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***Prospective Study***

**Laparoscopic *vs* mini-incision open appendectomy: A prospective study**

ÇiftçiF. Appendicitis

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**Abstract**

**AIM:** To compare laparoscopic *vs* mini-incision open appendectomy in light of recent data at our centre.

**METHODS:** The data of patients who underwent appendectomy between January 2011 and June 2013 were collected. The data included patients’ demographic data, procedure time, length of hospital stay, the need for pain medicine, postoperative visual analog scale of pain, and morbidities. Pregnant women and patients with previous lower abdominal surgery were excluded. Patients with surgery converted from laparoscopic appendectomy (LA) to mini-incision open appendectomy (MOA) were excluded. Patients were divided into two groups: LA and MOA done by the same surgeon. The patients were randomized into MOA and LA groups a computer-generated number. The diagnosis of AA was made by the surgeon with physical examination, laboratory values, and radiological tests (abdominal ultrasound or computed tomography). All operations were performed with general anaesthesia. The postoperative vision analog scale score was recorded at postoperative hours 1, 6, 12, and 24. Patients were discharged when they tolerated normal food and passed gas and were followed up every week for three weeks as outpatients.

**RESULTS:** Of the 243 patients, 121 (49.9%) underwent mini-incision open appendectomy, while 122 (50.1%) had laparoscopic appendectomy. There were no significant differences in operation time between the two groups (*P =* 0.844), whereas the visual analog scale of pain was significantly higher in the open appendectomy group at the 1st hour (*P =* 0.001), 6th hour (*P =* 0.001), and 12th hour (*P =* 0.027). The need for analgesic medication was significantly higher in the mini-incision open appendectomy group (*P =* 0.001). There were no differences between the two groups in terms of morbidity rate (*P =* 0.599). The rate of total complications was similar between the two groups (6.5% in LA *vs* 7.4% in OA, *P =* 0.599). All wound infections were treated non-surgically. Six out of seven patients with pelvic abscess were successfully treated with percutaneous drainage; one patient required surgical drainage after a failed percutaneous drainage. There were no differences in the period of hospital stay, operation time, and postoperative complication rate between the two groups. Laparoscopic appendectomy decreases the need for analgesic medications and the visual analog scale of pain.

**CONCLUSION:** The laparoscopic appendectomy should be considered as a standard treatment for acute appendicitis. Mini-incision appendectomy is an alternative for a select group of patients.

**Key words*:*** Appendicitis; Mini-incision open appendectomy; Laparoscopic surgical procedure; Abdominal abscess; Surgical wound infections

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**Core tip:** Acute appendicitis is mostly encountered disease in a daily routine. Researchs regarding decreasing morbidity and mortality are still needed, although it is very well known. Hospital stay, operation time, postoperative complication rates are important for the management of acute appendicitis. Therefore, we suggest that laparoscopic appendectomy should be accepted as a standard treatment for acute appendicitis. Mini-incision appendectomy is an alternative for a select group of patients.

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**INTRODUCTION**

The most common reason for admission to the emergency room is acute appendicitis (AA), and appendectomy is a daily surgical procedure performed around the world[1,2]. Open appendectomy (OA) is accepted as a standard treatment for (AA); its morbidity and mortality are very low[1,2]. However, laparoscopic appendectomy (LA) has recently become more accepted[1,2] Many advantages of LA have been shown such as lower hospital stay, shorter recovery period, shorter period for returning to daily activities, lower postoperative pain, and lower postoperative infections[1–6]. In spite of these advantages, there is controversy over the best model of appendectomy techniques in the literature. Any extra potential advantages resulting from the laparoscopic approach are hard to prove because OA has the advantages of minimally invasive surgery such as a small incision, faster return to daily activities, and short hospital stays[3,7]. Moreover, there are some discouragements for LA such as longer operation time, higher intra-abdominal abscess, and higher failure rate in complicated appendicitis cases[2,4,5,8]. Therefore, there is no consensus in the literature about whether LA should be chosen as a routine procedure for all acute appendicitis cases or only for selected cases such as young women, obese patients, and professional workers[3,7,9].

**MATERIALS AND METHODS**

Our hypothesis is that for treatment of AA, whether complicated or not, in all adult patients, LA is superior to MOA (Mini-incision Open Appendectomy) in terms of safety and effectivity. The longer operation time and higher intra-abdominal abscess rate in LA will improve in advanced laparoscopic surgical centres with increased laparoscopic experience. Therefore, we compared the shorter and longer outcomes of LA and MOA in patients with AA.

