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ORIGINAL ARTICLE

Efficacy of Laparoscopy versus Open Surgical Appendectomy in Complicated Appendicitis

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ABSTRACT

Background: Appendicitis is most found in the second decade of life. It can be categorized into two major categories: uncomplicated and complicated appendicitis. Laparoscopic appendectomy (LA) and Open appendectomy (OA) are two common techniques for the surgical removal of appendices in acute appendicitis. The goal of this research was to examine and explain the effectiveness of laparoscopic appendectomy in patients with complicated appendicitis.

Methods: A retrospective study was carried out in General Surgery Department, Faculty of Medicine, Zagazig University from March 2020 to September 2020. It involved 36 patients with reported complicated appendicitis randomly assigned (through alternation) to two groups of 18 patients, Group A; patients underwent open appendectomy by gridiron incision at McBurney stage. Group B; patients undergoing laparoscopic appendectomy. All patients were subjected to demographic data taking, complete clinical examination, Laboratory investigations and Radiological investigation.

Results: Postoperative wound infection was higher in the open group (A) than in the laparoscopic group (B) but did not display a substantial difference (33.3 per cent infected in open cases and just 11.1 per cent infected in laparoscopic cases) with PV=0.23. Postoperative hospital stays and the time required to return to usual every day practices were lower in laparoscopic group (B) than in open group (A with P Value = 0.09 and 0.0002 respectively.

Conclusions: LA constitutes a safe and feasible procedure for the treatment of complicated appendicitis and can be the first choice with no increase in postoperative complications.

Keywords: Laparoscopic appendectomy; Open appendectomy; McBurney's

INTRODUCTION

Acute appendicitis is one of the most frequent general surgical emergencies in the world, with an average lifetime risk of 7–8% reported. Acute appendicitis occurs at a rate of approximately 90–100 patients per 100,000 population per year in developing countries [1].The highest prevalence typically happens in the second or third decade of life, and the disorder is less frequent in extreme of age. Any of the analyses indicate a slight male predominance. Appendectomy is also one of the most performed [2]**.**Direct luminal obstruction can cause appendicitis (often by faecolith, lymphoid hyperplasia, or stool; rarely by appendix or caecal tumor), but these appear to be anomalies rather than regular occurrences. While some infectious agents are suspected to cause or be involved with appendicitis, the complete spectrum of specific causes remains unclear. The hypotheses rely on genetic causes,[3].Clinically acute appendicitis is known as a distinct type of acute inflammation with various fates. One is a simple swollen appendicitis without a gangrene or necrosis that does not contribute to perforation. This so-called reversible form may present as a phlegmonous (pus-producing) or advanced inflammation (but without gangrene or perforation) that may need surgery or, instead as a mild inflammation that may settle either spontaneously or with antibiotic therapy [4]. Complicated appendicitis is an acute appendicitis that is complicated by peritonitis, burst, gangrene, or intra-abdominal abscess, accounting for 14 to 55% of all appendicitis. Studies have found that it is linked with the occurrence of severe complications after appendectomy. Significant postoperative risks include wound inflammation and intra-abdominal

abscess, which remain major causes of extended hospital stay and higher hospital charges, thus compromising quality of life. [5]. Although open appendectomy (OA) was the treatment of choice in the early 1990s, LA for uncomplicated appendicitis was the gold standard in the early 2000s. The benefits of LA include decreased overall postoperative morbidity and wound infection, shorter time of stay (LOS), less postoperative pain and early postoperative recovery. However, the role of LA in complicated appendicitis remains problematic due to evidence of a higher occurrence of intra-abdominal abscess (IAA) and longer time of activity [6,7]. The aim of the current study was to investigate and to clarify the efficacy of laparoscopic appendectomy in patients with complicated appendicitis.

METHODS

A retrospective study was carried out at the Department of General Surgery, Faculty of Medicine, Zagazig University, from March 2020 to September 2020. It involved 36 patients with reported complicated appendicitis. Patients were randomly distributed to two classes with 18 patients each. Group A; patients had an open appendectomy; (OA) patients had a gridiron incision at McBurney. group B; patients had a laparoscopic appendectomy (LA). The population ranged from 20 to 57 years with a median age of 30.5 years (34.6±1 years) in Group B. Patients were well aware of the risks and benefits of all treatments. The informed consent was received from each patient and was accepted by the Research Ethics Committee. The research was performed in compliance with the Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments concerning humans. Criteria for inclusion: age greater than 18 years. Patients with reported complex appendicitis (perforated, gangrenous appendix or acute appendicitis with pus formation). Patients with prior abdominal surgery, diathesis bleeding, compromised renal or hepatic activity, cardiopulmonary or cerebrovascular issues and pregnant females were excluded.

