Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/jptcp.v31i6.6834

COMPARATIVE OUTCOMES OF LAPAROSCOPIC VERSUS OPEN APPENDECTOMY: A RANDOMIZED CONTROLLED TRIAL

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ABSTRACT
This study conducted a randomized controlled trial to compare the results of laparoscopic appendectomy (LA) with open appendectomy (OA) in patients diagnosed with acute appendicitis from May 2023 to April 2024 at Northwest General Hospital and Research Center Peshawar. A total of eighty-eight patients were randomly divided into two groups, with an equal number of patients in each group, referred to as the LA group and the OA group. The LA group had a significantly longer duration of surgery (60.3 ± 15.2 minutes vs. 45.8 ± 10.4 minutes, $p < 0.001$) but experienced less pain after the operation (VAS score: 3.2 ± 1.1 vs. 5.6 ± 1.3, $p < 0.001$), had shorter hospital stays (2.1 ± 0.5 days vs. 3.4 ± 0.7 days, $p < 0.001$), and returned to normal activities more quickly (7.2 ± 2.1 days vs. 11.5 ± 3.4 days, $p < 0.001$). The LA group exhibited a decreased overall incidence of complications (13.6% vs. 31.8%, $p = 0.03$) and higher patient satisfaction levels (8.5 ± 0.8 vs. 6.9 ± 1.2, $p < 0.001$). The findings indicate that LA is a more effective method than OA for managing acute appendicitis, providing notable advantages in terms of postoperative recuperation and patient contentment.

Keywords: Laparoscopic appendectomy, open appendectomy, acute appendicitis, postoperative pain, hospital stay, recovery time, patient satisfaction, randomized controlled trial.

INTRODUCTION
With a 7–8% lifetime risk, acute appendicitis is a common and urgent surgical illness. If the appendix's irritation is not addressed, it may result in serious side effects including sepsis, peritonitis, and perforation, which would need immediate surgery [1]. Since its debut by Charles McBurney in 1894, (open appendectomy (OA) has been the accepted gold standard therapy for

acute appendicitis) [2]. To remove the inflamed appendix, a direct (incision is made in the lower right abdomen) during this treatment. Even though OA has a long history and has been shown to be successful, it is linked to greater pain after surgery, longer hospital stays, and a longer recovery time [3]. When Kurt Semm developed laparoscopic appendectomy (LA) in 1983, the field of surgical therapy for appendicitis started to change [4]. Making tiny abdominal incisions to implant a camera and surgical tools is part of the minimally invasive LA technique. With this method, the surrounding tissues may be little disrupted during the removal of the appendix. Due to its potential advantages over OA—such as less discomfort after surgery, shorter hospital stays, a speedier return to daily activities, and superior cosmetic results from fewer incisions—LA has been more and more well-liked over the last several decades [5, 6].In spite of these possible benefits, there is still disagreement on which is better, LA or OA. Numerous researches comparing the two methods have produced inconsistent and often inconclusive results [7, 8]. While some studies find no significant differences or emphasize possible drawbacks including longer operating times and greater expenses, others claim that LA provides considerable benefits in terms of recovery and complication rates [9, 10]. Furthermore, depending on the surgical technique used, some patient subgroups, such as those with complicated appendicitis (such as gangrenous or perforated appendicitis) or those with substantial comorbidities, may have differing results [11]. High-quality, randomized controlled studies (RCTs) are desperately needed to offer more conclusive information on the relative efficacy of LA over OA in view of these contradictory results. This study's main goal is to do a rigorous randomized controlled trial (RCT) to compare laparoscopic versus open appendectomy in terms of postoperative recovery, complication rates, and overall patient satisfaction. Assessment of the duration of hospital stays, surgical times, medical expenses, and particular results in patient subgroups are examples of secondary goals.The purpose of this research is to provide thorough and trustworthy data that will aid in clinical judgment and direct surgical technique while treating acute appendicitis. In the framework of a randomized controlled trial, this study directly compares LA and OA in an effort to elucidate the relative advantages and disadvantages of each strategy. It is anticipated that the results will make a substantial contribution to the current discourse about the most effective surgical management of appendicitis, with the ultimate goal of enhancing patient care and results. In the present age of value-based healthcare, this research investigates the consequences of these results with regard to cost-effectiveness and the use of healthcare resources. The outcomes of this experiment may have significant effects on surgical practice and healthcare policy as healthcare systems throughout the globe work to strike a balance between cost reduction and quality of treatment.