***Patients***

From January 2011 to June 2013, the data of patients who underwent MOA and LA were recorded at the general surgery department of Safa Hospital. Patients with completed follow-up were included in the study. Pregnant women and patients with previous lower abdominal surgery were excluded. The patients were randomized into MOA and LA groups a computer₋generated number. Patients with surgery converted from LA to MOA were excluded. Patients were divided into two groups: LA and MOA done by the same surgeon. All patients gave their informed consent. Patients’ demographic data, procedure time, histopathologic reports, the need for analgesics, postoperative visual analog scale (VAS) score at 1, 6, 12 and 24 h, the hospital stay period, the period of time to return to daily activity, morbidity, and mortality were recorded. The diagnosis of AA was made by the surgeon with physical examination, laboratory values, and radiological tests (abdominal ultrasound or computed tomography). All operations were performed with general anaesthesia.

***Methods***

LA was performed based on the three trocars technique: a 10 mm port was placed at the umbilical area for the scope; a 5 mm port was placed in the left lower quadrant; a 5 mm port was inserted in the suprapubic area. The mesoappendix was transected with ultrasonic energy, and the appendix was tied at the radix. Appendectomy was completed by endo scissors and was removed from the abdomen through a 10 mm port in the umbilical area in an endo-loop (EndoLoop, Vicryl Coated Ligature, Ethicon UK Ltd., Edinburgh, UK). The appendix stump was not embedded. A drain tube was placed in the rectovesical area when considered necessary.

MOA was performed as a standard treatment. A 3 cm Mc Burney incision was made to enter the peritoneum. Appendectomy was completed followed by tying off of the mesoappendix and radix of the appendix. The appendix stump was embedded. A drain tube was placed in the rectovesical area when considered necessary. All appendectomy specimens were sent for histopathological examination. All patients received intravenous 3rd generation cephalosporin as a prophylactic antibiotic (Seftriakson – Novosef, 1000 mg iv, Zentiva, İstanbul, Türkiye). Patients with complicated AA received both 3rd generation cephalosporin and metronidazole (Biteral, 500 mg iv, Deva, Istanbul, Turkey) as prophylactic antibiotics. All patients received a dose of analgesic medication (diclofenac sodium, 75 mg im, Deva, İstanbul, Turkey) prior to intubation in the operating room. In the postoperative period, patients received analgesic medication based on the need for pain medication. The postoperative vision analog scale (VAS) score was recorded at postoperative hours 1, 6, 12, and 24. Patients were discharged when they tolerated normal food and passed gas and were followed up every week for three weeks as outpatients. Sutures were removed one week after surgery. Follow-ups for complications occurred in postoperative weeks two and three. Patients with complications were admitted to the hospital.

***Statistical analysis***

Results for categorical variables are given as frequencies and proportions (%), and results for continuous variables are given as mean ± standard deviations. Results for categorical variables were compared by χ2 tests; results for continuous, normally distributed variables were compared by student *t*-tests; and results for non-normally distributed continuous variables were compared using a Mann Whitney *U* test. Variables were considered statistically significant if the *P*-value ≤ 0.05 was in the 95% confidence interval. Statistical analyses used SPSS for SPSS 16.0 software (SPSS Inc., Chicago, Illinois, USA).

**RESULTS**

The study’s 243 patients were randomly divided into two groups, either MOA (*n =* 121) or LA (*n =* 122). Five patients who had undergone conversion from LA to OA were excluded from the study. As shown in Table 1, there were no statistical differences in demographics between the two groups. The data of the operations are shown in Table 1. The mean operating time was similar in both groups. Between the two groups, diagnoses of gangrenous, inflamed, and perforated appendicitis histopathologically were normally distributed. However, the rate of false appendicitis was statistically lower in the LA group (*P =* 0.009). The early postoperative VAS was statistically lower in LA, whereas the differences were similar at the postoperative 24 h mark (*P =* 0.056, Table 2). The need for analgesics in the LA group was lower in the postoperative period (*P =* 0.001). The length of hospital stay was lower in LA, but the difference was not statistically significant (*P =* 0.071, Table 2). The rate of total complications was similar between the two groups (6.5% in LA *vs* 7.4% in OA, *P =* 0.599). All wound infections were treated non-surgically. Six out of seven patients with pelvic abscess were successfully treated with percutaneous drainage; one patient required surgical drainage after a failed percutaneous drainage (Table 2). There were no other complications such as bowel obstruction or incisional hernia. The follow-up period was similar in both groups (14.7 mo for OA and 15.6 mo for LA, *P* = 0.449). No mortality was reported in the follow-up period.