All patients were subjected to Demographic data taking, full clinical evaluation, laboratory investigations (complete blood count (CBC), sodium (Na) and potassium (K) in seriously dehydrated patients and urine study in reported cases of urinary tract infection), and radiological investigations involved ultrasound (transvaginal or pelvic abdominal) and computed tomography (CT) scan in difficult cases (appendicular abscess or masses).Markedly dehydrated patients had fluid resuscitation and a Foley catheter to provide sufficient urinary production. Any form of electrolyte was corrected due to the induction of general anesthesia. Prior to surgery, both patients received a regular regimen of intravenous antibiotics (1.5 gm of ampicillin, sulbactam and 500 mg of Metronidazole).

Technique of Open Appendectomy (OA):

The patient was put in the supine position and was undergoing general anesthesia with endotracheal intubation. When the patient was anaesthetized and the abdominal musculature relaxed, the abdomen of the patient was closely inspected for appendicular mass. The skin incision at McBurney's point was continued into the subcutaneous tissue until the outer oblique fascia was exposed.A small incision was made in the external oblique fascia along the line of its fibers. This incision was sharply extended with scissors along the direction of the fibers. The underlying fibers of the internal oblique muscle and the transversus abdominis muscle were identified, split and retracted along the direction of their fibers. Next, retractors were adjusted to expose the peritoneum. Then grasping the peritoneum with clamps was done, carefully verifying those intra-abdominal viscera had not been inadvertently grasped. A small incision was made in the peritoneum by scissors. The cecum was delivered into the field gently grasping the cecum with moistened gauze and delivering it into the wound using a rocking movement and the anterior tenia of the cecum was followed till identification of appendix. Medial mobilization of the cecum was done bluntly with a finger combined with sharp or electrocautery in cases of difficult retrocecal appendix. The mesoappendix was divided between clamps and ligated with an absorbable suture (Vicryl 2.0). The base of the appendix was divided and ligated with absorbable suture material. Purse string sutures were done in cases of inflamed base of the appendix. The wound was closed in layers. If perforation or gangrene were present, the skin and subcutaneous tissue closure was by widely spaced sutures **Figure (1).**

Technique of Laparoscopic appendectomy

The patient was put in a 15° Trendelenburg position with both arms tucked away. The rotation to the left has been completed. The surgeon was seated on the left side of the patient. The first assistant stood on the left side of the surgeon. The console was on the right side of the patient. A urinary catheter was inserted after induction of general anesthesia. The pneumoperitoneum was developed in a typical manner, using either the Veress needle technique or the open technique, depending on the choice of the surgeon. The 1st trocar (10 mm) was introduced at the lower margin

of the umbilicus. The intraperitoneal pressure was set to be 14 mmHg. Laparoscopy was then performed with "zero" angle viewing laparoscope to ensure the clinical diagnosis and identify the position of the appendix to determine the best site of insertion of the other trocars.

A second 5 mm suprapubic trocar was inserted. A third operating trocar was inserted in the left iliac fossa**.** In 2 cases 4th trocar in the right upper quadrant was inserted to facilitate dissection of retrocecal appendix. After the ports were inserted, a rapid diagnostic laparoscopy was performed to validate the diagnosis and to determine other pathologies. The left hand of the surgeon held the intestinal clamp catch to retract the cecum and then expose the appendix. Cautery was used in tough situations to incise the retroperitoneal attachments of the cecum. The right-hand surgeon worked a dissecting instrument or a cauteric scissor, which was used to create a window in the mesoappendix at the base of the mesoappendix and clips or endoloop technique for appendiceal base.