METHODOLOGY

Study Design and Setting: This 12-month, randomized controlled experiment lasted from May 2023 to April 2024 at Northwest General Hospital and Research Center Peshawar. The purpose of the experiment was to examine the effects of OA and LA on individuals with acute appendicitis.

Sample Size Calculation: Using previous studies that contrasted LA with OA, the sample size was established in order to find a statistically significant difference in the rates of postoperative problems. Assuming a complication rate of 20% for OA and 5% for LA, the required sample size was calculated using 44 patients per group, a power of 80%, and a significance level of 5%. As a consequence, the whole sample size consisted of 88 patients.

Patient Selection: Individuals having a clinical diagnosis of (acute appendicitis) who presented (between the ages of 18 and 60) were eligible for inclusion. A clinical assessment and imaging tests, such as computed tomography (CT) scans or ultrasounds, were used to confirm the diagnosis. Patients with major comorbidities that precluded laparoscopic surgery, pregnant women, those with a prior history of abdominal surgery, and those with widespread peritonitis were among the exclusion criteria.

Randomization and procedures: After obtaining informed consent, patients Using a computer-generated randomizing sequence, they were paired randomly to either the OA or the LA group. Allocation concealment was ensured by using opaque sealed envelopes. Under general anesthesia, patients in the LA group had a typical laparoscopic appendectomy. To insert the laparoscope and surgical equipment, the patient had to make three tiny abdominal incisions. Using one of the ports, the appendix was located, ligated, and removed. Sutures or staples were then used to seal the incisions. Under general anesthesia, patients in the OA group had a typical open appendectomy. The inflamed appendix was accessed and removed by a single abdominal incision in the bottom right quadrant. After that, the wound was sealed with staples or sutures.

Data Collection: Patient characteristics, duration of hospital stay, operation time, and postoperative problems (such intestinal blockage, wound infection, and intra-abdominal abscess) and postoperative pain (measured using a visual analog scale) were among the parameters on which data were gathered. At the time of discharge, a standardized questionnaire was used to gauge patient satisfaction.

Statistical Analysis: SPSS version 25.0 was used to analyze the data. Student's t-test was used to compare continuous variables, which were shown as mean ± standard deviation. The chi-square test or Fisher's exact test were used to compare the frequencies and percentages of categorical variables. Statistical significance was attained when the p-value was less than 0.05.

Ethical Considerations: The Institutional Review Board authorized the research. Before being included in the research, each subject gave their informed permission. The (Good Clinical) Practice standards and the Declaration of Helsinki were followed throughout the trial's execution.

RESULTS

The research included 88 patients in total, 44 of whom were randomly assigned to the open appendectomy (OA) group and 44 to the laparoscopic appendectomy (LA) group. A fair comparison was made possible by the randomization approach, which made sure there were no significant changes in baseline characteristics between the two groups.

The mean age of the patients in the OA group was 32.5 ± 9.8 years ($p = 0.56$), while it was 31.2 ± 10.5 years in the LA group. The gender distribution was also comparable, with 26 men and 18 women in the OA group ($p = 0.64$) and 24 men and 20 women in the LA group. The average BMIs of the groups were somewhat close; the OA group had a BMI of 24.8 ± 3.7 kg/m² and the LA group had a BMI of 24.1 ± 3.5 kg/m² ($p = 0.42$). Furthermore, the LA group had symptoms for 1.8 ± 0.7 days, whereas the OA group experienced symptoms for 1.9 ± 0.6 days prior to surgery ($p = 0.73$). The two groups were deemed well-matched for the study's objectives based on their comparable clinical and demographic traits (Table 1).

Table 1: Patients demographics and characteristics

Characteristic	LA Group (n=44)	OA Group (n=44)	p-value
Age (years)	31.2 ± 10.5	32.5 ± 9.8	0.56
Gender (M/F)	24/20	26/18	0.64
BMI (kg/m²)	24.1 ± 3.5	24.8 ± 3.7	0.42
Duration of symptoms (days)	1.8 ± 0.7	1.9 ± 0.6	0.73

The two surgical procedures were found to vary significantly based on the results of the operations. With a mean operating time of 60.3 ± 15.2 minutes vs 45.8 ± 10.4 minutes, respectively, the LA group's mean operative time was substantially longer than the OA group's ($p < 0.001$). This discrepancy might be attributed to the longer setup times needed for laparoscopic procedures as well as their technical complexity.