**DISCUSSION**

As a minimally invasive technique, controversy regarding the superiority of LA over OA has existed for several years[1,9,10]. Because there are no differences in surgical outcomes between the two groups, OA is considered the better option due to lower cost[3]. However, lower postoperative pain, diagnostic accuracy, especially in women and the elderly, shorter periods of healing, and better cosmetic results have been considered advantages of LA over OA[2,4,9]. There were different protocols in previous studies, which resulted in various outcomes reported in the literature[3]. The longer operating time required for LA is a factor in comparing the two groups, and it extends farther in laparoscopic procedures done by inexperienced surgeons[1,4,9]. A previous study reported that operating time is shorter if the procedure is performed by an experienced surgeon due to better exposure[11]. Because our surgical team has laparoscopic procedure experience, we have concluded that the operating times for LA and MOA are similar. In our institution, ultrasonic energy is used for transsecting the mesoappendix. But it is not actually mandatory, electro-cautery and other devices can be preferred[12-14]. Moreover, the similar operating time should be considered a positive factor for LA. The hospital stay period is directly dependent on a patient’s general condition[4], and a shorter hospital stay in LA has been shown in previous studies; this outcome was proven by meta-analysis studies[3,6,7,9]. The 48 h discharge policy recommended for both OA and LA by previous studies has caused confusion due to different policies of individual hospitals[3,9]. Many studies list hospital stay periods by the number of days *vs* hours because They may be affected by social standards, insurance systems, and hospital discharge policies[3,4,9,15]. In this study, we used hours to define hospital stay periods to reflect differences between the two groups. The hospital stay period was shorter by three hours in LA; it is unclear if this is clinically significant. A meta-analysis done by Cochrane Colorectal Concor Group revealed that returning to daily activities in a shorter amount of time is considered as an advantage for LA[3,9,16]. Minimal trauma to the abdominal wall is considered the main reason for faster healing and lower pain for LA[3,11,17-28]. Early mobilisation after LA is another advantage, and this is achieved by minimal manipulation of the cecum and ileum during the procedure[3]. While the recovery period was shorter in LA, it was not considered significant.

Postoperative pain on day one was evaluated by the need for analgesics and VAS[3]. Evaluating pain was difficult due to the use of different analgesics, administration of those analgesics in different forms, and different cultures’ perceptions of pain. Therefore, to obtain a better result in regard to pain evaluation, we used two methods. Many previous studies have shown lower needs for analgesics and VAS[3,9]. In this study, postoperative pain was measured by VAS, and the need for analgesics was statistically lower in the LA group. All of these results supported LA as the preferred option for AA. The presence and degree of postoperative complications are generally considered as safety indicators for a procedure. The most common complications of AAs are wound infections, intra-abdominal abscess, and ileus[9]. It has been shown that postoperative complications are lower in LA *vs* OA[3,4,7,9]. Lower complications in LA, as shown in this study, are due to the lower incidence of wound infections. There is considerable controversy regarding the occurrence of intra-abdominal abscess after appendectomy, which is a serious and life threating complication[9]. Some studies in the literature have shown that the rate of intra-abdominal abscess is higher in OA[1-3,5,15,16]. Moreover, some studies have favoured LA in terms of these complications. The laparoscopic technique has some advantages such as the removal of intra-abdominal infected fluid with suction. However, it can spread infected fluid into the peritoneum, especially in perforated appendicitis and when using more irrigation. Additionally, carbon dioxide insufflation can spread bacterial contamination into the peritoneum[3,9,13]. It is believed that using advanced surgical techniques and gaining more laparoscopic experience may decrease the intra-abdominal abscess rate in LA[3]. Overall, the lower rate of wound infection is an advantage for LA because the infected appendix can be removed from a small incision in an endobag[3,4,9]. The economical analysis of these two techniques is another issue that must be addressed. Although there are many studies about the cost₋analysis between LA and OA[29,30], we did not make an actual consideration, which needs to be addressed in further studies. In this study, pregnancy group was excluded, because we believe in that MOA *vs* LA in the pregnant should be evaluated in a separate study[31].