The appendixal stump mucosa was gently cauterized during transection. The appendix was pushed into the umbilical port and inserted with the whole port removed. Irrigation and insertion of the drain have never been undertaken in complex situations. Trocars have been removed under direct vision. Fascia was closed at the 10-mm trocar site, and most of the wounds were closed. Antibiotics have not been eliminated in patients with difficult appendicitis but have been updated according to the findings of culture and continued for 7 to 10 days till the patient was afebrile. The specimens were sent for pathology for assessing pathological diagnosis Figure (2).

Post-operative : Analgesics were given intramuscularly. Antibiotics were continued or stopped according to the clinical findings. Oral intake was started as soon as patients could tolerate it and when bowel function become adequate. Patients were discharged as soon as they take orally adequately and mobilize. Postoperative complications were recorded both during hospitalization and at follow up. The follow up in the outpatient's clinic was at one week, one month and six months. Patients' follow up record was maintained and updated in computer data. Patients were instructed to report back immediately for any complication related to the surgery irrespective of the duration of follow up.10 days later stitches were removed.

Postoperative: Postoperative morbidity and wound infection: both of them are handled conservatively by wound dressing twice daily with saline wash and betadine, as well as by wound culture and sensitivity, and antibiotics is administered accordingly. Pelvic abscess: undergone restrictive antibiotic therapy dependent on culture and susceptibility.

STATISTICAL ANALYSIS

All data were analysed using IBM SPSS 23.0 for windows (SPSS Inc., Chicago, IL, USA).

RESULTS

This study was performed in 36 patients with reported complicated appendicitis randomly assigned (by alternation) to two groups of 18 patients each, Group (A): patients underwent open appendectomy with gridiron incision at McBurney stage. Class (B): patients undergoing laparoscopic appendectomy. Patient age varied from 20 to 57 years with a median age of 30.5 years in Group A and 32 years in Group B and mean age 34.6 years in Group A and 35 years in Group B.

A comparison was done between Group (A) and Group (B) in the intraoperative findings, this study showed that 25% of patients had gangrenous appendix, 61.1% had perforated appendix with pus and 13.9% had acute appendicitis with adhesions with no statistically significant difference between the two groups. Table (1)

The operative time was significantly longer in the laparoscopic group (Group B) with mean time 84.6 minutes than open group (Group A) with mean time 54.2, *P* value was 0.0001. Table (2).

Intraoperative complications: In Group A (Open): 5 cases were met, Caecal serosal tears which were repaired primarily by absorbable sutures. In Group B (Lap): 3 cases were met, Bleeding from mesoappendix which was controlled by clips. **Table (3)** Associated lesion and its management; In Group A (Open): One case of complicated ovarian cyst was found and excision was done after gynecological consultation. Two cases of caecal mass and midline approach was done, right hemicolectomy was performed in both cases (proved to be cancer cecum after histopathological examination). In Group B (Lap): Three cases of right ovarian cysts and one case of left ovarian cyst were found; one was punctured and the others left with no intervention according to gynecological consultation which was done intraoperatively. One case associated with migrating intrauterine device into the peritoneal cavity with adhesion and removal of the device was performed by LA.

This study showed that postoperative complications were higher in the OA group (38.9%) than LA group (16.7%), the result was statistically insignificant (P=0.14). Table (4):

Overall post-operative complications showed no significant difference between the 2 groups with P value =0.14. The post-operative wound infection was higher in the open group (A) than the laparoscopic group (B) but did not reach the

significant difference, (33.3% infected in open cases and only 11.1% infected in laparoscopic cases) with *PV*=0.23 **Table (5)**. Also, there was no significant difference between Group A and Group B regarding pelvic abscess and fecal fistula.

Post-operative hospital stays, and time needed to return to normal daily activities were lower in the laparoscopic group (B) than in the open group (A) with significant difference. *P Value* = 0.09 and 0.0002 respectively. **Table (6)**

Table (1): Intraoperative findings

Variables	Total N (%)	(Group A) open N (%)	(Group B) lap N (%)	[f] p
Gangrenous appendix	9 (25%)	4 (22.2%)	5 (27.8%)	0.99
Perforated appendix with pus	22 (61.1%)	11 (61.1%)	11 (61.1%)	1
Acute appendicitis with adhesions	**5 (13.9%)**	**3 (16.7%)**	**2 (11.1%)**	**0.99**

