

Laparoscopic Versus Open Appendectomy for Diagnosed Acute Appendicitis in Children

^{*#}YU LIU, [#]ZHENGMIN CUI AND [#]RONGPENG ZHANG

From Departments of Pediatric Surgery; ^{}Qilu Hospital, Shandong Univeristy, and [#]Linyi People's Hospital, Linyi: China.*

Correspondence to: Dr Zhengmin Cui, Department of Pediatric Surgery, Linyi People's Hospital, Jiefang Road, Linyi, 276003, China. lzx_ld2010@163.com

PII: S097475591600078

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ABSTRACT

Objective: To compare the efficacy and safety of laparoscopic appendectomy and open appendectomy for acute appendicitis in children.

Methods: This study was conducted in a retrospective comparison of hospital records compared postoperative complications, duration of operation, and postoperative length of stay between the children (age \leq 18y) who underwent laparoscopic or ($n=190$) open ($n=199$) appendectomy over a six-year period. Quality of life was evaluated immediately and 1 month postoperatively.

Results: The major complication rate after surgery in laparoscopic group was significantly lower than that of open appendectomy group (13% vs 27%, $P<0.05$). The mean (SD) postoperative hospital stay was also shorter in laparoscopic group (2.4 (0.6) days vs 3.7 (1.1) days, $P<0.05$). The postoperative minor complication rate and hospital expenses were not significantly different between the two groups. The duration of surgery was longer in laparoscopic group ($P<0.05$). Children in laparoscopic group had less postoperative pain and higher quality of life after one month than those in open appendectomy group.

Conclusions: Laparoscopic technique seems to be safer than open appendectomy for acute appendicitis in children.

Key words: *Appendicitis, Complications, Laparoscopy, Surgery, Treatment.*

Appendectomy is considered as an effective and safe treatment option for acute appendicitis. In recent years, laparoscopic appendectomy has become a standard therapeutic procedure for acute appendicitis in many hospitals [1-4]. However, there is limited information about the comparison between open and laparoscopic surgery in children with acute appendicitis. We performed this retrospective comparison of efficacy and safety of laparoscopic and open appendectomy.

METHODS

We included patients (children \leq 18 years of age), who were diagnosed with acute appendicitis, and in whom we performed appendectomy in Linyi People's Hospital, China from 1st September 2008 to 1st September 2014. The study was approved by our hospital Ethics Committee. Informed consent was

obtained from patients' guardians. Patients with incidental appendectomy were excluded. We analyzed the clinical data of patients, including sociodemographic characteristics, postoperative complications, duration of the surgery, blood loss, postoperative length of hospital stay, and postoperative quality of life within 3 months. In addition, the cost of hospitalization was also estimated.

The level of medical treatment and the severity of disease determined the type of operation. Open appendectomy was performed through a gridiron **incision** after continuous epidural anesthesia. As a diagnostic purpose, laparoscopic surgery was intended for the insertion of 3 trocars and 30-grade, 10 mm laparoscopic optics. Before the procedure, the patients received general anesthesia. A Veress needle was inserted from the incision above the navel to release CO₂ into the abdominal cavity. The trocars were placed after establishing pneumoperitoneum, and then the laparoscopic instruments was put into the abdominal cavity through trocars. The involved appendix was dissected from adhesion and mesoappendix. All operations were performed by specialists in General surgery or Pediatric surgery.

Postoperative pain was assessed by a score based on severity of pain: 0=no pain; 1=mild pain; 2=moderate pain; 3=severe pain. The score of pain activities scale was assessed by severity of pain in three activities (rest, daily activities and strenuous exercise): 0=no pain; 1=mild pain; 2=moderate pain; 3=severe pain. The clinical pain scores were measured at day 1 and 1 month after operation.

Major complications, including perforation, abscesses, recurrence of appendicitis and wound infection were recorded. Minor complications, including antibiotic-related rash, fever, diarrhea, vomiting and paralytic ileus were also recorded. Duration of the surgery was the time period from incising the skin to the last suture insertion. Postoperative length of stay was calculated from the end of surgery to the date of discharge. The discharge criteria included no fever, no abdominal pain, healed operative wound, and stable vital signs.

Postoperative quality of life was evaluated by the SF-36 at one month after surgery. The SF-36 [5], includes 8 items: physical functioning (PF), role limitations due to physical health (RP), bodily pain (BP), general health perceptions (GH), vitality (VT), social functioning (SF), role limitations due to emotional problems (RE), and mental health (MH). All items were standardized from 0 to 100 with ameliorated status. The data related to pain and quality of life are routinely collected at our unit.

