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Comparative Study between Laparoscopic Versus Open Appendicectomy

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Abstract: ***Background**: Appendicitis is a common condition requiring surgical intervention, with laparoscopic appendicectomy becoming an increasingly preferred method. The present study compares clinical outcomes between laparoscopic and open appendicectomy in patients with acute appendicitis, focusing on surgery duration, hospital stay, and surgical site infections. **Method**: A prospective, randomized study was conducted from September 2022 to February 2024, involving 100 patients diagnosed with acute appendicitis. Patients were randomized into two groups: Group - O (open appendicectomy) and Group - L (laparoscopic appendicectomy). Surgical outcomes, including surgery duration, hospital stay, and rates of surgical site infections, were compared. **Results**: The study found a significant reduction in surgery duration (Group - O: 27.22 ± 1.87 minutes, Group - L: 17.60 ± 1.47 minutes, p = 0.001) and hospital stay (Group - O: 6.94 ± 2.78 days, Group - L: 3.50 ± 1.64 days, p = 0.001) in the laparoscopic group. The rate of surgical site infections was comparable between both groups (Group - O: 10%, Group - L: 6%, p = 0.737). **Conclusion**: Laparoscopic appendicectomy offers significant advantages over open appendicectomy, including shorter surgery times and faster recovery with reduced hospital stay. Although the surgical site infection rates were similar, the laparoscopic method showed a slight benefit in terms of lower infection rates. These findings support laparoscopic appendicectomy as the preferred approach for most cases of acute appendicitis, with further research needed to confirm these results in larger, multicenter studies.*

Keywords: Appendicitis, laparoscopic appendicectomy, open appendicectomy, surgery duration, hospital stay, surgical site infection.

1. Introduction

Appendicitis is a common condition that affects both the adult and pediatric populations, with the highest incidence occurring between the ages of 10 and 20 years. The lifetime risk of developing appendicitis is 8.6% for males and 6.7% for females. Diagnosis relies on clinical presentation, supported by imaging techniques, and often involves scoring systems such as the Alvarado score. A variety of imaging modalities can be used, with computed tomography (CT) being the most common. Surgical intervention remains the gold standard treatment for acute appendicitis [1, 2]; however, recent research has increasingly focused on non - surgical alternatives, including antibiotics and endoscopic retrograde appendicitis therapy (ERAT), as potential strategies to avoid the risks associated with surgery. [3]

Appendicitis is the most common cause of surgical abdomen in all age groups Approximately 7–10 % of the general population develops acute appendicitis with the maximal incidence being in the second and third decades of life. [4] Open appendicectomy has been the gold standard for treating patients with acute appendicitis for more than a century, but the efficiency and superiority of laparoscopic approach compared to the open technique is the subject of much debate nowadays. [4] There is evidence that minimal surgical trauma through laparoscopic approach resulted in significant shorter hospital stay, less postoperative pain, faster return to daily activities in several settings related with gastrointestinal surgery. [4, 5] However, several retrospective studies, several randomized trials and meta - analyses [6] comparing laparoscopic with open appendicectomy have provided conflicting results. [7] Some of these studies have demonstrated better clinical outcomes with the laparoscopic approach, while other studies have shown marginal or no clinical benefits and higher surgical costs. [8, 9]

There is no clear consensus on which modality is best for performing appendicectomy, the present study was undertaken with an aim to compare the outcomes between laparoscopic and open appendicectomy in patients with acute appendicitis and the objectives of the study were to compare the duration of hospital stay, duration of surgery and surgical site infections between the two groups.

2. Material and Methods

The present prospective, randomized study was conducted in the Department of Surgery, Sri Aurobindo Medical College and Hospital, Indore (M. P.) from September 2022 to February 2024 on 100 patients with acute appendicitis posted for surgical intervention, fulfilling the inclusion and exclusion criteria.

All the patients of age more than 18 years of either sex diagnosed to have acute appendicitis and willing to undergo surgical intervention and willing to provide voluntary written informed consent to participate in the study were included in the study, while patients not willing to participate in the study and those having comorbidities like hypertension, diabetes mellitus type - 2, joints pain, obstructive sleep apnea, cardiac illness were excluded from the study.

The study was approved by the Institutional Ethics Committee and Scientific Review Committee. All the patients were included in the study after obtaining a voluntary written informed consent from them. All the ethical considerations were upheld during the study period and all the patients were explained about their rights during the study period. The present study was not funded by any pharmaceutical company or any institution.

The study conducted by **Nazir *et al.*** [10] titled, "Comparison of Open Appendicectomy and Laparoscopic Appendicectomy in Perforated Appendicitis, " included 65 patients in each group. The mean operating time for the laparoscopic appendicectomy group was 46.98 ± 2.99 minutes, while for the open appendicectomy group, it was 53.02 ± 2.88 minutes. The sample size was calculated based on a comparison of two means, resulting in a required sample size of 8 patients per group, with a 95% confidence interval and 80% study power. However, since our institute saw a sufficient number of patients during the study period, we included 50 patients in each group. The present study used a convenience sampling technique.

