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Original Research Article

Retrospective Study for Assessing Outcomes and Cost-Effectiveness in Open Versus Laparoscopic Appendectomy

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Abstract:

Introduction: One of the most frequent causes of excruciating abdominal pain in the globe is acute appendicitis. Although laparoscopic appendectomy (LA) is becoming more popular due to benefits including less discomfort, quicker recovery, and better cosmesis, open appendectomy (OA) has historically been the standard procedure. The viability and cost-effectiveness of LA are still unclear in low- and middle-income environments.

Methods: A retrospective observational study was conducted at Narayani Central Hospital, Birgunj, Nepal, including 265 patients who underwent appendectomy between 1 March 2023 and 30 November 2024. Among them, 193 underwent OA and 72 underwent LA. Patients with conversion to laparotomy, primary laparotomy cases, pregnancy, or incomplete records were excluded. Analysis was done on hospital costs, duration of stay, complications, operating time, and demographics. Continuous variables were compared using the t-test or Mann-Whitney U test, while categorical variables were compared using Chi-square/Fisher's exact test.

Results: Male predominance (63%) and younger age groups (10–19 years) were common across both groups. In comparison to OA (19.17%), the overall complication rate was substantially lower in LA (2.78%) ($p < 0.001$). Mean operative time was longer for LA (80.49 ± 21.95 min) versus OA (34.40 ± 11.79 min) ($p < 0.05$). Hospital stay was slightly shorter in LA (2.06 ± 0.29 days) compared to OA (2.09 ± 0.42 days) ($p < 0.05$). The average cost was higher for LA (NPR 42,819 ± 1,400) than OA (NPR 41,981 ± 3,156) ($p < 0.05$). No vascular or visceral injuries occurred in either approach. Subgroup analysis showed no significant difference in complications between the Veress and Hasson techniques.

Conclusion: LA demonstrated fewer complications, shorter recovery, and better cosmetic outcomes but required longer operative time and incurred slightly higher direct costs. OA remains a practical, safe, and accessible approach in resource-limited settings. However, with adequate training and investment, LA can offer superior patient outcomes with acceptable cost differences.

Keywords: Appendicitis, Laparoscopic Appendectomy, Open Appendectomy, Retrospective Study, Cost-Effectiveness.

Introduction

Acute appendicitis (AA) remains one of the most common causes of acute abdominal pain, with a lifetime risk of 7–9%. The usual treatment has always been open appendectomy (OA), which McBurney initially described in 1894. Laparoscopic appendectomy (LA) has become more common as minimally invasive surgery has advanced because of benefits like less pain after surgery, a shorter hospital stays, fewer wound problems, and better cosmetic satisfaction.

Despite these benefits, LA adoption in low-resource environments — including Nepal — remains limited. Constraints include equipment cost, availability of laparoscopic infrastructure, and varying levels of surgeon training. While developed nations have embraced LA as the preferred approach, many South Asian hospitals continue to rely on OA, especially for complicated appendicitis or in financially constrained settings.

Although previous international studies have compared OA and LA, locally generated data from Nepal — especially from private tertiary centers — remain scarce. Considering differences in healthcare systems, patient affordability, and resource limitations, it is essential to evaluate whether findings from high-income countries apply to Nepal.

Therefore, this study was conducted to compare clinical outcomes, complications, and cost differences between OA and LA at Narayani Central Hospital, Birgunj. Providing evidence from a real-

world Nepalese setting may support clinical decision-making and guide policies regarding the scaling of laparoscopic services.

Materials and Methods

This retrospective observational study was conducted in the Department of Surgery at Narayani Central Hospital, Birgunj, Nepal, and included all patients who underwent an appendectomy for clinically proven acute appendicitis between March 1, 2023, and November 30, 2024. The hospital is a tertiary-level referral center catering to patients from the Terai region of Nepal and adjoining border areas of India. The Nepal Health Research Council (NHRC) granted ethical permission for the study through the expedited review process (Ref. No. 2783). Because the study was retrospective, informed consent was not required. No identifying information was used in the analysis, and patient confidentiality was rigorously upheld.

