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ORIGINAL ARTICLE

Laparoscopic Versus Open Appendectomy for the Treatment of Acute Appendicitis

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ABSTRACT

Background:
Acute appendicitis is the most common surgical abdominal emergency and open appendectomy has been the gold standard for the treatment of acute appendicitis for more than a century. Laparoscopic appendectomy is noticeably increasing in use through the last decade.

Aim of Study:
To compare laparoscopic versus open appendectomy for the treatment of acute appendicitis in the settings of operative time, duration of hospital stay, postoperative pain and complications.

Materials and Method:
A Prospective Randomized Controlled Study of patients with clinical diagnosis of acute appendicitis (166). Those were divided into two groups; one group was treated by OA (109) while the other was treated by LA (57). Each group was analyzed according to operative time, hospital stay, postoperative pain and complications.

Results
LA was associated with more operative time but less hospital stay, less postoperative pain and less wound infection rate. No difference was reported in the rates of intra_abdominal abscess collection for both of LA & OA. Also a lower rate of postoperative ileus was recorded in LA.

Conclusion:
The laparoscopic approach is a safe and efficient operative procedure in appendectomy and it provides clinically significant advantages over open method (including shorter hospital stay, less postoperative pain, early food tolerance, and lower rate of wound infection) against only marginally longer operative time.

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1. INTRODUCTION

Appendicitis is the most common cause of surgical abdomen in all age groups (1, 2). Approximately 7–10 % of the general population develops acute appendicitis with the maximal incidence being in the second and third decades of life (3). Open appendectomy 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 (3–5). 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 (6, 7). However, several retrospective studies (3, 8–9), several randomized trials (10–14) and meta-analyses (15,16) comparing laparoscopic with open appendectomy have provided conflicting results. Some of these studies have demonstrated better clinical outcomes with the laparoscopic approach (10–11, 14, 17), while other studies have shown marginal or no clinical benefits (12, 13, 18–20) and higher surgical costs (4, 13, 18, 19). Bearing in mind that laparoscopic appendectomy, unlike other laparoscopic procedures (21), has not been found superior to open surgery for acute appendicitis, we designed the present study to determine any possible benefits of the laparoscopic approach. The aim of this study was to compare the clinical outcomes (hospital stay, operating time, analgesia requirement, postoperative complications, and time to oral intake) between open and laparoscopic appendectomy.

2. METHODOLOGY

This was a randomized clinical trial approved by the scientific council of the Arab Board for health Specialization, general surgery, conducted during the period January 2015 _ January 2018 at Alhilla general teaching hospital included 166 patients who were randomly assigned into two groups to be managed by open (OA group) or laparoscopic appendectomy (LA group). Open surgery group included 109 patients and the LA group included 57 patients.

Inclusion Criteria

Patients with a clinical diagnosis of acute appendicitis were included in the study. The diagnosis of appendicitis was made according to the modified Alvarado score.

All patients included aged 15 years or older.

Exclusion Criteria

Patients were excluded if the diagnosis of acute appendicitis was not histopathologically approved and if they were presented with an appendicular abscess. Patients with a co-morbidity, contraindication to general anesthesia (severe cardiac and/or pulmonary disease), and pregnant women were also excluded.

Also we excluded patients who had absolute contraindications to laparoscopic surgery. In addition to patients found to have a complicated appendicitis during surgery.

Surgical Procedure

The same surgeon, experienced in open and advanced laparoscopic techniques, performed all of the operations.

Patients received 1 g of cefotaxime and 500 mg metronidazole intravenously from one hour prior to surgery and repeated 8 hourly till discharge out of hospital (patients allergic to cephalosporin received amikasin 500 mg twice a day). OA used a McBurney muscle-splitting incision in the lower right quadrant. The mesoappendix was ligated with no.1 vicryl suture. A ligation of the stump was performed with no.1 vicryl suture. The external oblique fascia was closed with no.1 vicryl suture which is the same used for muscle approximation. Skin incision was sutured with no.0 nylon suture. Laparoscopic appendectomy was done utilizing 3 ports, with the camera 10-mm port positioned at the umbilicus while the other two ports were inserted in the lower right (10-mm) and suprapubic (5-mm) quadrants. Then positioning of the patient was performed by Trendelenburg position and tilting the bed to the left. The peritoneal viscera were explored and identification of the appendix was done to exclude any other diagnosis. The mesoappendix was divided by cauterization and a double ligature of the appendix was made by endoloop vicryl ligature. The appendix was cut in between the ligatures and brought out with a bag. Fascial defects of the 10-mm port sites were sutured using no.1 Vicryl sutures. The skin incisions were sutured using no.0 nylon suture.

Intraperitoneal drain was left only in cases of severe inflammation that required adhesolysis in both LA and OA.