3. Method

All the patients admitted to Sri Aurobindo Medical College and Post Graduate Institute, as well as MOHAK Bariatrics & Robotics, Indore with acute appendicitis formed our study population. Informed consent was obtained from all patients who were willing to participate in the study. The enrolled patients were thoroughly examined and investigated as per the study's requirements. A pre - anesthetic check - up was conducted for all participants. A well - informed verbal and written consents were taken from the patients or their relatives, in groups.

The eligible patients were randomized into two groups using computer generated numbers. Patients randomized to Group - O underwent open appendicectomy (Figure 1), while those randomized to Group - L underwent laparoscopic appendicectomy (Figure 2).

Figure 1: Open appendicectomy

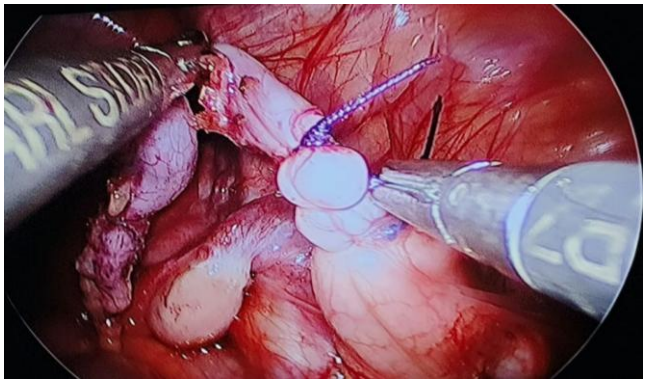

Figure 2: Laparoscopic appendicectomy

The following investigations were conducted for all patients: Complete Blood Count (CBC), Random Blood Sugar (RBS), and tests for HIV, HBsAg, and Anti - HCV. Liver function tests, including serum protein, serum bilirubin, SGOT, SGPT, and ALP, were also performed. Additionally, serum creatinine and urea levels were measured, along with a prothrombin time test and blood group determination.

Special investigations included an ultrasound of the abdomen (USG abdomen), an electrocardiogram (ECG), a 2D echocardiogram, and a chest X - ray (CXR). These tests were carried out to provide a comprehensive assessment of the patients' health. The duration of hospital and surgical site infections were our main outcome measures. All the data was collected in a customized proforma designed for the specific requirement of the study.

Statistical Analysis Plan

The data was initially recorded in a customized format and then transferred to Microsoft Excel for analysis. Descriptive statistics were presented as frequencies and percentages. The means were compared using the Independent t - test, while proportions were compared using the Z - test for two sample proportions. The association between two categorical variables was assessed using the Pearson Chi - square test. A p - value of less than 0.05 was considered statistically significant.

4. Results

We included a total of 100 patients with acute appendicitis in our study, who were randomized into two equal groups of 50 patients each. Group - O patients underwent open appendicectomy, while Group - L patients underwent laparoscopic appendicectomy.

Table 1: Distribution of patients according to age

Age Group	Group	
	Group – O	Group - L
<=20 years	10 (20.0%)	15 (30.0%)
21 - 40 years	32 (64.0%)	29 (58.0%)
41 - 60 years	7 (14.0%)	5 (10.0%)
>60 years	1 (2.0%)	1 (2.0%)
Total	50 (100.0%)	50 (100.0%)
Mean age (years)	29.26 ± 12.28 years	26.90 ± 10.01 years
't' value, df	1.053, df=98	
P value	0.295, Not Significant	

Independent 't' test applied.

Most of the patients in both the groups were in the age group of 21 - 40 years, followed by <=20 years. The mean age of the patients in Group - O was 29.26 ± 12.28 years, while in Group - L it was 26.90 ± 10.01 years, which was comparable (P=0.295). (Table 1)

Table 2: Distribution of patients according to sex

Sex	Group		Chi - square value, df	P value
	Group - O	Group - L		
Female	17 (34.0%)	19 (38.0%)	0.174, df=1	0.677, NS
Male	33 (66.0%)	31 (62.0%)		
Total	50 (100.0%)	50 (100.0%)		

Pearson chi - square test applied.

Males outnumbered the females in both the groups and both the groups were comparable with respect to the sex of the patients (P=0.677) (Table 2).

Table 3: Comparison of mean surgery time

Parameter	Group	
	Group - O	Group - L
Surgery Time (Minutes)	27.22 ± 1.87	17.60 ± 1.47
't' value, df	28.632, df=98	
P value	0.001*	

Independent 't' test applied.

The mean duration of surgery in Group - O was 27.22 ± 1.87 minutes, while in Group - L, it was 17.60 ± 1.47 minutes. The mean duration of surgery was significantly longer in Group - O compared to Group - L (P=0.001). (Table 3)

Table 4: Comparison of mean hospital stay

Parameter	Group	
	Group - O	Group - L
Hospital stay (days)	6.94 ± 2.78	3.50 ± 1.64
't' value, df	7.530, df=98	
P value	0.001*	

Independent 't' test applied.

