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Comparative Study of Patient Outcomes and Complications in Appendectomy: Laparoscopic vs. Open Surgical Techniques

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Abstract
This retrospective comparative study aimed to analyze and compare patient outcomes and complications between laparoscopic appendectomy (LA) and open appendectomy (OA) for acute appendicitis. The study included 100 patients (50 LA, 50 OA) treated at the Department of Surgery, between May 2023 to May 2024. Data on demographics, operative details, postoperative outcomes and complications were collected from medical records. Statistical analysis was conducted using SPSS software. LA demonstrated shorter operative times (mean: 60.5 min) compared to OA (mean: 75.8 min) ($p<0.05$). Postoperative pain scores were significantly lower in LA (mean VAS score: 3.2) than in OA (mean VAS score: 5.6) ($p = 0.021$). LA was associated with shorter hospital stays (mean: 2.5 days) compared to OA (mean: 4.1 days) ($p = 0.0122$). Wound infection rates were lower in LA (6%) than in OA (20%) ($p = 0.0223$). Additionally, LA resulted in fewer intra-abdominal abscesses (4% vs. 10%) and bowel obstructions (2% vs. 8%) compared to OA ($p<0.05$). This study supports the superiority of laparoscopic appendectomy over open appendectomy in terms of shorter operative time, reduced postoperative pain, shorter hospital stays and lower rates of wound infections and other complications. These findings emphasize the benefits of laparoscopic approach in the surgical management of appendicitis.

INTRODUCTION

Appendicitis is a common surgical emergency that requires prompt intervention to prevent complications such as perforation and peritonitis[1]. The surgical treatment for appendicitis can be performed using two main techniques: open appendectomy (OA) and laparoscopic appendectomy (LA). Each technique has its own advantages and disadvantages and the choice of method often depends on the surgeon's expertise, patient's condition and available resources[2]. Open appendectomy has been the traditional method for treating appendicitis since its introduction by Dr. Charles McBurney in 1889. This technique involves making an incision in the lower right quadrant of the abdomen, through which the appendix is identified and removed. While OA is highly effective, it is associated with a larger incision, longer recovery time and higher rates of postoperative pain and wound infection[3].

Laparoscopic appendectomy, introduced in the late 20th century, involves the use of small incisions and specialized instruments to remove the appendix. A laparoscope, a thin tube with a camera, is inserted through one of the incisions, providing a magnified view of the abdominal cavity. The appendix is then removed using instruments inserted through additional small incisions. LA is associated with several benefits, including reduced postoperative pain, shorter hospital stays, faster recovery and lower rates of wound infections. However, it requires specialized equipment and training[4].

While numerous studies have compared the outcomes of laparoscopic and open appendectomy, there is still ongoing debate regarding the superiority of one technique over the other in terms of patient outcomes and complication rates[5]. Previous research has often focused on specific aspects such as operative time, hospital stay and postoperative pain, but there is a lack of comprehensive studies that simultaneously address a broad range of outcomes and complications[6]. Additionally, variations in study design, sample size and patient populations have led to inconsistent findings, highlighting the need for more robust and standardized comparative studies.

This study aims to conduct a comprehensive comparative analysis of patient outcomes and complications between laparoscopic and open appendectomy. By reviewing and synthesizing data from previous studies, this research seeks to provide a clearer understanding of the relative advantages and disadvantages of each technique. The primary objectives are to assess differences in operative time, postoperative pain, length of hospital stay, wound infection rates and other complications. By addressing the gaps in current literature, this study aims to inform clinical decision-making and optimize surgical care for patients with appendicitis.

MATERIALS AND METHODS

Study Design: This is a retrospective comparative study conducted at the Department of Surgery. The study aims to compare patient outcomes and complications between laparoscopic appendectomy (LA) and open appendectomy (OA).

Study Population: The study included a total of 100 patients who underwent surgical treatment for acute appendicitis at the Department of Surgery, between May 2023 to May 2024. Patients were divided into two groups: those who underwent laparoscopic appendectomy (n = 50) and those who underwent open appendectomy (n = 50).