Statistical analysis: Statistical analysis was performed by Fisher's exact test or t-test through SPSS version 17.0 to compare parameters of open appendectomy and laparoscopic appendectomy in children with acute appendicitis. $P < 0.05$ was considered statistically significant.

RESULTS

389 children (age \leq 18 years) (216 boys and 173 girls) were included in the study. There were 190 patients with laparoscopic appendectomy and 199 with open appendectomy. Patient demographics and baseline characteristics are shown in **Table I** and were similar in both groups.

Postoperative pain scores between the two groups were summarized in **Table II**. Preoperative severity of pain and its influence on activities showed no significant difference in the two groups ($P=0.17$). The pain severity score was substantially lower in the laparoscopic group than in the open appendectomy group from the 2nd to the 26th day after the procedure ($P=0.04$). The impact of patient's pain on daily activities was also lower in laparoscopic group from the 8th to the 22th day after operation ($P=0.01$). The patients in both groups had no pain at 1 month postoperatively.

The incidence of minor complications was comparable between the laparoscopic group and the open appendectomy group (11/190 vs. 12/199). However, the incidence of major complications in laparoscopic group was significantly lower than in open appendectomy group ($P=0.01$). All data were presented in (**Table III**).

For children with acute appendicitis, the median operative time of the laparoscopic group was significantly longer than that of the open appendectomy group ($P=0.01$). There was also a significant difference in the length of hospital stay between two groups ($P=0.02$).

Quality of life scores were comparable in the two groups preoperatively and 1 month postoperatively, but a significantly higher score of vitality and mental health were found in laparoscopic group at 1 month postoperatively ($P=0.01$) (**Fig. 1**).

DISCUSSION

In this retrospective comparative analysis, we observed that laparoscopic appendectomy in children is a safe surgical procedure with minimal access and lesser frequency of major complications and post-operative incisional pain.

Several earlier studies in adults have also documented the advantages of laparoscopic appendectomy over open appendectomy in terms of rapid postoperative recovery and lower degree of surgical stress [6-9], less postoperative complication [10-14], shorter hospitalization period [15-17]. The benefits of laparoscopic appendectomy are controversial in children with perforated appendicitis and acute appendicitis [18-20]. An earlier study [21] also documented the benefits of laparoscopic

appendectomy in terms of reduction of major complications. We documented laparoscopic appendectomy to result in shorter duration of hospitalization. This result is in agreement with most earlier studies, [9,13,17].

Our study had a major limitation of being a retrospective comparison rather than a controlled assessment of differences between these two procedures. Non-standardized evaluation is also a serious limitation of such retrospective studies. Long-term follow-up was also not done.

Laparoscopic appendectomy needs longer duration of operation, as it involves trocar entry, diagnostic laparoscopy and several small incisions.

We conclude that Laparoscopic appendectomy seems to have considerable advantages over open appendectomy in cases of acute appendicitis in children for relieving postoperative pain and reducing major postoperative complication rates.

WHAT THIS STUDY ADDS?

Laparoscopic surgery seems to be superior to open appendectomy in terms of length of stay, major postoperative complications, and postoperative pain.

Contributors: YL: conceptualization of study and data collection; RZ: data collection; ZC: data analysis and drafting of the manuscript. All authors approved the final version of manuscript.

Funding: None; *Competing interest:* None stated

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TABLE I PATIENT DEMOGRAPHICS AND BASELINE CHARACTERISTICS

<i>Characteristics</i>	<i>Laparoscopic group (n=190)</i>	<i>Open group (n=199)</i>	<i>P</i>
Age, mean (SD) (years)	8.3 (2.3)	7.9 (2.6)	0.86
Sex, n (male/female)	102/88	114/85	0.55
Symptom duration, mean (SD) (hours)	34.2 (11.4)	38.2 (19.4)	0.98
WBC, mean (SD) (10 ³ /mL)	14.8 (6.4)	15.6 (4.7)	0.52
CRP, mean (SD) (mg/L)	40.2 (38.9)	43.5 (42.6)	0.84
Diarrhea, n	34	31	0.55
Vomiting, n	93	98	0.75
Temperature, mean (SD) (°C)	37.3 (1.1)	36.9 (0.8)	0.99