F= Fisher exact test

Table (2): Operative time in the 2 groups

Group	Mean	Std. Deviation	Median	Minimum	Maximum	P-Value
(Group A) open (18 patients)	54.2	11.8	54	31	79	t=6.2 p=0.0001
(Group B) lap (18 patients)	**84.6**	**17.1**	**83.5**	**45**	**117**	

Table (3): Intraoperative complications

Variables	Total N (%)	(Group A) open N (%)	(Group B) lap N (%)	[f] p
Caecal serosal tears	5 (13.8%)	5 (27.7%)	0 (0.0%)	0.045(S)
Bleeding	**3 (8.3%)**	**0 (0.0%)**	**3 (16.6%)**	**0.23**

F= Fisher exact test (S) p<0.05 significant

Table (4): Overall postoperative complications

Group	(Group A) open (18 patients)	(Group B) lap (18 patients)	P value
Complicated cases	**7(38.9%)**	**3 (16.7%)**	**0.14**

χ 2 = Chi square test

Table (5): Individual postoperative complications

Complication	Total (36 patients)	(Group A)open (18 patients)	(Group B) lap (18 patients)	[f] P value
Wound infection	8 (22.2%)	6 (33.3%)	2 (11.1%)	0.23
Pelvic abscess	1 (2.8%)	0 (0%)	1 (5.5%)	0.99
Fecal fistula	**1 (2.8%)**	**1 (5.5%)**	**0 (0%)**	**0.99**

f =Fisher Exact test

Table (6): Hospital stay and time needed to return to work

Parameter	(Group A) open (18 patients)	(Group B) lap (18 patients)	P value
Hospital stay (days)			
Mean ±SD	3±2.9	1.8±1.8	U=1.7
Median	1	1	0.09
Range	1-11	1-7	
Return to normal daily activities (days)			
Mean ±SD	**8.8±3.7**	**4.9±1.9**	**U=3.7**
Median	**8**	**4.5**	**0.0002**
Range	**5-18**	**3-10**	

U test =Mann-Whitney U test of significant

Figure (1): Complicated appendicitis with mass, pus formation

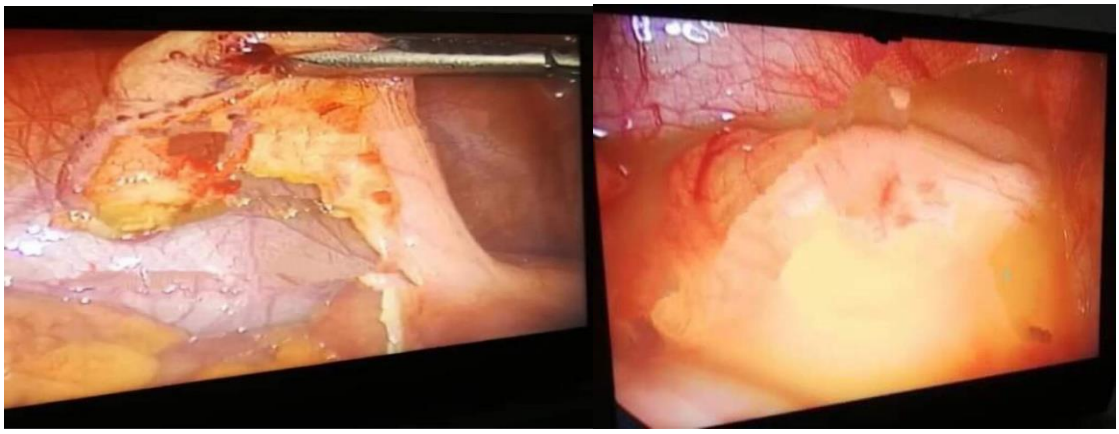

Figure (2): Technique of Laparoscopic appendectomy for complicated appendicitis with peritonitis.

DISCUSSION

McBurney (1894) Identified as open appendectomy in 1894. Since then, Semm [8] (1983) has implemented laparoscopic appendectomy for the first time; similar to open appendectomy, laparoscopic appendectomy has lower postoperative pain and lower analgesic doses. It also has not only less tissue damage but also less intestinal irritation, so that the effects of the reduction of adhesion can occur after surgery. Requires early ambulation and food consumption and a brief period of hospitalization. Patients will then return early to normal [9].In the treatment of CA, despite growing dependency on laparoscopic procedure, certain questions remain regarding the duration of the procedure, the risk of conversion to OA, and postoperative septic complications, including wound infection and intra-abdominal abscess [10].

