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Open versus Laparoscopic Appendectomy in Children: A Comparison of Complications

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ABSTRACT

Although between 4% and 20% of all appendectomies in adults are performed laparoscopically, this procedure is rarely done in the pediatric age group because of the substantially more difficult technique, the expected risks and suspected higher rate of complications. In a prospective study of 500 consecutive appendectomies, we tried to assess the actual rate of complications of each operative approach. We included 362 conventional and 138 laparoscopic appendectomies, the median age of the patients was 10.8 years. The mortality was 0 in both groups.

We observed 89 minor and 11 major complications. All major complications (wound infections needing re-operation under general anesthesia, intra-abdominal abscesses, ileus due to adhesions and a case of renal insufficiency because of glomerulonephritis) occurred in the conventional group (n=11, ie, 3% of 362 open appendectomies). Seventy-two minor complications were seen in the same group (20%). In the laparoscopic group, there were 17 (13%) minor complications and no severe complications. This difference was statistically significant.

We conclude that in children laparoscopic appendectomy does not carry a greater risk of intra- or postoperative complications and can therefore safely be established as a standard procedure.

Key Words: Appendicitis, Laparoscopy, Complications, Appendectomy in children.

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INTRODUCTION

Whereas between 4% and 20% of all appendectomies are already done laparoscopically in adults, only a few specialized centers routinely perform this procedure in children.[1,2] One of the reasons is the fear of intraoperative severe complications (eg, vascular or bowel injuries). Another reason is the considerably more demanding technique in children, together with the suspected higher rate of intra-abdominal abscess formation, so that the overall risk is usually considered too high.[3,4]

In this study, we tried to correlate the actual rate of complications with the operative technique.

PATIENTS AND METHODS

In a prospective, non-randomized study, we observed 500 consecutive appendectomies in our department. Laparoscopic appendectomy was performed when a surgeon and theater staff experienced in pediatric laparoscopy as well as the equipment were available and when the parents agreed to the procedure.

Results (rate of complications in the respective groups) were tested for significance by Chi-square test; a $P<0.05$ was considered significant.

RESULTS

The median age of patients was 10.8 years (SD: 4.2 years; range: 4 days to 19 years). The intraoperative and histological diagnoses are depicted in **Table 1**. Three hundred and sixty-two children had appendectomy through a conventional gridiron (McBurney and Murphy) incision, 138 laparoscopically; in 6 cases (4.3%), conversion to open appendectomy was necessary. There were no intraoperative complications in the group of open surgery or in the laparoscopic group. Conversion from laparoscopic to open surgery was intended once; in five other cases, it was necessary because of technical problems or poor visualization.

There were 99 (20%) postoperative complications overall. Of these, 89 (89%) were minor and 10 (11%) severe. Taking a closer look at perforated appendicitis as a major factor for morbidity,[5] we counted 72 cases (20%) in the

Table 1.
Final diagnoses in 500 patients with suspected appendicitis.

Appendicitis	n=362
chronic recurrent appendicitis	n=39
acute	n=47
phlegmonous	n=178
perforated	n=86
perityphlitic abscess	n=12
nonspecific abdominal pain	n=93
oxyuriasis	n=13
adnexitis	n=7
enteritis	n=4
ovarian cyst	n=4
acute cystitis	n=2
neurogenic appendicopathy	n=1
intussusception	n=1
Crohn's disease	n=1
no diagnosis	n=12

conventional group and 14 (10%) in the laparoscopic group. Eighty-two (22.7%) of the conventional and 17 (12.8%) of the laparoscopic appendectomies had complications. Mortality was 0 in both groups.

The postoperative follow-up was at least two months. All severe complications occurred in the open group (n=11, 3%); the difference is statistically significant (p=0.04). There were significantly fewer minor complications in the laparoscopic group (n=17, 12.8%) than in the conventional group (n=72, 19,9%), p=0.007.

