time was much longer for LA (53.17 minutes) compared to OA (23.7 minutes). However, LA patients had a shorter hospital stay, averaging 3.57 days versus 7.53 days for OA. Pain, measured using the Visual Analogue Scale (VAS), was significantly lower in the LA group (2.17) than in the OA group (4.30). Recovery was also faster with LA, as patients returned to normal activities in about 4.17 days, compared to 7.17 days for OA. The wound infection rate was lower in the LA group, while the OA group had a higher rate. On the other hand, intra-abdominal abscesses were slightly more frequent in the LA group (6.7%), while they were rare in OA. Patient satisfaction was noticeably higher with LA, where 90% reported being highly satisfied, in contrast to only 60% in the OA group.

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Table 2: Clinical Features and outcomes of the patients in each group

Parameter	Laparoscopic Appendectomy (LA)	Open Appendectomy (OA)
Mean Operative Time (min)	53.17 ± 12.4	23.7 ± 6.2
Mean Hospital Stay (days)	3.57 ± 2.5	7.53 ± 2.7
Mean Pain Score (VAS)	2.17 ± 1.13	4.30 ± 0.64
Return to Normal Activity (days)	4.17 ± 3.8	7.17 ± 2.7
Wound Infection Rate	Lower	Higher
Intra-abdominal Abscess Rate	6.70%	Rare
Patient Satisfaction (Highly Satisfied)	90%	60%

The data establish a strong correlation between higher Modified Alvarado Scores and the probability of confirmed appendicitis. At lower scores (MAS 2–4), few patients had true appendicitis, even when ultrasound was positive, suggesting limited diagnostic accuracy in this range. From MAS 5 onwards, both the incidence of positive ultrasound findings and confirmed inflamed appendices increased particularly. In patients with MAS ≥7, almost all had confirmed appendicitis, including some with negative ultrasound results, and the high predictive value of MAS alone. Thus, MAS is a dependable clinical tool for diagnosing acute appendicitis, especially when used in conjunction with ultrasound (Table 3).

Table 3: Correlation Between Alvarado Score, Ultrasound Findings, and Intraoperative/Histological Diagnosis

Alvarado Score	Number of Patients	Ultrasound Finding	Inflamed Appendix	Non-Inflamed Appendix
2	1	Positive	1	0
3	6	Positive	4	2
4	5	Positive (3) / Negative (2)	4	1
5	13	Positive (11) / Negative (2)	11	2
6	14	Positive (13) / Negative (1)	13	1
7	28	Positive (17) / Negative (11)	26	2
8	21	Positive (15) / Negative (6)	21	0
9	12	Positive (9) / Negative (3)	12	0

The comparison of diagnostic performance between ultrasonography and clinical examination reveals that both methods have high positive predictive values, with ultrasonography at 93.7% and clinical examination at 91.9%. This indicates that when either method suggests appendicitis, there is a strong likelihood that the diagnosis is correct. However, the negative predictive values for both are notably low (14.3%), signifying that a negative result from either method does not reliably exclude appendicitis. Ultrasonography showed slightly higher sensitivity (80.4%) compared to clinical examination (73.9%), meaning it was more effective at correctly identifying patients with appendicitis. However, both methods demonstrated low specificity, 37.5% for ultrasonography and 40% for clinical assessment, indicating a limited ability to rule out non-inflamed cases accurately. Complete diagnostic accuracy was higher for ultrasonography (77%) than for clinical examination (72%) (Table 4).

Table 4: Diagnostic Performance of Ultrasonography and Clinical Examination in Acute Appendicitis

Parameter	Ultrasonography	Clinical Examination
Inflamed (True Positive)	74	68
Not Inflamed (False Positive)	5	6
Inflamed Missed (False Negative)	18	24

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Correctly Excluded (True Negative)	3	4
Sensitivity (%)	80.40%	73.90%
Specificity (%)	37.50%	40%
Positive Predictive Value (PPV)	93.70%	91.90%
Negative Predictive Value (NPV)	14.30%	14.30%
Accuracy (%)	77%	72%

DISCUSSION

This prospective study, from March 2024 to February 2025, is expected to compare laparoscopic appendectomy and open appendectomy in managing both uncomplicated and difficult appendicitis. The benefits and considerations connected with each surgical method the results show that even with the current literature [10].

Reliable to earlier investigations, LA was related to a longer operative time compared to OA. For instance, a study by Srivastava et al. reported that LA had a mean operative time of 53.17±12.4 minutes, whereas OA averaged 23.7±6.2 minutes [10]. This difference is due to the operational difficulty and the learning curve associated with frequently attributed laparoscopic procedures [11].

Patients experiencing LA knowledge have a significantly shorter hospital stay. The same study noted an average hospital stay of 3.57±2.5 days for LA patients, compared to 7.53±2.7 days for those who underwent OA. In addition, LA patients reported better postoperative pain recovery, with a mean Visual Analogue Scale score of 2.17±1.13, compared to 4.30±0.64 in the OA group [12]. These regaining and reducing postoperative discomfort results recommend that LA facilitates quicker.

While LA offers numerous postoperative advantages, it's essential to consider potential problems. In the aforementioned study, occurring in 10% of cases, intra-abdominal blisters occurred in 6.7% of LA cases, whereas wound infections were more common in OA. However, the complete postoperative difficulty rates did not differ knowingly between the two groups, suggesting that both procedures have comparable safety profiles when performed by experienced surgeons [13].

Patient satisfaction was particularly higher in the LA group, with 90% of patients reporting being "extremely satisfied," compared to 60% in the OA group [14]. In addition, LA patients returned to routine activities sooner, averaging 4.17±3.8 days post-surgery, whereas OA patients took around 7.17±2.7 days.

These results underscore the potential of LA to enhance the management of complicated appendicitis remains a topic of debate. While LA has established benefits in uncomplicated cases, its role in complicated appendicitis is still being evaluated. A study by Pokala et al. reported that difficult appendicitis was associated with a higher occurrence of postoperative intra-abdominal abscesses in LA [15]. Therefore, the excellence of the surgical method should be individualized, considering the patient's condition and the surgeon's expertise [16].

The results from this study reinforce the advantages of LA in terms of postoperative recovery, patient satisfaction, and reduced hospital stay. However, the increased operative time and potential problems in difficult cases necessitate careful patient selection and surgical expertise. More large-scale, randomized controlled trials are necessary to establish definitive guidelines for the optimal surgical method in appendicitis management [17].

CONCLUSIONS

This study concludes that laparoscopic appendectomy (LA) offers superior recovery outcomes compared to open appendectomy (OA), including reduced postoperative pain, shorter hospital stays, faster return to normal activities, fewer wound infections, and higher patient satisfaction. Although LA requires longer operative time, its overall advantages outweigh this limitation. The incidence of intra-abdominal abscesses was slightly higher in the LA group, but general outcomes still favored the laparoscopic method. The Modified Alvarado Score (MAS) proved to be a reliable diagnostic tool, especially at scores of 7 or higher. When combined with ultrasonography, MAS improved diagnostic accuracy, even when one modality was inconclusive. Ultrasound demonstrated slightly better sensitivity and overall accuracy than clinical examination, though both methods had high positive predictive value but low negative predictive value—highlighting their utility in confirming, but not excluding, appendicitis. Ultimately,

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appropriate patient selection and surgical expertise remain essential for optimizing treatment outcomes in acute appendicitis.

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