TABLE II CHANGES FROM PRE-TREATMENT TO 1 MONTH AFTER OPERATION IN PAIN SCORES

	<i>Laparoscopic group (n=190)</i>		<i>Open group (n=199)</i>	
		<i>Pain activities scale score</i>		<i>Pain activities scale score</i>
Preoperative	2.9 (0.5)	8.9 (0.5)	2.8 (0.7)	8.9 (0.8)
Postoperative day 2	2.4 (0.6)	6.9 (2.2)	2.9 (0.5)	7.6 (1.4)
Postoperative day 4	1.79 (0.8)	7.2 (2.4)	2.7 (0.2)	7.9 (1.2)
Postoperative day 6	0.9 (0.4)	6.5 (2.1)	2.3 (0.5)	7.1 (0.9)
Postoperative day 8	0.5 (0.6)	4.9 (0.5)	2.3 (0.9)	6.9 (0.5)
Postoperative day 10	0.3 (0.3)	3.4 (0.7)	2.1 (0.7)	5.8 (0.7)
Postoperative day 12	0.2 (0.5)	2.9 (0.7)	1.9 (0.5)	5.9 (1.5)
Postoperative day 14	0.1 (0.5)	1.9 (1.2)	1.4 (0.8)	4.6 (1.2)
Postoperative day 16	0	1.4 (1.4)	1.2 (0.5)	2.9 (0.9)
Postoperative day 18	0	0.9 (0.9)	1.3 (0.9)	3.0 (0.7)
Postoperative day 20	0	0.6 (1.6)	0.9 (1.1)	2.5 (0.5)
Postoperative day 22	0	0.5 (0.8)	0.7 (0.8)	1.9 (0.8)
Postoperative day 24	0	0.9 (1.2)	0.6 (1.2)	1.7 (1.2)
Postoperative day 26	0	0.4 (0.9)	0.9 (0.8)	2.2 (0.9)
Postoperative day 28	0	0.4 (0.8)	0.2 (0.7)	1.2 (0.8)
Postoperative day 30	0	0.2 (0.6)	0.1 (0.9)	1.2 (0.5)

TABLE III COMPARISON OF COMPLICATIONS BETWEEN OPEN AND LAPAROSCOPIC APPENDECTOMY GROUPS IN CHILDREN WITH ACUTE APPENDICITIS.

<i>Complications</i>	<i>Laparoscopic group (n=190)</i>	<i>Open group (n=199)</i>
<i>Major complications, n (%)</i>		
Perforation	1 (0.5)	3 (1.5)
Abscesses	2 (1.0)	4 (2.0)
Recurrence	5 (2.6)	16 (8.0)
Wound infection	18 (9.5)	29 (14.6)
<i>Minor complications, n (%)</i>		
Antibiotic-related rash	1 (0.5)	2 (1.0)
Fever	0	2 (1.0)
Diarrhea	4 (2.1)	3 (1.5)
Vomiting	4 (2.1)	5 (2.5)
Paralytic ileus	2 (1.0)	0

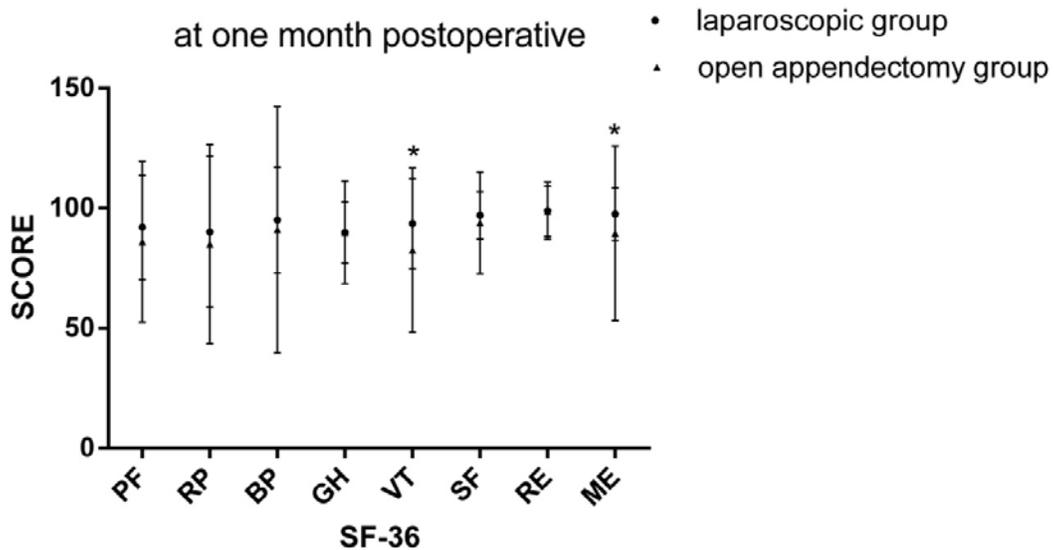


FIG. 1 The SF-36 scores at preoperative and one month after operative of two groups. * $P < 0.05$.