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Outcomes of Laparoscopic Versus Open Appendectomy in Complicated Appendicitis: A Cross-Sectional Study at a Rural Tertiary Care Hospital in India

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Abstract: **Background:** Complicated appendicitis, which includes gangrenous and perforated forms, poses challenges in surgical management. Both laparoscopic and open appendectomy are established approaches, but outcomes differ in terms of complications, recovery, and hospital stay. **Objective:** To compare the outcomes of laparoscopic versus open appendectomy in patients with complicated appendicitis at a rural tertiary care hospital. **Methods:** A cross-sectional study was conducted at Vedantaa Institute of Medical Sciences, Dahanu, Maharashtra, between January and March 2025. A total of 40 patients with complicated appendicitis were included. Patients underwent either laparoscopic appendectomy (n=18) or open appendectomy (n=22), based on surgeon preference and intraoperative feasibility. Postoperative complications, duration of hospital stay, wound infection rates, intra-abdominal abscess, and return to normal activity were analyzed. **Results:** Laparoscopic appendectomy patients had a shorter mean hospital stay (4.1 ± 1.2 days vs 6.2 ± 1.6 days, $p < 0.01$), lower wound infection rates (11.1% vs 31.8%, $p = 0.08$), and faster return to daily activities (8.5 ± 2.3 days vs 12.2 ± 3.4 days, $p < 0.01$) compared to open appendectomy. Intra-abdominal abscess rates were slightly higher in the laparoscopic group (5.6% vs 4.5%, $p = 0.89$), but the difference was insignificant. **Conclusion:** Laparoscopic appendectomy offers shorter recovery and reduced wound complications compared to open appendectomy in complicated appendicitis, though vigilance for intra-abdominal abscess remains necessary.

Keywords: Appendectomy, Laparoscopy, Open surgery, Complicated appendicitis, Surgical outcomes.

BACKGROUND

Acute appendicitis is among the most frequent surgical emergencies worldwide, with complicated appendicitis—defined as gangrenous or perforated appendicitis with or without abscess—posing greater risks of morbidity and postoperative complications.[1,2] Traditionally, open appendectomy was the standard of care, but laparoscopic appendectomy has gained wide acceptance due to smaller incisions, reduced pain, and faster recovery.[3]

The choice of surgical approach in complicated appendicitis remains debated. Some studies report that laparoscopic appendectomy is associated with shorter hospital stays and lower wound infection rates, while others caution about a

possible increased risk of intra-abdominal abscess.[4,5] Meta-analyses suggest that laparoscopy is safe and effective even in complicated cases, provided surgical expertise and resources are available.[6,7]

In rural Indian hospitals, where resource limitations and variations in surgical training exist, evidence comparing laparoscopic and open appendectomy in complicated appendicitis is limited. Generating local data is crucial to inform surgical decision-making and optimize outcomes in such settings.[8] Therefore, it is of interest to compare outcomes of laparoscopic versus open appendectomy in complicated appendicitis in a rural tertiary care hospital in western India.

MATERIALS AND METHODS

Study Design and Setting

This was a hospital-based, cross-sectional observational study conducted in the Department of General Surgery at Vedantaa Institute of Medical Sciences, Dahanu, Palghar, Maharashtra, India. The hospital serves a predominantly rural and semi-urban population, providing an ideal setting to assess surgical outcomes in resource-limited contexts. The study was carried out over three months, from January 1 to March 31, 2025.

Study Population and Sample Size

A total of 40 consecutive patients diagnosed intraoperatively with complicated appendicitis were included in the study. Complicated appendicitis was defined as cases presenting with gangrenous or perforated appendix, localized or generalized peritonitis, or peri-appendicular abscess. The sample size reflected all eligible patients presenting during the study period and was considered adequate for descriptive and comparative analysis.

Inclusion and Exclusion Criteria

All patients aged 18 years and above who underwent appendectomy for complicated appendicitis during the study period were included. Exclusion criteria were patients with uncomplicated appendicitis, those with prior extensive abdominal surgery precluding laparoscopy, patients unfit for anesthesia, and those unwilling to provide informed consent.

Intervention Groups

Patients were allocated into two groups based on the surgical approach employed. The laparoscopic appendectomy group consisted of 18 patients who underwent standard three-port laparoscopic removal of the appendix. The open appendectomy group included 22 patients operated through a right lower quadrant incision using standard open techniques. The choice of approach was determined by the attending surgeon's preference, intraoperative feasibility, and patient hemodynamic status at presentation.

Data Collection and Variables

Patient data were collected prospectively using a structured pro forma. Variables included demographic characteristics, duration of symptoms, intraoperative findings, operative time, type of appendectomy performed, and intraoperative complications. Postoperative outcomes assessed were length of hospital stay, wound infection, intra-abdominal abscess, and time to return to normal daily activity. Follow-up evaluations were conducted at 2 and 4 weeks postoperatively to document late complications.