Patients aged 10 years and above, of either sex, who underwent OA or LA during the study period were included, provided that their medical and operative records were complete. Cases that required conversion from laparoscopy to open surgery, appendectomies performed as part of other surgical procedures, primary laparotomy for generalized peritonitis, stump appendicitis, appendicitis in pregnancy, or cases with missing or incomplete records were excluded from the analysis. Based on the operative approach described in surgical notes, patients were categorized into two groups: OA and LA. The decision regarding the surgical technique was made by the operating surgeon following standard clinical judgment and in consultation with the patient or attendant, taking into account disease severity, available resources, and patient preference.

OA was performed using a standard right lower quadrant incision (McBurney or Lanz), followed by delivery of the appendix, ligation and division of the mesoappendix, and removal of the appendix after securing its base. Depending on the surgeon's option, the stump was either ligated or inverted. A 10-mm umbilical port and two 5-mm ports positioned in the suprapubic and right lower quadrant regions were used in the three-port LA procedure. Pneumoperitoneum was created using the Veress needle technique in most patients, while the Hasson open method was reserved for those with prior abdominal surgery. The mesoappendix was divided using bipolar cautery, the appendix was ligated and excised, and the specimen was retrieved using a sterile bag or through the 10-mm port. The peritoneal cavity was irrigated in cases of perforation or purulent contamination, and port-site closure was performed according to standard protocols.

Postoperative care was provided according to hospital guidelines, including intravenous fluids, analgesics, and antibiotics. Oral intake was initiated once bowel sounds returned, usually within six hours after surgery. Patients were discharged when they tolerated oral diet, had stable vitals, and required only oral analgesics. Wound inspection was performed on the second postoperative day, and follow-up on the seventh postoperative day. Additional visits were advised when complications such as wound infection occurred. Transportation or follow-up costs were not included in hospital expense calculations.

A standardized data proforma was used to extract data from inpatient records, operation notes, anesthetic charts, and billing documents. Age, sex, postoperative problems, surgical time, length of hospital stay, and overall hospital cost were among the variables gathered. While hospital stay was assessed from the day of operation to discharge, operative time was defined as the period from skin incision to final skin closure. Intra-abdominal abscess, Surgical site infection, hemorrhage, and vascular or visceral damage were among the complications noted. GNU PSPP (version 3) was used for analysis once all data was imported into Microsoft Excel. To ascertain whether continuous variables were normal, the Shapiro-Wilk test and Q-Q charting were employed. The independent samples t-test was used to compare regularly distributed variables between groups, while the Mann-Whitney U test was used to evaluate non-normally distributed data. The Chi-square test or, when suitable, Fisher's exact test was used to compare categorical variables. Statistical significance was defined as a p-value of less than 0.05.

Results

Demographics: A total of 265 patients underwent appendectomy during the 21-month study period, of which 193 (72.8%) underwent OA and 72 (27.2%) underwent LA. The demographic characteristics of both groups were comparable, with the majority of patients belonging to the 10–19-year age range and a male predominance. The mean age was 25.8 ± 12.9 years in the OA group and 27.56 ± 9.19 years in the LA group. No statistically significant differences were noted in baseline demographics between groups.

The postoperative outcomes demonstrated a clear advantage of LA over OA. The LA group had a considerably lower overall complication rate (2.78%) than the OA group (19.17%) ($p < 0.001$). Wound infection was the most common complication, occurring predominantly after open surgery. Intra-abdominal abscess occurred in only one laparoscopic case, while no vascular or visceral injuries were recorded in either group.

Operative time differed markedly between the two techniques. LA required significantly longer operative duration (80.49 ± 21.95 minutes) compared with OA (34.40 ± 11.79 minutes) ($p < 0.05$). Despite this, the hospital stay was slightly shorter for LA (2.06 ± 0.29 days) than OA (2.09 ± 0.42 days), although the difference was not clinically significant. The mean hospital cost was modestly higher in the LA group (NPR 42,819 ± 1,400) than in the OA group (NPR 41,981 ± 3,156) ($p < 0.05$).

A subgroup analysis within the laparoscopic cohort showed that the Veress technique was used in 97.2% of cases, while the Hasson technique was used in 2.8%. One complication occurred in each subgroup, though the small number of Hasson cases limits interpretation. No trocar-related injuries were reported.