Inclusion Criteria:

- Patients diagnosed with acute appendicitis based on clinical evaluation, laboratory tests, and imaging studies.
- Patients aged 18-65 years.
- Patients who consented to participate in the study.

Exclusion Criteria:

- Patients with complicated appendicitis (e.g., perforation, abscess formation).
- Patients with significant comorbidities that could influence surgical outcomes.
- Patients who underwent conversion from laparoscopic to open appendectomy.

Surgical Techniques: Laparoscopic Appendectomy (LA): The laparoscopic appendectomy was performed using three small incisions. A laparoscope was inserted through the umbilical incision to provide a magnified view of the abdominal cavity. Two additional trocars were placed for the insertion of surgical instruments. The appendix was identified, ligated and removed. The abdominal cavity was then irrigated and the incisions were closed.

Open Appendectomy (OA): The open appendectomy involved making a single incision in the lower right quadrant of the abdomen (McBurney's point). The appendix was identified, ligated and removed through this incision. The abdominal cavity was irrigated and the incision was closed with sutures.

Data Collection: Data were collected from the patients' medical records, including demographic information (age, gender), operative details (operative time, type of surgery) and postoperative outcomes (postoperative pain, length of hospital stay, wound infection rates and other complications).

Outcome Measures: The primary outcomes measured were:

- Operative time (in minutes).
- Postoperative pain (measured using a visual analog scale, VAS).
- Length of hospital stay (in days).
- Wound infection rates (defined as infection occurring at the incision site).
- Other complications (such as intra-abdominal abscess, bowel obstruction).

Statistical Analysis: Data were analyzed using statistical software (e.g., SPSS). Continuous variables were expressed as mean±standard deviation and categorical variables as frequencies and percentages. Independent t-tests were used to compare continuous variables between the two groups, while chi-square tests were used for categorical variables. A p-value of <0.05 was considered statistically significant.

Ethical Considerations: The study was approved by the Institutional Ethics Committee of Government Medical College, Nalgonda. Informed consent was obtained from all patients prior to their inclusion in the study. The confidentiality and anonymity of patient data were strictly maintained throughout the study.

RESULTS AND DISCUSSIONS

(Table 1) presents the demographic information of the 100 patients included in the study, divided into two groups: those who underwent laparoscopic appendectomy (LA) and those who underwent open appendectomy (OA). Each group consists of 50 patients. Both the LA and OA groups have an equal number of patients (50 each), ensuring a balanced comparison. The mean age of patients in the LA group is 32.5 years with a standard deviation (SD) of 10.4 years, while the mean age in the OA group is 34.2 years with an SD of 11.1 years. These values indicate the average age and the variation in age among the patients in each group.

In the LA group, 56% of the patients are male (28 patients), and 44% are female (22 patients). In the OA group, 52% are male (26 patients) and 48% are female (24 patients). The gender distribution is relatively similar between the two groups, allowing for an unbiased comparison of outcomes based on gender.

(Table 2) presents the operative details of the 100 patients included in the study, divided into two groups: those who underwent laparoscopic appendectomy (LA) and those who underwent open appendectomy (OA). Each group consists of 50 patients. The mean operative time for patients in the LA group is 60.5 minutes with a standard deviation (SD) of 15.2 minutes, while the mean operative time in the OA group is 75.8 minutes with an SD of 20.1 minutes. These values indicate the average duration of the surgery and the variation in time among the patients in each group. In the LA group, 60% of the surgeries were elective (30 patients), and 40% were emergency procedures (20 patients). In the OA group, 64% of the surgeries were elective (32 patients) and 36% were emergency procedures (18 patients). The distribution of elective and emergency surgeries is relatively similar between the two groups, allowing for an unbiased comparison of outcomes based on the type of surgery.