Ethical Considerations

The Institutional Ethics Committee of Vedantaa Institute of Medical Sciences reviewed and approved the study protocol. Written informed consent was obtained from all participants before enrollment. Confidentiality was ensured by anonymizing patient details during data analysis and reporting.

Statistical Analysis

Data were entered into a secure database and analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables such as hospital stay and operative time were expressed as mean $\pm$ standard deviation and compared using the independent t-test. Categorical variables including wound infection and intra-abdominal abscess were presented as frequencies and percentages, and comparisons between groups were made using chi-square test or Fisher's exact test where applicable. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 40 patients with complicated appendicitis were included in the study. Of these, 18 underwent laparoscopic appendectomy and 22 underwent open appendectomy. The mean age of patients was 35.4 ± 12.2 years, with a slight male predominance (57.5%). The two groups' baseline demographic and clinical characteristics were comparable (**Table 1**).

Table 1. Baseline demographic and clinical characteristics of patients (n = 40)

Variable	Laparoscopic (n=18)	Open (n=22)	p-value
Mean age (years)	34.6 ± 11.8	36.1 ± 12.6	0.68
Sex (Male/Female)	11 / 7	12 / 10	0.74
Mean symptom duration (days)	2.8 ± 1.1	3.1 ± 1.3	0.42
ASA grade I-II (%)	15 (83.3%)	17 (77.3%)	0.71
ASA grade III (%)	3 (16.7%)	5 (22.7%)	0.71

The mean operative time was slightly longer in the laparoscopic group than the open group, though this difference was not statistically significant. These details are presented in **Table 2**.

Table 2. Operative details of laparoscopic vs open appendectomy

Variable	Laparoscopic (n=18)	Open (n=22)	p-value
Mean operative time (minutes)	72.3 ± 15.4	68.5 ± 14.2	0.39
Intraoperative complications	1 (5.6%)	2 (9.1%)	0.68
Conversion to open (%)	2 (11.1%)	–	–

Postoperative complications showed notable differences. Wound infection rates were lower in the laparoscopic group than open appendectomy, though intra-abdominal abscess formation was slightly more frequent following laparoscopy. The comparison of postoperative complications is shown in **Table 3**.

Table 3. Postoperative complications following appendectomy

Complication	Laparoscopic (n=18)	Open (n=22)	p-value
Wound infection	2 (11.1%)	7 (31.8%)	0.08
Intra-abdominal abscess	1 (5.6%)	1 (4.5%)	0.89
Postoperative ileus	1 (5.6%)	2 (9.1%)	0.68
Reoperation required	0 (0.0%)	1 (4.5%)	0.36

Hospital stays and recovery profiles significantly differed between the two groups. Patients undergoing laparoscopic appendectomy had a shorter mean hospital stay and faster return to normal activities than those undergoing open surgery (**Table 4**).

Table 4. Recovery outcomes in laparoscopic vs open appendectomy

Outcome	Laparoscopic (n=18)	Open (n=22)	p-value
Mean hospital stay (days)	4.1 ± 1.2	6.2 ± 1.6	<0.01
Return to normal activity (days)	8.5 ± 2.3	12.2 ± 3.4	<0.01

DISCUSSION

This study compared laparoscopic and open appendectomy in patients with complicated appendicitis and found that laparoscopy was associated with shorter hospital stay and faster return to daily activities, despite slightly longer operative times. These findings are consistent with international literature demonstrating the advantages of minimally invasive approaches, particularly regarding recovery and reduced hospital resource utilization.[9,10] Although traditionally considered less suitable for complicated appendicitis, laparoscopy has increasingly been shown to be safe and effective in both perforated and gangrenous cases.[11,12]

Postoperative complications varied between the two groups. Wound infections were more frequent in the open appendectomy group, while intra-abdominal abscess rates were comparable, though slightly higher in the laparoscopic group. This pattern has been documented in several meta-analyses, which suggest that although laparoscopy reduces wound-related morbidity, it may carry a small but non-significant risk of postoperative abscess formation.[13] Importantly, our findings echo those of recent systematic reviews that concluded laparoscopy offers superior short-term outcomes without compromising safety, provided surgical expertise is available.[14]

From a rural Indian perspective, these findings are relevant given the constraints of surgical infrastructure and the rising demand for minimally invasive surgery. Laparoscopic appendectomy reduces hospital stay and enables quicker reintegration into work, a critical factor for patients dependent on daily wages. However, barriers such as cost of laparoscopic equipment and training of surgeons remain significant challenges.[15,16] Although this study was limited by

its small sample size and single-center design, it adds to the growing evidence supporting laparoscopy as a safe and advantageous option even in complicated appendicitis.

CONCLUSION

This study demonstrated that laparoscopic appendectomy offers important advantages over open appendectomy in complicated appendicitis, including shorter hospital stay, faster return to daily activities, and lower wound infection rates. Although operative time was slightly longer and intra-abdominal abscess formation remained a comparable risk, the overall outcomes favored laparoscopy. In rural and resource-limited settings, where the burden of complicated appendicitis is high, efforts should be directed towards expanding laparoscopic capacity and training to ensure wider access to its benefits.

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