Table 1: Demographic Characteristics of the Study Population

Variable	OA (n = 193)	LA (n = 72)
Mean Age (years)	25.8 ± 12.9	27.56 ± 9.19
Age Range	10–72	10–68
Male: Female	125: 68	42: 30
Most Common Age Group	10–19 years	10–19 years

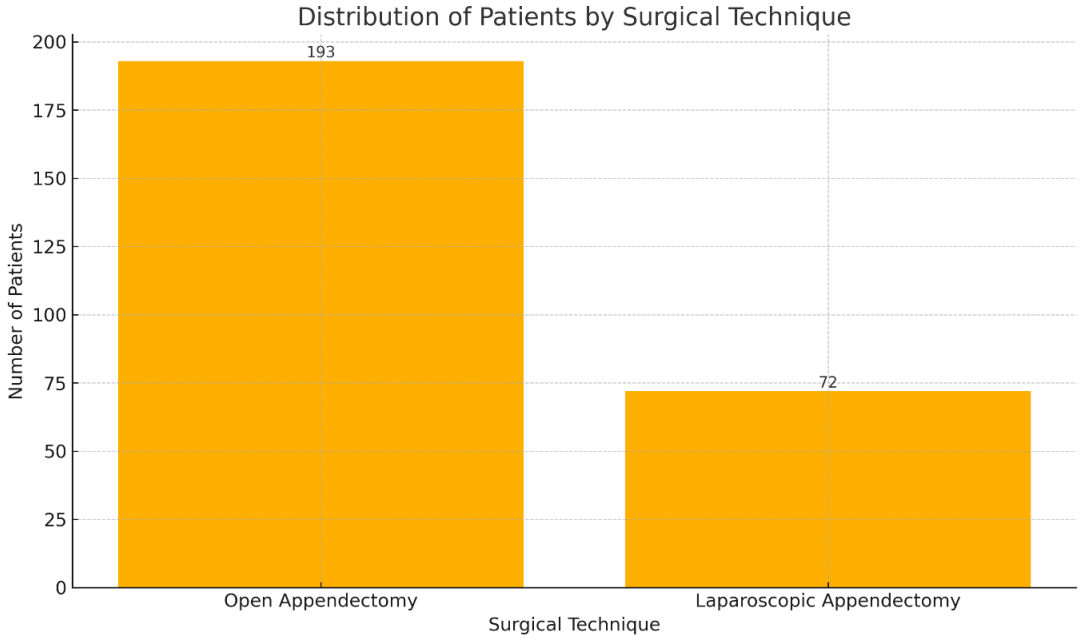

Figure 1: Distribution of Patients by Surgical Technique

Table 2: Operative and Postoperative Outcomes

Outcome	Open Appendectomy	Laparoscopic Appendectomy	p-value
Operative Time (min)	34.40 ± 11.79	80.49 ± 21.95	< 0.05
Hospital Stay (days)	2.09 ± 0.42	2.06 ± 0.29	< 0.05
Hospital Cost (NPR)	41,980.93 ± 3,155.98	42,819.44 ± 1,399.96	< 0.05
Total Complications (%)	19.17%	2.78%	< 0.001