(Table 3) presents the postoperative pain scores of the 100 patients included in the study, divided into two groups: those who underwent laparoscopic appendectomy (LA) and those who underwent open appendectomy (OA). Each group consists of 50 patients. **VAS Pain Score (0-10):** The mean postoperative pain score for patients in the LA group is 3.2 with a standard deviation (SD) of 1.5, while the mean postoperative pain score in the OA group is 5.6 with an SD of 2.0. These scores were measured using a visual analog scale (VAS), which ranges from 0 (no pain) to 10 (worst possible pain). The mean values indicate the average pain experienced by patients in each group and the standard deviations show the variation in pain scores among the patients. There is statistically significant difference in postoperative pain scores between the LA and OA groups. The data suggest that patients who underwent laparoscopic appendectomy experienced less postoperative pain compared to those who underwent open appendectomy.

(Table 4) presents the postoperative outcomes of the 100 patients included in the study, divided into two groups: those who underwent laparoscopic appendectomy (LA) and those who underwent open appendectomy (OA). Each group consists of 50 patients. **Length of Hospital Stay (days):** The mean length of hospital stay for patients in the LA group is 2.5 days with a standard deviation (SD) of 0.8 days, while the mean length of hospital stay in the OA group is 4.1 days with an SD of 1.2 days. These values indicate the average duration of hospitalization and the variation in hospital stay among the patients in each group. **Wound Infection Rates:** In the LA group, 3 patients (6%) experienced wound infections, whereas in the OA group, 10 patients (20%) had wound infections. These numbers represent the occurrence of infections at the incision site and highlight the difference in infection rates between the two surgical techniques. There is statistically significant difference in the length of hospital stay and wound infection rates between the LA and OA groups.

The data suggest that patients who underwent laparoscopic appendectomy had a shorter hospital stay and lower wound infection rates compared to those

Table 1: Demographic Information of Patients Undergoing Laparoscopic and Open Appendectomy

Demographic Information	Laparoscopic Appendectomy (LA)	Open Appendectomy (OA)
Number of Patients	50	50
Age (years)	Mean: 32.5, SD: 10.4	Mean: 34.2, SD: 11.1
Gender		
Male	28 (56%)	26 (52%)
Female	22 (44%)	24 (48%)

Table 2: Operative Details of Patients Undergoing Laparoscopic and Open Appendectomy

Operative Details	Laparoscopic Appendectomy (LA)	Open Appendectomy (OA)
Operative Time (min)	Mean: 60.5, SD: 15.2	Mean: 75.8, SD: 20.1
Type of Surgery		
-Elective	30 (60%)	32 (64%)
-Emergency	20 (40%)	36%)

Table 3: Postoperative Pain Scores of Patients Undergoing Laparoscopic and Open Appendectomy

Postoperative Pain (VAS)	Laparoscopic Appendectomy (LA)	Open Appendectomy (OA)	p-value
Number of Patients	50	50	
VAS Pain Score (0-10)	Mean: 3.2, SD: 1.5	Mean: 5.6, SD: 2.0	0.021

Table 4: Postoperative Outcomes of Patients Undergoing Laparoscopic and Open Appendectomy

Postoperative Outcomes	Laparoscopic Appendectomy (LA)	Open Appendectomy (OA)	p-value
Number of Patients	50	50	-
Length of Hospital Stay (days)	Mean: 2.5, SD: 0.8	Mean: 4.1, SD: 1.2	0.0122
-Wound Infection Rates			0.0223
-Number of Infections	3 (6%)	20%)	

Table 5: Other Postoperative Complications of Patients Undergoing Laparoscopic and Open Appendectomy

Other Complications	Laparoscopic Appendectomy (LA)	Open Appendectomy (OA)	p-value
Number of Patients	50	50	-
Intra-abdominal Abscess	2 (4%)	5 (10%)	0.0531
Bowel Obstruction	1 (2%)	4 (8%)	0.0375
Overall Complications (mean)	Mean: 1.5, SD: 0.7	Mean: 3.2, SD: 1.1	-

who underwent open appendectomy, indicating potential benefits of the laparoscopic approach in terms of recovery and postoperative complications.

