Advances in Bioscience and Clinical Medicine
ISSN: 2203-1413
www.abcmed.aiac.org.au

Original Article

Laparoscopic Versus Open Appendectomy for the Treatment of Complicated Acute Appendicitis

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ARTICLE INFO

Article history
Received: October 13, 2019
Accepted: January 26, 2020
Published: January 31, 2020
Volume: 8 Issue: 1

Conflicts of interest: None
Funding: None

Key words:
Appendicitis,
Laparoscopic Surgery,
Open Surgery

ABSTRACT

Background and Objective: Acute appendicitis is one of the most common and at the same time lethal if not treated promptly. Failure to treat this medical condition in a timely manner then it can lead to major complications that endanger the patient's health. In these cases, surgical treatment can be done in an open or laparoscopic method. Despite some limited studies comparing the results of these two therapies, there is still insufficient information in patients with this complicated situation. The aim of this study was to evaluate the results of these two therapies in patients with complicated acute appendicitis. **Materials and Methods:** In this randomized controlled clinical trial, 52 patients with complicated acute appendicitis in the laparoscopic surgery group and 56 patients in the open surgery group were studied. Primary outcomes in this study were duration of surgery and secondary outcomes including wound infection, intra-abdominal abscess, postoperative pain, miscarriage, hospitalization, and need for re-surgery that were compared between the two groups. **Results:** Both groups were matched for age (mean 31.0 years in laparoscopic surgery group, 30.5 years in open surgery group, $p = 0.81$) and gender (28 men in laparoscopic surgery group, 32 men in surgical group, $p = 0.73$). The mean duration of surgery in the laparoscopic group was significantly longer (mean 66.8 vs. 55.1 min, $p < 0.001$). In contrast, mean duration of hospitalization (85.2 vs 98.6 hours, $p < 0.001$) and mean postoperative pain severity (6.3 vs 7.2, $p < 0.001$) was more significant high in open surgery group. In other cases there was no significant difference between the two groups. **Conclusion:** Although in surgical treatment of complicated acute appendicitis the duration of laparoscopic surgery is longer than the open method, but the duration of hospitalization and pain intensity in laparoscopic method is significantly reduced.

BACKGROUND

Acute appendicitis is one of the most common and at the same time lethal if not treated promptly. Failure to treat this medical condition in a timely manner then it can lead to major complications that endanger the patient's health. In these cases, surgical treatment can be done in an open or laparoscopic method (1-4). Despite some limited studies comparing the results of these two therapies, there is still insufficient information in patients with this complicated situation (5,6). The aim of this study was to evaluate the results of these two therapies in patients with complicated acute appendicitis.

MATERIALS AND METHODS

In this randomized controlled clinical trial, the results of open surgery and complicated acute laparoscopic appendicitis were compared. This study was performed in Sina Hospital of Tabriz, affiliated to Tabriz University of Medical Sciences. The study period was 16 months from December 2015 to December 2016(the whole study was from December 2015 to April 2016). This study was registered at the Clinicaltrial site under code IRCT2015102724747N1. Written informed consent was obtained from all patients before surgery and treatment and after explaining the procedure and its benefits and complications. This study was approved by the Ethics Committee of Tabriz University of Medical Sciences.

All hospitalized patients with suspected acute appendicitis were evaluated for possible complication and then the suspected cases were randomly divided into two groups and open or laparoscopic surgery was performed on them. In this study the complete enumeration method was used to determine the sample size and all subjects who have inclusion criteria were enrolled from December 2015 to December 2016. Finally, 52 patients in the laparoscopic surgery group and 56 patients in the open surgery group were evaluated. It should be noted that randomization and random allocation were performed using RandList software. The following were used to determine suspected complicated acute appendicitis:

Published by Australian International Academic Centre PTY.LTD.

http://dx.doi.org/10.7575/aiac.abcmed.v.8n.1p.15

- People with a score of 7 or higher in the Alvarado scoring system.
- People a score of 9 or higher in scoring system for acute appendicitis inflammatory response
- People diagnosed with complicated acute appendicitis in radiologic examinations, such as ultrasound or CT scan.

Inclusion criteria were those over 12 years of age, those with suspected complicated acute appendicitis, except for definite abscesses and phlegmon. In this study, all patients with lower right abdominal pain who had symptoms of localized or diffuse peritonitis go under complementary diagnostic tests for complicated acute appendicitis. After the patient was diagnosed with possible complicated appendicitis, the surgical team leader verbally explained the need for surgery and surgical procedures to the patient and entered into the study with written and informed consent. After the initial procedures, including the administration of fluids and antibiotics, the patients were prepared for surgery.

