

Laparoscopic Versus Open Appendectomy for Acute Appendicitis in Children

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Objective: To compare the efficacy and safety of laparoscopic appendectomy and open appendectomy for acute appendicitis in children. **Methods:** This study was conducted as a retrospective comparison of hospital records for postoperative complications, duration of operation, and postoperative length of stay between children (aged <18y) who underwent laparoscopic ($n=190$) or 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.

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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 a retrospective comparison of efficacy and safety of laparoscopic and open appendectomy.

METHODS

We included patients (children <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 1 month. In addition, the cost of hospitalization was also estimated.

The level of medical treatment and the severity of disease determined the type of surgery. 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 using 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 <18 years) (216 boys) were included in the study. There were 190 patients with laparoscopic appendectomy. Patient demographics and baseline characteristics were similar in both groups (**Table I**).

Postoperative pain scores between the two groups are 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 major complications in laparoscopic group was significantly lower than in open appendectomy group ($P=0.01$), although it was comparable for minor complications (**Table III**). 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 ($P=0.01$) (**Web Fig. 1**).

TABLE I PATIENT DEMOGRAPHICS AND BASELINE CHARACTERISTICS

Characteristics	Laparoscopic group (n=190)	Open group (n=199)
Age (y)	8.3 (2.3)	7.9 (2.6)
Male gender*	102 (53.7)	114 (57.3)
Symptom duration (h)	34.2 (11.4)	38.2 (19.4)
WBC (10 ³ /mL)	14.8 (6.4)	15.6 (4.7)
CRP (mg/L)	40.2 (38.9)	43.5 (42.6)
Diarrhea*	34 (17.9)	31 (15.6)
Vomiting*	93 (48.9)	98 (49.2)
Temperature (°C)	37.3 (1.1)	36.9 (0.8)

Values in mean (SD) or *No. (%); all P values >0.05.

TABLE II CHANGE IN PAIN SCORES FROM PRE-TREATMENT TO 1 MONTH AFTER SURGERY

	Laparoscopic group (n=190)		Open group (n=199)	
	Pain score	Pain activities scale	Pain score	Pain activities scale
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)

WHAT THIS STUDY ADDS?

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

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 [6,7], less postoperative complication [8-11], shorter hospitalization period [12,13]. The benefits of laparoscopic appendectomy are controversial in children with perforated appendicitis and acute appendicitis [14]. An earlier study [15] 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, [7,10,13].

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.

TABLE III COMPLICATIONS IN OPEN AND LAPAROSCOPIC APPENDECTOMY GROUPS IN CHILDREN WITH ACUTE APPENDICITIS

Complications	Laparoscopic group (n=190)	Open group (n=199)
<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

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.

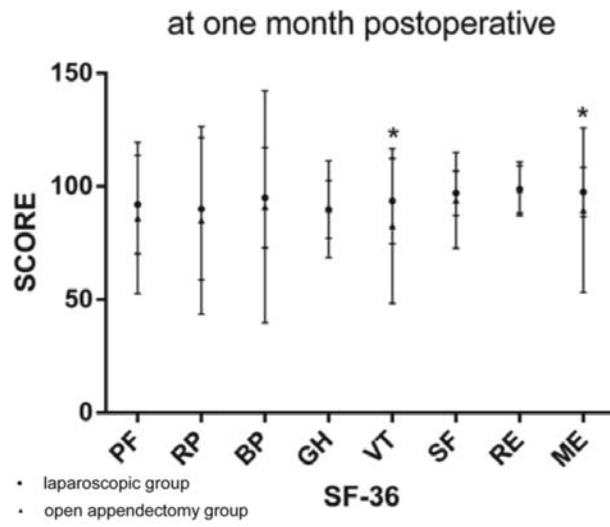
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WEB FIG. 1 The SF-36 scores at preoperative and one month after operative of two groups (* $P < 0.05$).