In conclusion, LA has a similar hospital stay, operating time, and rate of postoperative complications as MOA, yet decreases the need for analgesics and VAS. Therefore, LA should be the suggested treatment for AA. MOA is still a viable alternative for selected patients.

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**COMMENTS**

***Background***

Laparoscopic appendectomy is still not accepted as a standart management for acute appendicitis due to longer operation time and higher cost. In the literature, there are few studies on surgical treatment comparing laparoscopic and mini-incision open appendectomy.

***Research frontiers***

Hospital stay, operation time, postoperative complication rates are important for the management of acute appendicitis. It is important for the patient’s comfort to understand the best technique with regard to mini₋incision open and laparoscopic techniques.

***Innovations and breakthroughs***

Acute appendicitis is mostly₋encountered disease in a daily routine. Researchs regarding decreasing morbidity and mortality are still needed, although it is very well known. There were no differences in the period of hospital stay, operation time, and postoperative complication rate between the two groups. Laparoscopic appendectomy decreases the need for analgesic medications and the visual analog scale of pain. Therefore, the author suggest that laparoscopic appendectomy should be accepted as a standard treatment for acute appendicitis. Mini-incision appendectomy is an alternative for a select group of patients.

***Applications***

The author suggest that laparoscopic appendectomy should be accepted as a standard treatment for acute appendicitis. Mini-incision appendectomy is an alternative for a select group of patients.

***Peer-review***

The author describes the differences between two techniques about the acute appendicitis. This is a interesting issue.

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**Table 1 Patients’ characteristics and operative data *n* (%)**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **LA (*n =* 122)** | **MOA (*n =* 121)** | ***P* value** |
| Age (yr)1  (median, range) | 25.9 ± 9.6  (26.91-99) | 28.8 ± 11.1  (29.81-97) | 0.249 |
| Gender (F/M) | 56/66 | 50/70 | 0.389 |
| ASA score | 108/16/3 | 106/11/4 | 0.449 |
| BMI3 (kg/m2) | 24.1 ± 2.9 | 24.6 ± 3.1 | 0.998 |
| Operative time (min) | 51.0 ± 13.9 | 50.9 ± 19.9 | 0.844 |
| Surgeon | 122 | 121 |  |
| Appendix |  |  |  |
| Normal | 8 (6.5) | 18 (14.8) | 0.009 |
| Gangrenous | 14 (11.4) | 11 (9.0) | 0.149 |
| Phlegmonous | 93 (76.2) | 86 (71.0) | 0.079 |
| Perforated | 7 (5.7) | 6 (4.9) | 0.073 |

1Students’ *t* test; 2χ2 test; 3mean ± SD. BMI: Body mass index; ASA: American Society of Anaesthesiology; MOA: Mini-incision open appendectomy; LA: Laparoscopic appendectomy.

**Table 2 Result of mini-incision open appendectomy *vs* laparoscopic appendectomy *n* (%)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **LA (*n =* 122)** | **OA (*n =* 121)** | ***P* value** |
| Hospital stay (h)3 |  | 25.61 ± 23.72 | 28.92 ± 21.93 | 0.0714 |
| Return to daily activities (d) |  | 4 (2–12) | 5 (3–15) |  |
| Overall morbidity |  | 8 (6.5) | 9 (7.4) | 0.5992 |
| Mortality |  | 0 | 0 | - |
|  | 1st hour | 7.1 ± 0.5 | 7.6 ± .0.7 | 0.0011 |
| VAS score3 | 6th hour | 3.9 ± 1.1 | 4.5 ± 1.2 | 0.0011 |
|  | 12th hour | 2.6 ± 1.3 | 3.1 ± 1.4 | 0.0271 |
|  | 24th hour | 2.4 ± 0.7 | 2.9 ± 0.9 | 0.0561 |
|  | 1 | 33 (27.0) | 18 (14.8) |  |
| Number of analgesics | 2 | 46 (37.7) | 42 (34.7) |  |
|  | 3 | 25 (20.4) | 27 (22.3) | 0.004 |
|  | 4 | 17 (13.9) | 33 (27.2) |  |
|  | Pelvic abscess | 4 | 3 |  |
| Postoperative complications | Wound infection | 1 | 5 |  |
|  | Atelectasis | 1 | - |  |

1Student’s *t* test; 2χ2 test; 3mean ± SD; 4Mann-Whitney test. MOA: Mini-incision open appendectomy; LA: Laparoscopic appendectomy.