

# Laparoscopic Appendectomy for Perforated Appendicitis in Children

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## ABSTRACT

**Aim:** To evaluate the outcome of laparoscopic (LA) vs open appendectomy (OA) in children with perforated appendicitis.

**Materials and methods:** Retrospective review was conducted from January 2013 to October 2016 evaluating 81 patients with perforated appendicitis based on surgical approach. We compared demographics, mean operative time, length of stay, infectious complications, and follow-up in patients with OA (n = 37) and LA (n = 44).

**Results:** Compared with OA, LA resulted in a lower rate of wound infection (4.5 vs 8.1.5%; p<0.05). The occurrence of the intraabdominal abscess was significantly lower in the LA group (0 vs 5.4%; p<0.05). There was a significant difference in the duration of operation between the two groups; it was 61.6 ± 20.3 minutes in OA, compared with the LA group (51.6 ± 28.6 minutes) (p<0.05).

**Conclusion:** We conclude that LA provides better postoperative course, less postoperative pain, and less postoperative complications.

**Keywords:** Children, Complicated appendicitis, Complications, Laparoscopic appendectomy, Open appendectomy.

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**Conflict of interest:** None

## INTRODUCTION

Acute appendicitis is one of the most common causes of surgical abdomen in children and accounts for 1/3 of childhood admission for abdominal pain.<sup>1</sup> Perforation is most common in young children with rate as high as 82% in age under 5 years and up to 100% in 1-year-old children. The overall incidence of perforation varies from 20 to 76% with a median of 36%.<sup>2</sup> The high perforation

rate is usually due to delayed diagnosis, as the child is usually less communicative and the symptoms are usually diagnosed as gastroenteritis.<sup>3</sup>

Laparoscopic appendectomy has become the preferred method in treatment of simple noncomplicated appendicitis, but there is still a controversy about the use of laparoscope in complicated appendicitis with concern about intraabdominal abscess and long operative time.<sup>4,5</sup>

## MATERIALS AND METHODS

This is a retrospective study which has been done in Zagazig University Hospital and International Medical Center, Jeddah, from the period from January 2013 to October 2016.

All cases operated for perforated appendicitis were included in the study.

During this period, all children less than 14 years who underwent appendectomy for perforated appendicitis has been evaluated regarding type of operation (OA or LA), demographic data (age, sex), operative time, duration of hospital stay, complication rate which includes wound infection, abdominal infection, adhesive intestinal obstruction, and readmission.

We use the Student's t-test to evaluate the statistical significance with a p-value of 0.05 or less considered as statistically significant.

## Surgical Technique

Laparoscopic appendectomy was performed through three ports. After general anesthesia, an 11-mm port was inserted through the umbilicus by open technique. Pneumoperitoneum was created to a pressure of 10 to 12 mm Hg by carbon dioxide insufflation. Another two 5-mm ports were inserted, one in the left iliac fossa and the other one in the suprapubic region. The appendix was visualized by release of all adhesions around it, mesoappendix was controlled by harmonic scalpel or any other energy device as ligature or diathermy, the base of the appendix was ligated by Vicryl endoloop, and, in one case, was divided by endo GIA stapler. The appendix was removed in endobag from the umbilical port, the small intestine was explored by a traumatic grasper to release any interloper adhesion or pus. Good peritoneal

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lavage was done and closed suction drain was inserted in the pelvis.

Open appendectomy has been done through right lower quadrant incision with muscle cutting when required. Postoperatively, intravenous ceftriaxone 50 to 100 mg/kg once daily, and metronidazole 10 mg/kg/8 hr were given until fever subsided and the white blood cells count decreased, and the patients were discharged when they can tolerate feeding and no fever and continued on oral antibiotic cefixime 7 mg once daily and metronidazole oral 10 mg/kg/8 hr for 1 week. All appendices were sent for histopathology. Pus was sent for culture and drug sensitivity. They were followed up in the outpatient clinic 5 days after their discharge from the hospital. Perforated appendicitis has been diagnosed by the presence of pus either localized or generalized or the presence of visible perforation or fecalith operative time was calculated from the end of the anesthesia till the end of the suturing.

## RESULTS

Eighty-one children who underwent appendectomy for perforated appendicitis between January 2013 and October 2016 were included in the study among 81 patients of whom 53 were male and 28 were female; 44 children underwent LA and 37 had OA. The demographic characteristics are shown in Table 1. The majority of the patients were male. This difference was statistically significant ( $p < 0.05$ ). There was no difference between LA and OA groups with respect to mean age ( $p > 0.05$ ). The median operative time in the LA group was  $51.6 \pm 20.3$  minutes, compared with the OA group ( $62.8 \pm 28.6$  minutes). There was no difference ( $p > 0.05$ ). There was no conversion to open in the LA group. The histopathology in the OA group was acute suppurative appendicitis in 29 patients and gangrenous appendicitis in 15 patients, and in the LA, in 25 patients, it was acute suppurative appendicitis and in 12 patients, it was gangrenous appendicitis. A significant difference was found as regards the duration of hospitalization between OA and LA; it was  $3.5 \pm 2.6$  vs  $5.8 \pm 2.9$  days ( $p < 0.05$ ). We had 7 children (13.6%) who developed postoperative complications in the LA group and 17 patients (45.9%) in the OA group (Tables 2 and 3) with significant difference,  $p < 0.05$ . Children in the LA group had a lower rate of wound infection (4.5 vs.