The mean hospital stay in Group - O was 6.94 ± 2.78 days, while in Group - L, it was 3.50 ± 1.64 days. The mean hospital stay was significantly longer in Group - O compared to Group - L. (Table 4)

Table 5: Comparison of surgical site infection

Surgical site infection	Group		Z test P value
	Group - O	Group - L	
Absent	45 (90.0%)	47 (94.0%)	0.737, Not significant
Present	5 (10.0%)	3 (6.0%)	
Total	50 (100.0%)	50 (100.0%)	

Z test for two sample proportion applied.

The surgical site infection in Group - O was 5 (10%), while in Group - L, it was 3 (6%). The rate of surgical site infection was comparable between the two groups (P=0.737). (Table 5)

5. Discussion

One hundred patients with acute appendicitis who were randomized to two groups (Group - O and Group - L) were included in the study. The main objective of the study was to compare the hospital stay and surgical site infections between the two groups.

Both the groups were comparable with respect to age and sex of the patients.

The mean duration of surgery was significantly shorter in the laparoscopic appendicectomy group (Group - L) compared to the open appendicectomy group (Group - O). Similar findings were reported by **Nazir *et al.* (2019)** [10] and **Yau *et al.* (2007)** [11], both of which showed a significantly reduced operating time for laparoscopic appendicectomy. These results align with our study, where we also observed a shorter operating time in the laparoscopic group. However, contrary to our findings, **Golub *et al.* (1998)** reported a longer mean duration of surgery in the laparoscopic group compared to the open appendicectomy group. [12] Similarly, **Katkhouda *et al.* (2005)** found that the mean operating time was significantly longer for laparoscopic appendicectomy (80 minutes) than for open appendicectomy (60 minutes). [9] **Marzouk *et al.* (2003)** also reported longer operating times for laparoscopic appendicectomy compared to open surgery. [13] On the other hand, **Azaro *et al.* (1999)** found no statistically significant difference in mean surgical times, with 84.4 minutes for laparoscopic appendicectomy and 59 minutes for open surgery. [14] However, the reasons for the difference could not be identified.

The mean hospital stay was significantly shorter in Group - L compared to Group - O. **Marzouk *et al.* (2003)** also found that the mean hospital stay was significantly shorter in laparoscopic group compared to open appendicectomy group. [13] In a study by **Guller *et al.* (2004)** the mean hospital stay was significantly shorter in laparoscopic group compared to open appendicectomy group. [15] These studies support our study's findings, while, contrary to our study's finding, the study by **Katkhouda *et al.* (2005)** found no significant difference in the length of stay between the two groups.

We found no significant difference in surgical site infection rate between the two groups. **Golub *et al*.** also found that incidence of intraabdominal abscess was higher in laparoscopic appendicectomy group, but this difference did not differ significantly. And there was no significant difference in the complication rates. [12] **Katkhouda *et al.* (2005)** in their study also found no significant difference in the complications rates between laparoscopic and open appendicectomy (18.5% versus 17%), but some complications in laparoscopic group required reoperation. [9] **Marzouk *et al.* (2003)** found a significantly higher rate of wound infection in open appendicectomy group compared to laparoscopic group, but found that intraabdominal complications were comparable between the two groups. [13] These studies support the fact that complications rates are higher in open appendicectomy group compared to laparoscopic group, supporting our study's finding too.

Considering shorter duration of surgery, hospital stay with slightly lower surgical site infections in Group - L, the present study found that laparoscopic appendicectomy is better than open appendicectomy.

The limitation of the study is that it was conducted in a single - center, which might introduce selection bias. Despite this limitation, most of the available literature support our study findings.

6. Conclusion

This study compared the clinical outcomes of laparoscopic and open appendicectomy in patients with acute appendicitis. The results indicate that laparoscopic appendicectomy (Group - L) has significant advantages over open appendicectomy (Group - O) in terms of shorter surgery duration and reduced hospital stay. The mean surgical time for laparoscopic appendicectomy was considerably shorter, and patients in Group - L had a significantly quicker recovery, as reflected by their reduced hospital stay.

Although the rate of surgical site infections was comparable between both groups, the laparoscopic approach still showed a slight benefit in terms of lower infection rates, although this difference was not statistically significant. These findings suggest that laparoscopic appendicectomy is associated with faster recovery and fewer complications compared to the traditional open appendicectomy, making it the preferred method for most patients with acute appendicitis.

The study's limitations include its single - center design, which may introduce selection bias, and a relatively small sample size. However, the results are consistent with existing literature that supports the benefits of laparoscopic surgery in appendicitis. Further multicenter, large - scale studies are needed to confirm these findings and refine treatment guidelines for acute appendicitis. Overall, laparoscopic appendicectomy appears to be a superior option for treating acute appendicitis, offering shorter recovery times and comparable complication rates, making it the method of choice in appropriate settings.

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