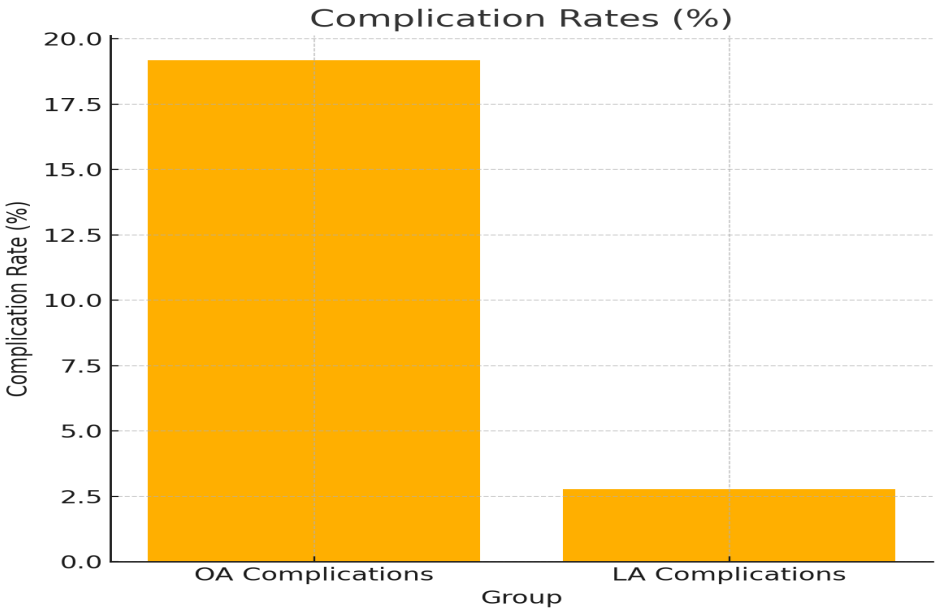

Figure 2: Comparison of Complication Rates Between OA and LA

Table 3: Specific Postoperative Complications

Complication	OA (n=193)	LA (n=72)	p-value
Wound Infection	36 (18.7%)	1 (1.4%)	< 0.001
Intra-abdominal Abscess	0	1 (1.4%)	0.24
Postoperative Bleeding	1 (0.5%)	0	1.00
Total Complications	37 (19.2%)	2 (2.8%)	0.0003

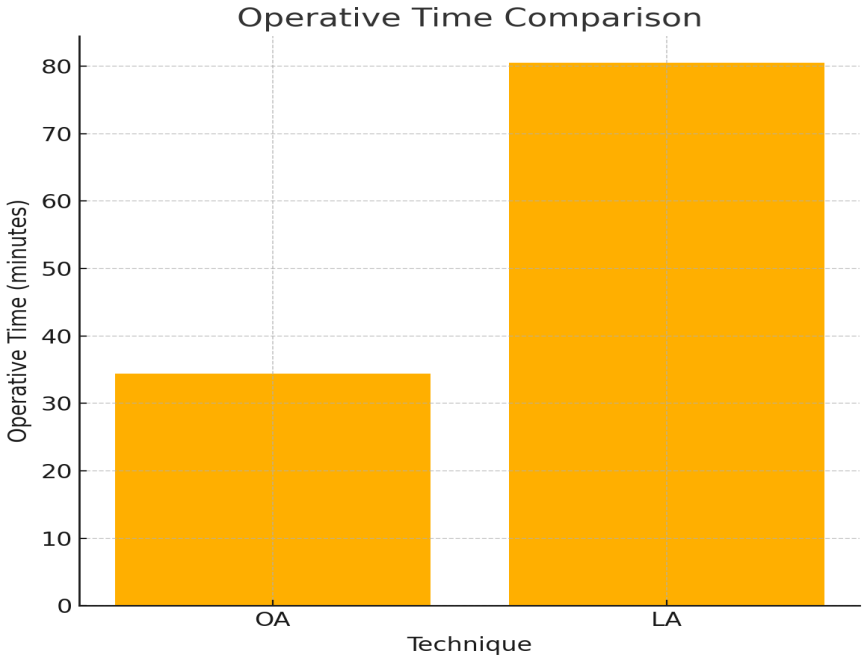

Figure 3: Operative Time Comparison

Table 4: Laparoscopic Subgroup Analysis

Variable	Veress (n=70)	Hasson (n=2)
Mean Surgery Time (min)	81 ± 21.84	62.5 ± 24.74
Mean Cost (NPR)	42,828.57 ± 1,419	42,500 ± 0
Complications	1 (1.43%)	1 (50%)