Furthermore, we compared length of hospitalization, duration of antibiotic therapy and duration of postoperative pain **(Table 2)**.

DISCUSSION

Outside specialized centers, laparoscopic appendectomy is still rarely performed in pediatric surgery. In Austria, about 9% of all appendectomies in adults[6] but only 2% in children. In Europe, between 4% (The Netherlands) and 12% (France) are performed laparoscopically. In the United States, minimal invasive surgery accounts for about 20% of all appendectomies.[7]

Although significantly shorter hospitalization, antibiotic treatment and less postoperative pain after laparoscopy is generally accepted today,[8] there is still common belief that there is a higher rate of intraoperative complications, especially injuries from Veress needles and trocars, as well as postoperative intra-abdominal abscesses.[9] We have shown in this study that this fear is not warranted: injuries from trocars are avoidable when open introduction (Hasson technique) is consistently used. (Ninety-five percent of our trocars were placed under direct vision in our series.)[10] There were no complications due to trocar placement itself.

The proportion of minor wound infections was comparable (4:7), whereas severe local infections needing opening of the wound, debridement and drainage under general anesthesia were practically only seen with the open approach (1:12).

Wound infections without reoperation, postoperative fever and paralytic ileus were counted as minor complications, whereas subcutaneous abscesses needing reoperation in full anesthesia, intra-abdominal abscesses, mechanical ileus and postoperative renal insufficiency counted as severe complications. Prolonged postoperative paralysis with vomiting was seen only once in the minimally invasive group, as opposed to 12 times in the conventional group.

Postoperative fever (>38.5° C axillary temperature) and leukocytosis as well as elevated C-reactive protein were more often (four times) seen in the conventional group.

Intra-abdominal abscesses after laparoscopic appendectomy usually occur at the site of the appendiceal stump. This could be due to technical errors (eg, slipped ligature, thermal damage, excessive length of stump). We have therefore usually used the endostapler device for resection of the appendix, a technique already recommended by others.[2,11] In our series, intra-abdominal abscesses were only seen in children operated conventionally (4 cases, 1%). Overlooked intra-abdominal debris or insufficient lavage may be the reason.

Re-laparotomy had to be performed in three cases; once, segmental resection of the small intestine was necessary because of inflammatory pseudotumor two weeks after perforated appendicitis. The frequency of perforated appendicitis was twice as high in the conventional group (20 vs 10 percent) because the patients were not randomized. Nevertheless, at least three severe complications (3% of 138) would have been expected in the laparoscopic group. Above all, all re-laparotomies were related to open surgery. Whether glomerulonephritis was due to appendicitis is debatable, but a connection cannot be excluded because it occurred immediately after surgery.

Table 2.
Duration of admission, pain and antibiotic therapy needed, regarding type of operation.

duration	of stay		of pain		of antibiotic therapy	
kind of complication	MIS	conv	MIS	conv	MIS	conv
minor wound infection n=11 (3+1/7)	3	5.6	1.3	2.3	4	5.4
severe wound infection n=13 (1/12)	3	12	2	7	7	8
intra-abdominal abscess n=4 (0/4)	0	16	0	8	0	12
paralytic ileus n=12 (1/12)	10	8.7	3	4	11	9.3
postoperative fever n=58 (12/46)	6	7.5	1.7	3.5	7.3	6.1
total n=500 (362/138)	3.4	6	0.9	2.6	3.3	4.9

MIS = minimal invasive surgery; conv. = conventionally (gridiron incision).
Figures in table show average value of days; figures in 1st column: n= total sum of patients, between brackets: part of minimally invasive/conventionally operated.

Duration of postoperative pain was considerably shorter after laparoscopic appendectomy. Because it is important in all patients to minimize pain, the substantially higher costs of laparoscopic appendectomy already seem to be justified.

CONCLUSION

In experienced hands, laparoscopic appendectomy in children does not carry a higher rate of postoperative complications than open appendectomy. It can therefore be safely established as a standard procedure under appropriate conditions.

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