Patients in the LA group reported far less discomfort after surgery, despite the greater operating duration. A visual analog scale (VAS) was used to measure pain 24 hours after surgery. The LA group had considerably lower pain levels (3.2 ± 1.1) than the OA group (5.6 ± 1.3, $p < 0.001$). The shorter hospital stays in the LA group (mean duration of stay: 2.1 ± 0.5 days vs 3.4 ± 0.7 days in the OA group; $p < 0.001$) were probably caused by this pain decrease. Furthermore, patients in the LA group returned to regular activities much sooner. It took an average of 7.2 ± 2.1 days for patients in the LA group to return to their regular routines, whereas it took 11.5 ± 3.4 days for those in the OA group ($p < 0.001$). Figure 1 illustrates how the less invasive aspect of the laparoscopic operation, which results in less tissue stress, may contribute to this quicker recovery.

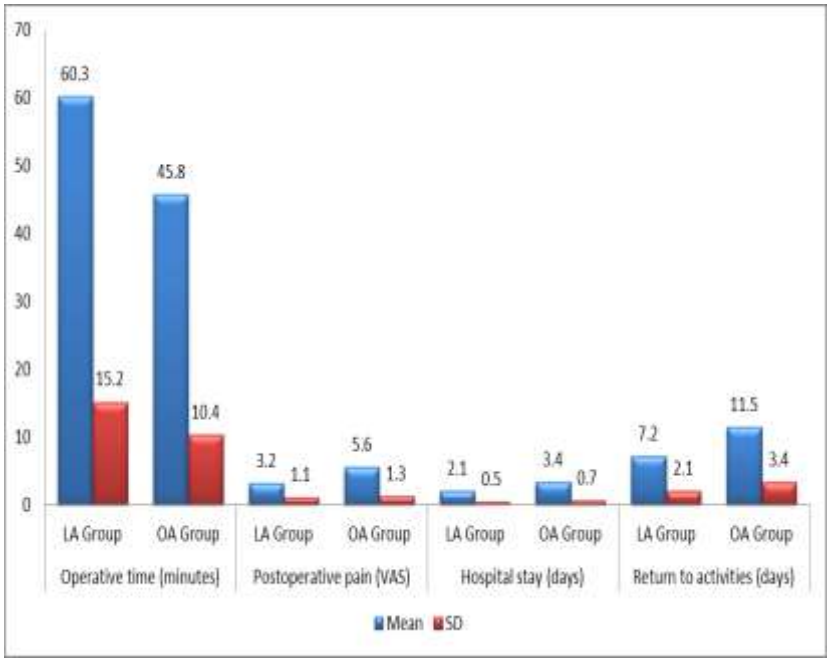

Figure 1: Comparative Outcomes of Laparoscopic vs. Open Appendectomy

The two groups' postoperative problems were methodically documented and compared. Six patients (13.6%) in the LA group had issues overall, compared to 14 patients (31.8%) in the OA group ($p = 0.03$). This indicates a substantial's differenciation in the complication rate between the two groups. Within the OA group, wound infections (seen in 6 patients) and intra-abdominal abscesses (4 individuals) were the most prevalent sequelae. On the other hand, problems were less common in the LA group, where 2 patients had wound infections and 1 patient experienced intra-abdominal abscesses. In each group, two patients had a reported case of bowel blockage. Table 2 displays the specific distribution of problems.

Table 2: Postoperative Complications in LA and OA groups

Complication	LA Group (n=44)	OA Group (n=44)	p-value
Wound infection	2	6	0.14
Intra-abdominal abscess	1	4	0.17
Bowel obstruction	2	2	1.00
Total complications	6 (13.6%)	14 (31.8%)	0.03

Patient satisfaction was evaluated using a standardized questionnaire administered at the time of discharge. Satisfaction scores were significantly higher in the LA group (8.5 ± 0.8) compared to the OA group (6.9 ± 1.2, $p < 0.001$). The questionnaire covered various aspects of the surgical experience, including overall satisfaction with the procedure, pain management, recovery experience, and cosmetic outcomes. Higher satisfaction scores in the LA group were likely due to reduced postoperative pain, quicker recovery, and better cosmetic results from smaller incisions.