**Table 1:** Patient's demographics

Variable	LA	OA	p-value
Number	44	37	NS
Age	7.6 (3–14)	8.2 (5–14)	NS
Sex (male:female)	30:14 (68.1:31.8%)	23:14 (62.1:37.8%)	<0.05

NS: Nonsignificant

**Table 2:** Operative time and postoperative course

Variable	LA	OA	p-value
Operative time (min)	$59.6 \pm 20.3$	$62.8 \pm 28.6$	>0.05 NS
Length of hospital stay (days)	$3.5 \pm 2.6$	$5.8 \pm 2.9$	>0.05 NS

NS: Nonsignificant

**Table 3:** Postoperative complications

Variable	LA	OA	p-value
Wound infection	2 (4.5%)	3 (8.1%)	<0.05
Abdominal infection	0	2 (5.4%)	<0.05
Adhesive intestinal obstruction	0	1 (2.7%)	<0.05
Readmission	0	2 (5.4%)	<0.05
Total	2 (4.5%)	8 (21.6%)	<0.05

8.1.5%;  $p < 0.05$ ). The occurrence of the intraabdominal abscess was significantly lower in the LA group (0 vs 5.4%;  $p < 0.05$ ).

## DISCUSSION

Open appendectomy has been done through muscle splitting right lower quadrant incision since long time, but recently, LA appendectomy has been increasing, and some surgeons perform it routinely, others select cases, and some others still do it open.<sup>1</sup> The advantages of LA include short hospital stay, less postoperative pain, good exploration of the abdomen, fewer complications, but its routine use in complicated appendicitis is still controversial.<sup>1</sup> The operative time depends on the surgical skills and the degree of inflammation of the appendix. Although LA surgery takes time for preparation, and connection of the tubes and also working in a small space provide some difficulties and require meticulous introduction of the instruments, OA also takes time for opening and closure of the abdomen, especially in obese patients and if muscle cutting was done. In our study, we did not observe any difference in the operative time between open and LA group; this is mainly due to increased surgical experience in LA surgery. Also in a study done by Li et al,<sup>6</sup> there was no difference in the operative time.<sup>10</sup> Some studies also reported no difference in the operative time.<sup>4,6,11</sup> And some other studies reported increased operative time for LA compared with OA in perforated appendicitis.<sup>7-9</sup> During LA, intraoperative complications can occur as visceral injury or parietal bleeding during trocar insertion. In one study, the incidence of bowel injury during LA was reported to be 0.8% and this injury can occur due to dissecting of the inflamed friable bowel or dissecting at the base of the appendix. In our study, we did not encounter any bowel injury.<sup>10</sup> Bleeding also can occur during LA which is due to improper control of mesoappendix. The reported incidence of bleeding from mesoappendix in LA in a large

retrospective study was 1.2%. In our study, we used a harmonic scalpel to control and divide the meso appendix with good control and no intraoperative bleeding.<sup>10</sup> Wound infection is a common complication after appendectomy, and most of the studies report wound infection rate to be less than 0.2% in nonperforated appendix and 5.7% in perforated appendix.<sup>11,12</sup> In the present study, the wound infection was more common in OA group than in the LA group (4.5 vs 8.1%;  $p < 0.05$ ). And this is the case with most published studies.<sup>13-15</sup> This lower infection rate may be related to avoiding direct contact of the inflamed appendix and the infected fluid with the abdominal wall, as the appendix was removed through endobag and the infected abdominal fluid is aspirated under vision, but in OA, the wound usually is contaminated from the infected fluid or the inflamed appendix. Jen et al<sup>16</sup> reported the incidence of postoperative abscess formation to range from 1% in nonperforated appendicitis and 5 to 20% in perforated appendix. Previous studies showed increased incidence of intraabdominal abscess formation after LA in perforated appendicitis and this is mainly due to spread of infected intraabdominal fluid with gas insufflations.<sup>2,6,17,18</sup> But in contrast, other studies concluded that LA is safer<sup>20</sup> or equivalent<sup>4,9,19,20,22</sup> to OA regarding the intraabdominal abscess formation. In our study, the incidence of postoperative abscess formation was much more common in the OA; it was 2.5% in LA and 14.6% in OA ( $p < 0.05$ ). This improvement is due to the ability to visualize the whole abdominal cavity and perform proper peritoneal lavage and proper suction of the infected fluid. The risk of prolonged ileus and bowel obstruction ranges from 0.2 to 1.2%.<sup>9,21,23,24</sup> In our study adhesive intestinal obstruction occur in one patient in OA group and no one in the LA group.

In our study, the length of hospitalization was decreased in the LA group, which is related to less pain, quicker ambulation, and early start of oral feeding, and fewer complications, less pain as the muscle cutting incision in OA is much more painful compared with muscle stretching port insertion. This also has been reported by several studies.<sup>4</sup> In this study, OA patients had significantly more postoperative clinic visits than LA patients. Similar finding was also noticed by Taqi et al<sup>21</sup> and Muncini et al<sup>25</sup> and this was mainly related to recurrent abdominal pain and follow-up for the infected wound.<sup>10,13</sup>

## CONCLUSION

In our study, we showed that LA for perforated appendicitis in children can be performed safely with a low incidence of complications and it offers children faster recovery; so, we recommend LA in all cases of complicated appendicitis.

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