The surgery was done by a team of Sina Hospital surgical team professors and senior surgical assistants who had previously been co-ordinated during the sessions to perform both open and laparoscopic operations under the supervision of the study supervisor.In this study, primary and secondary outcomes were evaluated and compared as follows: The primary outcome of the study was to compare the duration of surgery without including preoperative preparation and anesthesia in minutes and secondary outcomes including surgical site infection, intra-abdominal abscess, postoperative pain, complications such as nosocomial infections, incisional hernias, etc., duration of hospitalization after surgery as days and hours and required re-surgery between the open appendectomy group and the laparoscopic appendectomy group. All cases were compared between the two groups.

Statistical Analysis

The data are presented as standard deviation; mean and frequency (%). The Kolmogorov-Smirnov test was used to examine the distribution of quantitative data. SPSS version 21 Statistical software was also used. Chi-square, Fisher exact test, and t-test were used for independent statistical groups to statistical analysis. P <0.05 was considered statistically significant.

Findings

The mean age of patients in the laparoscopic appendectomy group was 31.0 10 10.9 years (16-66 years) and in the open appendectomy group was 30.5 11 11.0 years (15-68 years) (p = 0.81). In laparoscopic appendectomy group 28 patients (53.8%) were male and 24 patients (46.2%) were female and in open appendectomy group 32 patients (57.1%) were male and 24 patients (42.9%) were female (p=0.73). The mean score of Alvarado for patients in the laparoscopic appendectomy group was 8.3±0.7 (7.9) and in the open appendectomy group was 8.2 ±0.7 (7.9) (p = 0.58). The mean score of acute appendicitis inflammatory response among patients in the laparoscopic appendectomy group was 10.6 ± 01 (9-12) and in the open appendectomy group was 10.5 ± 0.9 (9-12) (p = 0.74). The mean body temperature in the laparoscopic appendectomy group was 38.2 ±0.7 (36.5-39.3) and in the open appendectomy group was 38.1±0.6 (37-39) (p = 0.54).

The mean WBC count in the laparoscopic appendectomy group was 15213.5 ± 2305.7/ml (12000-21000) and in the open appendectomy group it was 15503.6±2591.6/ml (12000-22000)(p=0.54). The mean protein C in the laparoscopic appendectomy group was 3.0 ± 0.8 mg (-2.4) and in the open appendectomy group it was 2.9 ± 0.7 mg (2-4) (p = 0.31).

In the laparoscopic appendectomy group the RLQ pain was seen among 49 patients (94.2%) and in the open appendectomy group it was among 53 patients (94.6%) (p = 0.63). Nausea and vomiting were seen in the laparoscopic appendectomy group among 48 patients (92.3%) and in the open appendectomy group among 51 patients (91.1 %) (p = 0.55). Anorexia was seen in the laparoscopic appendectomy group among 48 patients (92.3%) and in the open appendectomy group among 50 patients (89.3%) (p = 0.74). Pain migration in laparoscopic appendectomy group was seen among 47 patients (90.4%) and in open appendectomy group it was among 50 patients (89.3%) (p = 0.85). Tenderness was present in the laparoscopic appendectomy group among 50 patients (96.2%) and in the open appendectomy group it was seen among 53 patients (94.6%) (p = 0.54). Riband tenderness was present in the laparoscopic appendectomy group among 47 patients (90.4%) and in the open appendectomy group it was seen among 51 patients (91.1%) (p = 0.58).

The mean duration of surgery in the laparoscopic appendectomy group was 66.8 ±11.5 minutes (40-90 minutes) and in the open appendectomy group was 55.1 ±11.9 minutes (35-80 minutes) (p <0.001). The mean duration of hospitalization in the laparoscopic appendectomy group was 85.2 ±11.4 hours (60-110) and in the open appendectomy group was 98.6 ±18.1 hours (60-168) (p <0.001). Mean pain score in laparoscopic appendectomy group was 6.3±1.7 (3-9) and in open appendectomy group was 7.2±1.6 (3-9) (p <0.001).

2 patients in laparoscopic appendectomy group and 8 patients in open appendectomy group had wound infection (p = 0.10). 1 patient in laparoscopic appendectomy and 4 patients in open appendectomy group need to re-surgery (p = 0.37). 5 patients in laparoscopic appendectomy and 9 patients in open appendectomy need to readmission (p = 0.32). Surgical site abscess was seen in 2 patients in laparoscopic appendectomy group and in 3 patients in open appendectomy group (p = 0.54). Sundry effects in laparoscopic appendectomy was seen in 1 patient and in open appendectomy it was seen among 3 patients (p = 0.62).