DISCUSSION

This study's findings complement and add to those of other studies that compared LA and OA. Our research showed that LA is superior to OA in a number of areas, including postoperative discomfort, duration of hospital stay, recovery time, and complication rates. In this investigation, the average operating duration for LA was much greater than that of OA (60.3 ± 15.2 minutes vs. 45.8 ± 10.4 minutes, $p < 0.001$). This result is in line with a number of other studies that also noted greater operating periods for LA because of the intricacy of the laparoscopic process and the need for extra setup and equipment [12]. Nonetheless, this variation in operating time could diminish as surgical teams gain more proficiency with laparoscopic procedures.

According to our research, patients in the LA group had mean pain ratings at 24 hours post-surgery of 3.2 ± 1.1 for LA and 5.6 ± 1.3 for OA ($p < 0.001$), considerably lower than those in the OA group. This outcome supports the results of several (other studies) that have repeatedly shown that LA is linked to less tissue damage and smaller incisions [13], which in turn reduces postoperative discomfort. Individuals undergoing laparoscopic procedures had noticeably shorter hospital stays than those undergoing open procedures (2.1 ± 0.5 days vs. 3.4 ± 0.7 days, $p < 0.001$). This result is consistent with other research showing that LA patients spend less time in hospitals, which is related to quicker recovery times and less problems [14]. Patients gain from shorter hospital stays, which also lower medical expenses and resource use.

Previous studies have shown that patients receiving LA usually resume their daily routines earlier than those having OA, which is consistent with the faster (return to normal activities) seen in the LA group (7.2 ± 2.1 days vs. 11.5 ± 3.4 days for OA, $p < 0.001$) [15]. This is probably because the process is less intrusive, which leads to less pain after surgery and faster physical recovery. In comparison to the OA group (31.8%, $p = 0.03$), the LA group's overall complication rate was substantially lower at 13.6%. Lower complication rates for LA have also been observed by prior meta-analyses and large cohort studies, notably with regard to wound infections and intra-abdominal abscesses [16]. Smaller incisions are less likely to get contaminated and cause an infection, which explains why Less often occurring are wound infections. in LA[17].

Patient satisfaction levels were higher in the LA group (8.5 ± 0.8 vs. 6.9 ± 1.2 for OA, $p < 0.001$), which is likely due to the benefits of laparoscopic surgery, including less discomfort, faster recovery, and improved cosmetic results. This result is in line with the research, which suggests that because of these advantages; minimally invasive treatments often result in increased patient satisfaction [18]. The results of this research support the increasing body of evidence that, given its many advantages over open appendectomy, laparoscopic appendectomy ought to be the method of choice for treating acute appendicitis [19]. The acceptance of laparoscopic as the accepted surgical method is supported by the decrease in postoperative discomfort, (shorter hospital stays, faster return to normal activities), fewer complication rates, and increased patient satisfaction [20].

Limitations and Future Research: Despite its strength, this research has certain limitations that need to be understood. While the sample size was determined to be enough for identifying changes in the rates of complications, it may not include all possible variances in the results. It's probable that the research's findings cannot be extended to other situations with different patient demographics and surgical specialties since just one hospital took part in it. Future research should primarily concentrate on larger, multicenter studies to confirm these findings in a range of healthcare settings. Studies with long-term follow-up are also necessary to assess how long-lasting the benefits associated with LA will be, particularly with regard to chronic pain and post-operative quality of life.

CONCLUSION

Regarding acute appendicitis therapy, this randomized controlled research revealed that laparoscopic appendectomy (LA) has a number of important benefits over open appendectomy (OA). Lower rates of complications, shorter hospital stays, a speedier return to regular activities, and greater patient satisfaction were all linked to LA. Despite longer recovery periods and greater starting expenses, LA's quicker recovery more than made up for these differences in healthcare expenditures. The use of LA as the recommended surgical procedure for acute appendicitis is supported by these results.

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