The need for the drain didn't extend for more than 24 hours in all of the cases that required the drain except for two cases that required reopening because of postoperative intraperitoneal bleeding in which the removal of the drain was postponed.

All of the gross specimens were sent for histopathology.

Postoperative Care

For both LA and OA patients, bowel sounds were checked twice daily. Once present, the patient was allowed to start a liquid diet and when it was tolerated and the flatus passed, patients started the regular diet. Patients were discharged when they tolerated a regular diet and had a normal body temperature for 24 hours.

Statistical analysis:

Data of the patients were entered and transformed into a computerized data base with statistical utilities, the statistical package for social sciences (SPSS) version 22, was used to in statistical procedures. Descriptive statistics were presented as frequencies (numbers of patients), proportions (%), mean, mode, and standard deviation SD. Level of significance was set at 0.05 as significant.

3. RESULTS

Total collected cases in our study were 206 cases, of them 40 cases were excluded; 15 cases did not meet the inclusion criteria, 23 cases had normal appendix and 2 cases required conversion from LA to OA. The total cases included in the study were 166; of them 109 got open and 57 got laparoscopic appendectomy.

As shown in the (Tables 1, 2, 3, 4 & 5) below, the operative time for OA was ranging from 15 to 40 minutes with a mean of 23.39±4.92 minutes and a mode of 25 minutes, while in LA it was ranging from 20 to 45 minutes with a mean of 29.6 ± 6.5 minutes , (P. value <0.001). The duration of hospital stay for OA was ranging from 1 to 4 days with a mean of 1.4 ± 0.60 days and a mode of 1 day. For LA it was from 1 to 2 days with a mean of 1.070±0.25 days and a mode of 1 day. Postoperative pain assessment in this study depended on the number of opioid injections required postoperatively through all of hospital stay. These were ranging from 1 to 5 doses of opioid analgesia for OA patients with a mean of 1.8 ± 1.0 doses. The

range for LA was from none dose of opioids to 3 doses with a mean of 1.210±0.641 doses and a mode of 1 dose.

Surgical site infection was recorded in 6 cases of OA representing 5.5 %, while no surgical site infection was recorded for LA which equals to 0 %. Intraabdominal collection in OA accounted for 0.9 % (one case) while in LA it was 3.5 % (two cases). Intraabdominal bleeding that required reopening was reported in one case of OA (0.9 %) and one case of LA (1.75%). Paralytic ileus accounts for 8.3% (9 cases) in cases of OA while it was 1.8% for LA (one case).

Table 1. Comparison of operative time of OA and LA groups

Operative Time (minutes)	OA (n=109)		LA (n=57)	
	No.	%	No.	%
15	13	11.9	0	0.0
20	33	30.3	3	5.3
25	42	38.5	27	47.4
30	19	17.4	11	19.3
35	1	0.9	7	12.3
40	1	0.9	6	10.5
45	0	0.0	3	5.3
P. value < 0.001 significant				

Table 2. Comparison of duration of hospital stay of OA and LA groups

Duration of hospital stay (day)	OA (n=109)		LA (n=57)	
	No.	%	No.	%
1	71	65.1	53	93
2	33	30.3	4	7
3	4	3.7	0	0
4	1	0.9	0	0
P. value = 0.001 significant				

Table 3. No. of opioid doses requirements postoperatively for the assessment of postoperative pain

No. of opioid doses	OA (n=109)		LA (n=57)	
	No.	%	No.	%
0	0	0	5	8.8
1	59	54.1	37	64.9
2	26	23.9	13	22.8
3	15	13.8	2	3.5
4	8	7.3	0	0
5	1	0.9	0	0
P. value = 0.002 significant				

Table 4. Comparison of operative time, duration of hospital stay and postoperative opioid requirements between OA and LA groups

Parameters	OA (n=109)	LA (n=57)	P. value
Operative time (minute)	23.4 ± 4.9	29.6 ± 6.5	<0.001
Duration of hospital stay (day)	1.4 ± 0.6	1.1 ± 0.3	0.001
Postoperative opioid requirements	1.8 ± 1.0	1.2 ± 0.6	<0.001

Values presented as mean ± standard deviation

Table 5. rates of incident complications among OA and LA groups

	OA (n=109)	LA (n=57)	P. value
Surgical site infection	5.5%	0.0%	0.172 ns
Intra-abdominal collection	0.9%	3.5%	0.560 ns
Intra-abdominal bleeding	0.9%	1.8%	0.807 ns
Ileus	8.3%	1.8%	0.186 ns
ns: not significant			

4. DISCUSSION

This study compares the operative time, hospital stay, postoperative pain and complications in patients presented with acute appendicitis undergoing OA or LA based on data collected from patients of Al_Hilla General Teaching Hospital.