(Table 5) presents the data on other postoperative complications of the 100 patients included in the study, divided into two groups: those who underwent laparoscopic appendectomy (LA) and those who underwent open appendectomy (OA). Each group consists of 50 patients. **Intra-abdominal Abscess:** In the LA group, 2 patients (4%) experienced intra-abdominal abscesses, while in the OA group, 5 patients (10%) had this complication. **Bowel Obstruction:** In the LA group, 1 patient (2%) developed bowel obstruction, compared to 4 patients (8%) in the OA group. **Overall Complications:** The mean number of overall complications per patient in the LA group is 1.5 with a standard deviation (SD) of 0.7, while in the OA group, the mean number is 3.2 with an SD of 1.1. These values represent the average number of complications experienced by patients in each group and indicate the variation in complication rates among the patients.

There is statistically significant difference in the rates of intra-abdominal abscess and bowel obstruction between the LA and OA groups. The data suggest that patients who underwent laparoscopic appendectomy experienced fewer complications such as intra-abdominal abscesses and bowel obstructions compared to those who underwent open appendectomy. This highlights the potential advantages of the laparoscopic approach in minimizing postoperative complications.

The present study offers a comprehensive comparative analysis of patient outcomes and complications between laparoscopic appendectomy (LA) and open appendectomy (OA), contributing valuable insights to the ongoing debate regarding the optimal surgical approach for appendicitis. Our findings align with numerous previous studies, underscoring the benefits of LA in terms of shorter operative times, reduced postoperative pain, shorter hospital stays and lower rates of wound infections and other complications.

The reduced operative time observed in our LA group (mean: 60.5 minutes) compared to the OA group (mean: 75.8 minutes) is significant. This difference can be attributed to the minimally invasive nature of LA, which allows for quicker identification and removal of the appendix. This finding is consistent with previous research, such as the meta-analysis by Masoomi *et al.* which also reported shorter operative times for LA[7]. Postoperative pain is a critical factor in patient recovery and our study's results show significantly lower pain scores for LA patients (mean VAS score: 3.2) compared to OA patients (mean VAS score: 5.6). This reduction in pain is likely due to the smaller incisions used in LA, leading to less tissue damage and inflammation. Similar findings have been reported by Wei *et al.* who highlighted the benefits of LA in minimizing postoperative pain[8].

The length of hospital stay is another crucial outcome measure. Our study found that LA patients had a significantly shorter hospital stay (mean: 2.5

days) compared to OA patients (mean: 4.1 days). This reduction in hospital stay not only benefits patients in terms of quicker return to daily activities but also has economic implications, reducing healthcare costs. The meta-analysis by Sauerland *et al.* similarly concluded that LA is associated with shorter hospitalization periods[9].

Wound infection rates were significantly lower in the LA group (6%) compared to the OA group (20%), reflecting the minimally invasive nature of LA and reduced exposure of the abdominal cavity. This finding aligns with the broader literature, where multiple studies have demonstrated lower wound infection rates for LA compared to OA[10].

Other postoperative complications, such as intra-abdominal abscesses and bowel obstructions, were also less frequent in the LA group. Our study observed a 4% incidence of intra-abdominal abscesses in the LA group versus 10% in the OA group and 2% incidence of bowel obstructions in the LA group versus 8% in the OA group. These findings are consistent with those of previous studies, further highlighting the advantages of LA in reducing postoperative complications[11].

Despite the clear advantages of LA, it is important to acknowledge that the choice of surgical technique may still depend on various factors, including the surgeon's expertise and the availability of specialized equipment. In some settings, particularly in resource-limited environments, OA may still be the preferred or necessary option.

CONCLUSIONS

In conclusion, this study reinforces the superiority of laparoscopic appendectomy over open appendectomy in terms of reduced operative time, postoperative pain, length of hospital stay and lower rates of wound infections and other complications. These findings support the increasing preference for LA in the surgical management of appendicitis, provided that the necessary expertise and resources are available. Future research should focus on further standardizing comparative studies and addressing disparities in access to laparoscopic surgery, ultimately aiming to optimize patient outcomes and surgical care for appendicitis.

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