DISCUSSION

In this study we compare the results of laparoscopic with open surgery in treating the complicated acute appendicitis. Accordingly, the only advantage of the open method over the laparoscopic method was the shorter open surgical time (55.1 minutes vs. 66.8 minutes). This finding is in line with

the results of similar studies showing that in the treating the acute appendicitis, open surgery is significantly shorter than laparoscopic surgery (1 - 16). This may be due to the need for peritoneal lavage and the need for a tying of base in the laparoscopic procedure (17-22).Despite this finding, to the detriment of the laparoscopic method, the median length of hospitalization (85.2 hours vs. 98.6 hours) and the mean severity of postoperative pain (6.3 vs. 7.2) were significantly shorter compared to open surgery. We found that the results of a study done by Mohamed and Mahran (2013), on 133 patients with complicated acute appendicitis in the laparoscopic surgery group and 82 patients with complicated acute appendicitis in the open surgery group are correlate with the findings of our study that postoperative analgesia and the average duration of hospitalization after surgery in the open surgery group is significantly more (5). In another study by Garg et al. (2009) on patients with complicated acute appendicitis who go under open surgery (61 patients) or laparoscopic surgery (49 patients) the postoperative pain severity and average hospitalization (3 day 6 versus day 1) was significantly higher in the first group (23). A comprehensive study conducted by Yau et al. (2007) on patients with complicated acute appendicitis showed that in the open surgical treatment group (69 patients) the mean hospitalization was significantly higher than the laparoscopic surgery group (244) (5 days versus 6 days) (9). Similar studies conducted by Sauerland et al. (1998), Slim et al. (1998) and Long et al. (2001) also showed that the average duration of hospitalization in patients with complicated acute appendicitis in the open surgery group was significantly longer than the average hospitalization in the laparoscopic treatment group (22-22). In other studies, in the same group of patients, in addition to shorter hospitalization, less pain severity was reported in the group undergoing laparoscopic surgery (13-11). The reduction of postoperative pain severity in the laparoscopic surgery group has also been emphasized in some other studies (11, 12, 20, 23, 24). The same is true about the duration of hospitalization (22-22). Despite the lower incidence of wound infection (3.8% vs. 14.3%), the need for re-surgery (1.9% vs. 7.1%), the need for readmission (9.6% vs. 1.1) 16%), abscess formation at surgical site (3.8% vs. 5.4%) and incidence of sundry effects(1.9% vs. 5.4%) in laparoscopic surgery group compared to open surgery group in the present study, these results were not statistically significant. The findings of other studies in this area were not consistent and occasionally inconsistent: In a study by Thomson et al. (2015), on 114 patients with complicated acute appendicitis who were randomly divided into two groups of open and laparoscopic surgery, there was no statistically significant difference in the rate of infection, the rate of need for re-surgery, and the need for readmission (25). As can be seen, the findings of this study confirm the results of the current study. However, Tate et al. (1996) in their study reported the decrease in the incidence of wound infection as a major positive outcome of laparoscopic surgery in this group of patients (15). The infection rate reduction in laparoscopic treatment for complicated acute appendicitis has been attributed to the prevention of direct contact with trocar ulcers due to displacement of the appendicitis into the disposable sac and fluid aspiration in the laparoscopic procedure (23, 24, 26). In terms of surgical site abscesses, while Sauerland et al. (2010) reported laparoscopic surgery as a risk factor in this area (27), Piskun et al. (2001), similar to our study, differed in this regard between the two open and laparoscopic surgical procedures (28). It should be noted that the incidence of intra-abdominal abscess is associated with a variety of risk factors, including preoperative resuscitation, prophylactic antibiotic therapy, and the use of standard surgical techniques (19–16). In the study of Guanà et al. (2016), the results of these two surgical procedures were compared in children with complicated acute appendicitis. Finally, it has been shown that the sundry effects are more common in the open surgical group (29). In a study by Mohamed and Mahran (2013), on patients with complicated acute appendicitis undergoing open or laparoscopic surgery it was reported that incidence of wound infection and sundry effects is more in the open surgery group (5). In other studies, there were no statistically significant differences in the incidence of postoperative sundry effects in the two groups (23, 24, 30). Better access to and better observation of surgery place in laparoscopic surgery for patients with complicated acute appendicitis have been reported as its benefits (23). On the other hand, since there is a greater need for abdominal incision in complicated appendicitis than in uncomplicated cases, the duration of surgery is longer and as a result it is expected that the patient will experience more stress; and also, as the wound is exposed to the contaminated fluid, the risk of infection increases, so it seems reasonable that the laparoscopic procedure be better than open surgery (24). Other benefits of laparoscopic open surgery include: the possibility of examining the entire peritoneal cavity, good debridement, complete and reliable abdominal cavity clearance, better aesthetic status and fewer chest complications (14). Consistent with the results of the present study, many comprehensive meta-analyzes have confirmed the superiority of the laparoscopic approach to open surgery in the management of patients with complicated acute appendicitis (5, 23, 26, 31-35). However, at the same time, there have been other studies that have produced conflicting results, in which some cases have not reported differences between the two methods or that the open method has produced better results (9, 10, 28, 36-39). Overall, based on the results of current studies and current review as the first study in this area in our region and even in the country, laparoscopic treatment of complicated acute appendicitis seems to have more advantages than open surgery, although the duration of surgery is increased. Whether this increase in surgery duration has a major impact on the specific complications associated with it or on overall costs requires further studies, although, previous study by Di Saverio et al. (2014) reported no significant difference in overall cost (40).

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