In the present analysis, operational time was slightly longer in the laparoscopic group (Group B) with mean time of 84.6 minutes than in the open group (Group A with mean time of 54.2 minutes., (P value was 0.0001).

Kamal and Qureshi [11] The mean time of service was seen to be longer in LA (55 minutes) compared to OA (30 minutes). Another research performed by **Katkhouda et al. [12]** found that operational time was slightly longer in the laparoscopic community (80 minutes vs 60 minutes) with P = 0.0001. **Lin et al. [13]** compared 19 patients with CA and 75 with uncomplicated appendicitis and reported longer period of procedure and duration of hospitalization in CA cases. **Cash et al. [14]** equivalent to 50 cases of CA underwent LA in 2009 and 34 cases of CA underwent LA with less experience and the older technology in 1995. They indicated that operation time in both categories was comparable and the duration of hospital stay and wound infection was more beneficial in 2009. In this research, laparoscopy was conducted by a surgeon with expertise in laparoscopic approaches. Meta-analysis compared open and laparoscopic approach in difficult

appendicitis; based on the expertise of the surgeon, there are no variations between laparoscopic and open approach, except in developed countries due to lack of laparoscopic and surgical equipment [15].

In the present study, 27.7% of OA patients had intraoperative caecal serosal tears, although no cases had caecal serosal tears in LA. This was in accordance with **Soltan et al. [16]** who observed that caecal serosal tears were more frequent in OA (10 per cent) than in LA

(5 percent) in this analysis, intraoperative bleeding was more frequent in LA (16.6 percent) than in OA (0 percent) with no substantial difference. This was in accordance with **Christensen et al.** [17,18] found that complication and injuries to the intra-abdominal organs and major vessels after appendectomy are rare but have been documented. Also, **Pogorelic et al.** [19] Bleeding was observed to be present in 0.3 percent of patients with LA while intraoperative bleeding in OA was not complication Although total postoperative complications were higher in the OA group (38.9%) than in the LA group (16.7%) in this analysis, the finding was statistically negligible (P=0.14)

In the other hand, **Shirazi et al. [20]** reported that the rate of cumulative complications (LA: 15 percent, OA: 31.8 percent, P < 0.0001) was slightly lower in patients receiving LA.

Similarly, **Guller et al.** [21] showed that overall complications were significantly lower in laparoscopic group (P = 0.002).

This discrepancy in the importance of the total postoperative complications can be attributable to the number of cases examined and the anatomy in the appendix. A meta-analysis of randomized controlled trials with findings of 2877 patients in 28 trials was announced. Overall complications rates were similar, but wound infections were definitely decreased following laparoscopy (2.3 percent to 6.1 percent) [22].

In the current research, there was no substantial variation in pelvic abscess in one patient in the LA community. This was in accordance with Kocatas et al. [9], who observed that postoperative intra-abdominal abscess was more frequent in the LA community (8.2% vs. 2.6%), not statistically relevant (p=0.233). Both patients with postoperative intra-abdominal abscess were successfully treated with percutaneous drainage. Mortality did not exist during the sample time.

These observations are consistent with the results of other studies [23]. Duration of postoperative stay is one of the benchmarks of continuity of treatment representing the effectiveness of medical/surgical management and the rate of complications. Shorter hospital stays have many benefits; they minimise wound infection, costs and complications [24,25].

Shakya et al. [26] observed that LA had lower mean LOS than OA (3.46 Vs 4.81). The results are similar to other research. **Pradhan et al**. [27] found mean LOS lower for LA relative to OA (2.75 Vs 3.19 days). **Batajoo and Nk** [28] have identified the LOS 2.69 days for LA vs 4.03 days for OA.

The study has few limitations. First, the study has a chance of selection bias because it is based on only admitted patients. Second, the findings of the study cannot be generalized for all Egyptian population as it is based on a single site study.

CONCLUSION

LA is a simple and practical method for the treatment of difficult appendicitis and can be the first option without any rise in postoperative complications. However, the longer length of procedure is also a challenge for the laparoscopic technique considering the growing expertise of the surgeons. According to our findings, this topic should be discussed in future studies. Further wide sample size tests are required to validate our findings.

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