



Laparoscopic appendectomy for perforated appendicitis in children has complication rates comparable with those of open appendectomy

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Received 13 January 2012; revised 23 July 2012; accepted 27 July 2012

Key words:

Perforated appendicitis;
Children;
Laparoscopic
appendectomy;
Open appendectomy;
Complications

Abstract

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

Methods: We reviewed the medical files of 221 children who underwent LA ($n=75$), OA ($n=122$), and conversion (CO) ($n=24$), comparing duration of operation, re-admissions, re-operations, intra-abdominal abscesses (IAA), and wound infections.

Results: Compared to OA, LA resulted in fewer re-admissions (1.3% vs. 12.3%; $P=.006$), fewer re-operations (4% vs. 17.2%; $P=.006$), and fewer wound infections (0% vs. 11.5%; $P=.001$). No differences in the duration of operation (72.9 ± 23.0 min vs. 77.7 ± 48.0 min; $P=.392$) or IAA (4% vs. 11.5%; $P=.114$) were observed. Compared to LA, CO had more complications.

Conclusions: We report that LA is superior to OA with regard to incidence of re-admission, re-operation, and wound infection.

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Laparoscopic appendectomy (LA) is minimally invasive and associated with less postoperative pain in children [1]. It remains to be clarified whether LA is inferior to open appendectomy (OA) in terms of postoperative complications, since there is considerable discrepancy in the published data. A 2010 Cochrane study [2] performed on adults and children

reported that LA increases the rate of intra-abdominal abscess (IAA) in adults and postulated a similar trend in children. Other studies performed on children, however, found an equal [3] or decreased [4] rate of IAA. This discrepancy prompted us to investigate the impact of LA on duration of operation and complications, in children with perforated appendicitis.

1. Methods

After obtaining institutional review board approval (no. 3928-11), a retrospective review identified all children less than 18 years of age with intraoperative and histological confirmed perforated appendicitis who

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underwent appendectomy between January 2001 and December 2010 at the Department of Pediatric Surgery of Ruhr-University in Bochum, Germany. For inclusion in our study, patients had to fulfill the criteria of the definition for perforated appendicitis published in 2008 by St Peter et al. [5]: intraoperative evidence of perforation or intra-abdominal fecalith and confirmation of the perforation during histopathological examination. Only data from those patients who fulfilled both criteria were included. All other patients with a surgical diagnosis of perforated appendicitis who did not fulfill these strict criteria were excluded in order to rule out variation in the definition of perforation from 2001 to 2010.

Informed consent was obtained from each patient's guardian. The patients were divided into three groups: patients who underwent LA, patients who underwent OA, and patients who underwent a conversion (CO). LA was performed using 3 Endo-Loops® (Ethicon®, Norderstedt, Germany). The decision of whether to perform LA or OA was based on the surgeon's preference. Until 2007, COs were performed routinely if suppuration was visualized intra-abdominally. Since 2007, however, the only indication for CO is the inability to continue with LA. Surgical procedures were performed by consultants and residents. Our antibiotic regimen consisted of daily intravenous administration of cefuroxim (100 mg/kg body weight in three doses) for 7 days and metronidazole (20 mg/kg body weight in two doses) for 5 days starting at the onset of anesthesia. Some patients received an adapted antibiotic therapy based on the results of their intraoperative microbiological smear. Patients' medical records were reviewed retrospectively, and the following data were collected: age, sex, surgical procedure(s), duration of operation, and incidence of re-admission, re-operation, intra-abdominal abscess formation, adhesiolysis and wound infection. We excluded children presenting with additional diagnoses before the first admission.

Patients with a follow-up period less than 12 months, incomplete documentation, concomitant operations, or referred after appendectomy in other hospitals were excluded. We chose 12 months for the minimum follow-up in order to include late complications such as bowel obstruction that required adhesiolysis in addition to the complications that occurred within the first 30 postoperative days.

Comparative statistical analyses were undertaken using the Fisher's exact test for qualitative data and the Mann-Whitney *U* test for quantitative data. Qualitative and quantitative data are presented as bars, illustrating mean±standard deviation (SD). Statistical analyses were performed using SPSS® 20 (IBM®) software. Differences were considered significant at $P < .05$.

2. Results

2.1. Demographic data

Appendectomies were completed in 221 children with perforated appendicitis evident at operation and confirmed

by histopathology. Eleven otherwise eligible patients were excluded during the duration of the study: 8 patients with incomplete documentation, 1 patient with concomitant resection of a Meckel's diverticulum, and 2 patients referred with complications after appendectomies in other hospitals. Perforated appendicitis accounted for 221 (19.8%) of 1114 patients with appendicitis. Seventy-five (33.9%) children underwent LA, 122 (55.2%) underwent OA, and in 24 patients (10.8%) the operative procedure was converted intra-operatively from LA to OA (CO).

Mean patient age was 94 months (range, 15–212 months). Twenty-five different surgeons performed the surgical procedures, and the same surgeons operated on patients from different treatment groups (Table 1). Several surgeons performed operations both as residents and subsequently as board-certified pediatric surgeons. Consequently, 136 patients (61.5%) were operated on by 8 board-certified pediatric surgeons, and 20 residents operated on the remaining 85 patients (38.5%) under the supervision of a board-certified pediatric surgeon. The incidence of perforated appendicitis ($P = .137$) did not significantly differ between boys ($n = 124$) and girls ($n = 97$), and no deaths occurred. The median follow-up period was 25 months (range, 12–127 months) for LA,

Table 1 Count and type of surgical procedures performed by each participating surgeon.

Surgeon	LA	OA	CO	Total	
				Count	%
1	1	0	0	1	0.5
2	3	0	0	3	1.4
3	0	7	0	7	3.2
4	6	1	1	8	3.6
5	3	0	0	3	1.4
6	9	4	2	15	6.8
7	3	0	0	3	1.4
8	0	8	0	8	3.6
9	0	13	0	13	5.9
10	0	3	0	3	1.4
11	4	21	5	30	13.6
12	1	0	0	1	0.5
13	4	20	5	29	13.1
14	0	5	0	5	2.3
15	0	4	0	4	1.8
16	0	4	0	4	1.8
17	0	5	0	5	2.3
18	13	10	2	25	11.3
19	0	2	0	2	0.9
20	1	0	1	2	0.9
21	3	5	0	8	3.6
22	3	2	4	9	4.1
23	16	6	3	25	11.3
24	1	2	0	3	1.4
25	4	0	1	5	2.3
Total	75	122	24	221	100

LA, laparoscopic appendectomy; OA, open appendectomy; CO, conversion from LA to OA. %: percentage of all surgical procedures.

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