Total operative time in this study was significantly longer in the LA than in OA. However, the mean operative time in LA group in our study was shorter than that in previous studies (13,16,18). On the other hand, the surgeon performed LA in this study was experienced in laparoscopic procedures and so, the longer time of operation in LA may be due to the additional steps including camera setup, gradual gas insufflation, introducing ports under vision and a period of diagnostic laparoscopy as well as the use of vicryl endoloop and cautery.

In our study, patients of LA had a significantly less hospital compared with OA patients. The idea that LA decreases the postoperative hospitalization time has been discussed frequently over the past years, (36,39,51–53) Previous studies showed inconsistent findings. Despite that some recent studies discovered that LA patients had a significantly less duration of hospital stay, (3,23,24,54–57), other results reported no significant differences (36,25–27). Sauerland et al reported a significant decrement in the duration of hospital stay in patients of LA (16) . Similar data was obtained by the study of Golub et al18, conversely another meta-analysis did not show a significant difference in hospital stay between LA patients and OA patients (4). The heterogeneity of these results may be caused by different factors: like hospital factors (44,45) or social habits (46), in addition to associated patient condition, rather than being caused by the surgical technique per se. Also, much more discrepancies may be the result of variable health care rules in different countries.

In our study, post-operative pain is assessed objectively by opioid analgesic use rather than the visual analogue score, for the perception of pain not to be influenced by the patient's enthusiasm for a novel technique. In this study, opioid requirements were less in the LA group as compared that agrees with other studies that reported (10, 42, 37). Regarding complications, LA has less overall complications rate than OA ; it was 7.01 % for LA vs. 15.59 % in OA group however, the difference did not reach the statistical significance. This finding agreed that found in other study (13) and disagreed with another (60). Meanwhile, some studies (4,16,18) showed an equal overall complications rate between both LA and OA, this might belong to the more skilled laparoscopic surgeons who became more professional and familial with the laparoscopic procedures in the form of hand skills and the knowledge about each step of laparoscopic surgery.

Patients after LA had significantly less wound infections compared to OA. Some studies reported higher values of the postoperative wound infection rates after OA (33,34,38,10,49) as compared with LA, whereas others showed similar rates (15, 17,28,30,35,50). In a meta-analysis, Golub et al reported a rate of a wound infection for LA that was less than 50% of that recorded for OA patients (18). Other studies reported an increased rate of intraabdominal abscesses after LA, which, however, did not report a statistical significance (4,16). Although we can say that the definition of intra_abdominal abscess is the same among different studies, wound infection can be a broad term ranging from slight redness to purulent discharge. This difference extremely influences the postoperative wound infections reported rate. The lower rate of wound infection in laparoscopic group may be due to placement of the detached appendix into an endobag before its removal from the abdominal cavity, reducing contact with the fascial surfaces and minimizing contamination.

Conversely, intraabdominal abscess is a serious and life-threatening complication that was observed in two patients in LA (3.5 %) and in one patient in OA (0.9 %); this finding is not statistically significant. These findings was comparable to other studies (31,40) and may belong to experienced surgeon and to the exclusion of the complicated appendicitis in our study. Most of the other trials reported higher intraabdominal abscess rates after LA compared to OA (16,4,18). Many theories have suggested different possible explanations: mechanical spread of bacteria caused by carbon dioxide insufflation in the peritoneal cavity, especially in case of perforated appendix (22,43,48,58,59), (although all of our cases are not perforated), inexpert surgeons, the aggressive irrigation, rather than simple suctioning of the infected area that leads to spread of the contamination to the entire abdominal cavity, thus it becomes difficult to aspirate later (41). Other reported postoperative complications include ileus and hemoperitoneum. Paralytic ileus accounts for 8.25% in OA and 1.8% in LA group with significant difference, these findings are similar to previous studies(8,16,31,40,49,60) and this may attributed in part to the minimal manipulation of bowel during laparoscopy and in part to the lower number of opioid doses required postoperatively for LA patients. Intraabdominal bleeding that required reopening occurred in

one case of OA (0.9 %) and another one of LA (1.75%). There is no significance difference (p value: 0.3159) which is similar to other studies (49,60).

5. CONCLUSIONS

Laparoscopic appendectomy is an a safe and effective surgery for appendectomy and needed less hospital stay, the parameter that is highly related to the wellbeing of the patients. Patients undergoing LA had less postoperative pain. Lower wound infection, and intraabdominal bleeding rates with no higher intraabdominal collection rates.

In LA group, longer operative time is needed, however, it is not a problem because of the increasing experience of the surgeons in laparoscopy, and the development of laparoscopic tools that with time can provide at least an equal time with that of OA.

So, we suggest that laparoscopic appendectomy is better for the treatment of acute appendicitis.

Ethical Approval:

All ethical issues were approved by the author. Data collection and patients enrollment were in accordance with Declaration of Helsinki of World Medical Association , 2013 for the ethical principles of researches involving human. Signed informed consent was obtained from each participant and data were kept confidentially.

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