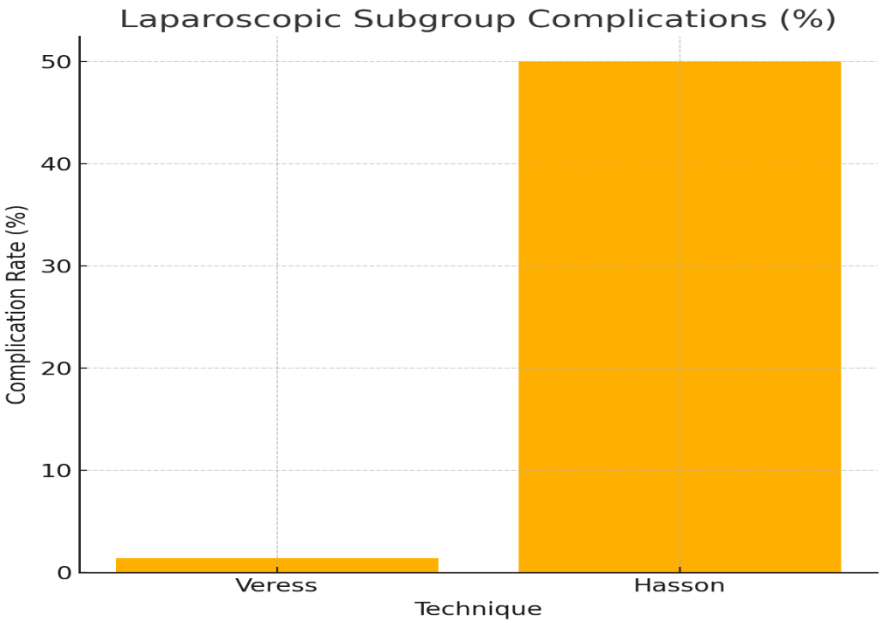

Figure 4: Complication Pattern in Laparoscopic Subgroups

Discussion

This study compared the postoperative outcomes of OA and LA in a tertiary center in Nepal, and the findings clearly demonstrated important differences in clinical performance between the two methods. The two groups were similar at baseline, allowing a meaningful comparison of outcomes attributed directly to the surgical technique rather than patient-related factors. With appendectomy being one of the most frequently performed emergency operations in the region, understanding the practical advantages and limitations of each approach is crucial for guiding routine surgical care.

The most striking observation was the substantially higher complication rate after open appendectomy. Wound infection was the predominant complication, occurring in nearly one-fifth of patients undergoing open surgery. In contrast, laparoscopic appendectomy had very few wound-related issues. The smaller incisions, reduced exposure of the surgical field, and controlled specimen retrieval likely contributed to this advantage. Although a single case of intra-abdominal abscess occurred following laparoscopy, its overall frequency remained extremely low and did not offset the general benefit of the minimally invasive technique.

Another notable finding was the difference in operative duration. Laparoscopic surgery required significantly more time than the open method. While this prolonged duration may seem disadvantageous, it must be interpreted in the context of equipment familiarity, instrument handling, and the learning curve associated with laparoscopy. In settings where laparoscopic surgery is not yet routine, operative time can naturally be longer. With increasing experience and improved access to equipment, operative efficiency is expected to improve, as has been documented in centers that transitioned gradually to minimally invasive practices.

Despite the variation in operative time, the length of hospital stay was nearly identical between the two groups, with a slight trend favoring laparoscopic surgery. This minimal difference is likely influenced by institutional discharge habits and patient expectations rather than clinical necessity. In many low-resource environments, patients may prefer to remain hospitalized longer for observation or logistical reasons. With standardized postoperative pathways, the shorter recovery associated with laparoscopy may become more apparent in future evaluations.

The financial comparison showed that laparoscopic appendectomy incurred slightly higher direct hospital costs than open surgery. This difference stemmed mainly from the instruments and consumables required for laparoscopy. However, the price gap was small and may narrow further as equipment becomes more widely available and reusable systems are adopted. It must also be recognized that direct hospital bills do not reflect the broader economic impact on patients. Lower wound infection rates, fewer follow-up requirements, reduced dressing expenses, and earlier return to daily activities may make laparoscopy more cost-effective overall, even when the initial bill is marginally higher.

The analysis of entry techniques in the laparoscopic group provided additional insight. The Veress needle was the preferred method and was associated with a very low complication rate in this study. Only two patients underwent the Hasson technique, and although one complication occurred, the small

number makes meaningful comparison difficult. Importantly, no major trocar-related injuries were recorded, reflecting safe surgical practice and appropriate patient selection for each entry method.

Overall, this study highlights that laparoscopic appendectomy offers several clear advantages without compromising safety, even in a resource-constrained environment. Open appendectomy remains a dependable procedure, particularly when cost or equipment limitations restrict laparoscopic access. However, the lower complication rate, better wound outcomes, and comparable recovery associated with laparoscopy support its broader adoption as surgical capacity grows. While the retrospective design and single-center setting are limitations, the findings contribute valuable evidence for hospitals in similar contexts and underscore the need for continued investment in laparoscopic training and infrastructure.

Conclusion

LA is associated with fewer complications, shorter recovery, and better cosmetic outcomes compared with open appendectomy. Although LA requires longer operative time and slightly higher direct cost, it remains a superior option where resources permit. OA continues to be a safe, effective, and practical alternative in low-resource settings.

Expansion of laparoscopic training programs and investment in infrastructure may help increase adoption of LA, improving overall surgical outcomes in Nepal.

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