



Outcome after introduction of laparoscopic appendectomy in children: A cohort study



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ABSTRACT

Introduction: Acute appendicitis in children is common and the optimal treatment modality is still debated, even if recent data suggest that laparoscopic surgery may result in shorter postoperative length of stay without an increased number of complications. The aim of the study was to compare the outcome of open and laparoscopic appendectomies during a transition period.

Materials and methods: This was a retrospective cohort study with prospectively collected data. All patients who underwent an operation for suspected appendicitis at the Astrid Lindgren Children's Hospital in Stockholm between 2006 and 2010 were included in the study.

Results: 1745 children were included in this study, of whom 1010 had a laparoscopic intervention. There were no significant differences in the rate of postoperative abscesses, wound infections, readmissions or reoperations between the two groups. The median operating time was longer for laparoscopic appendectomy than for open appendectomy, 51 vs. 37 minutes ($p < 0.05$). The postoperative length of stay was similar in the two groups. A simple comparison between the groups suggested that laparoscopic appendectomy had a shorter median postoperative length of stay, 43 vs. 57 hours ($p < 0.05$). However, there was a trend in time for a shorter postoperative length of stay, and a trend for more of the procedures to be performed laparoscopically over time so on regression analysis, the apparent decrease in length of stay with laparoscopy could be ascribed to the general trend toward decreased length of stay over time, with no specific additional effect of laparoscopy.

Conclusions: Our data show no difference in outcome between open and laparoscopic surgery for acute appendicitis in children in regard of complications. The initial assumption that the patients treated with laparoscopic surgery had a shorter postoperative stay was not confirmed with linear regression, which showed that the assumed difference was due only to a trend toward shorter postoperative length of stay over time, regardless of the surgical intervention.

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Acute appendicitis is a common disease in children and an appendectomy is the most common emergency operation performed in this population. For more than 100 years, an open appendectomy (OA) has been the treatment of choice for suspected appendicitis. The first appendectomy performed for the diagnosis of acute typhilitis was performed in Edinburgh by Robert Lawson Tait in 1880 [1] but it was McBurney who got his name immortalized after his paper in 1889 [2]. With improvements in anesthetics and later antibiotic treatment appendectomy evolved into routine practice, a further development came with the introduction of laparoscopic appendectomy (LA) in adults first presented

by Semm in 1983 [3] and in children by Ure and coworkers in 1992 [4]. The first paper to present a benefit of LA over OA in children was presented by Gilchrist and coworkers in 1992 [5] but there has been no consensus in this debate ever since. Stronger support for the laparoscopic method was presented in a Cochrane review by Sauerland and coworkers in 2004 [6], concluding that “in those clinical settings where surgical expertise and equipment are available and affordable, we would generally recommend to use laparoscopy and LA in all patients with suspected appendicitis unless laparoscopy itself is contraindicated or not feasible”. In 2006, Aziz and coworkers presented a metaanalysis [7] that included 23 studies with a total of 6477 patients. They showed that there were fewer postoperative complications after LA compared with OA. Based on these studies we decided to change from OA to LA in our department. To optimize the transition, we set up a strict protocol based on best available evidence at the time, together with prospective data collection of clinical data and outcomes.

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The preoperative diagnosis of acute appendicitis in children has been difficult and a high rate of negative appendectomies has been accepted to minimize the rate of perforations. A negative appendectomy rate in children of 20–30% has been reported [8], even if this number seems to decrease in recent years [8].

At our institution we have used imaging for diagnosis of acute appendicitis for more than ten years [8]. Virtually all patients that undergo surgery for suspected acute appendicitis have had an imaging diagnosis.

The aim of the study was to compare the outcome of open and laparoscopic appendectomies during a transition period.

1. Methods

This was a retrospective cohort study with prospectively collected data. All patients with the diagnosis of appendicitis, with any kind of appendectomy and all patients with an explorative laparoscopy were identified through the hospital discharge database and through our computerized theater log book. These patients were reviewed through our computerized notes system.

The study was conducted at the Department of Paediatric Surgery at the Karolinska University Hospital in Stockholm, Sweden. This department is the only tertiary referral center for pediatric surgery in the greater Stockholm area, 320–380 operations for suspected appendicitis are performed each year. OA was the procedure of choice until the autumn of 2007. At that point we designed a protocol for LA with the ambition to minimize the learning curve and to minimize the postoperative complications.

This protocol states the umbilical port to be introduced with an open technique according to Hasson [9]. We use a 12 mm Bluntport™ trocar (Covidien, USA) to accommodate a staple device and a specimen bag. Two 5 mm STEP™ trocars (Covidien, USA) are inserted in the lower left quadrant and suprapubically under direct vision. The base of the appendix is stapled with an Endo-GIA™ (Covidien, USA), 2.0 or 2.5 mm depending on the size of the appendix. If the abdominal cavity does not accommodate the Endo-GIA™ (Covidien, USA), endoloops are used. The mesoappendix is divided with either Endo-GIA™ (Covidien, USA) or monopolar hook diathermy. We advocate a liberal use of an Endo-Catch™ bag (Covidien, USA) in all cases, to avoid contamination

from the area of division. Suction and irrigation is used according to surgeon's choice.

All patients who underwent an operation for suspected appendicitis in our department from January 2006 to December 2010 were included in this study. All patients had at least three months of follow up as described below. Baseline data as age, gender, temperature, CRP and white blood cell count were collected. Surgical modality, conversion, surgeon, operating time, time of surgery, time of discharge, surgeon's assessment of disease, histopathological assessment of disease, wound infection, presence of postoperative abscess and reoperation within three months were also collected. Since 2006 all patients as identified above have been included in our yearly performance report, hence most of the data presented in this paper has been retrieved on a yearly basis with at least three months follow up. A repeated search for the whole period was performed for this paper, for accuracy.

The final diagnosis was made in accordance with Carr [10] and thus on the histopathology finding described in Table 1. For the missing data in the open group ($n = 23/735$) the clinical assessment has been used. As we did not have a predefined clinical criteria for perforation these data may not be accurate. A routine sampling for white blood cell count and neutrophils was not in place during the first part of the series.

To be able to stratify patients for statistical purposes, the outcome parameters needed to be defined. We have defined a postoperative abscess as a localized fluid collection seen with imaging at least three days after the initial operation. Both an inserted drain and a drainage procedure without insertion of a drain were considered as drain treatment.

A reoperation was considered when the patient had to undergo a procedure by a surgeon either under general anesthesia. This included drainage of abscesses.

A wound infection was considered when a patient had been seen by a physician either as an inpatient, as an outpatient at the outpatient clinic or at the emergency room, or seen by the local general practitioners. Either pus or foul fluid had to be seen together with signs of inflammation. Antibiotic treatment is not necessary for the inclusion. The search has been made through the regional computerized notes database that includes all nonprivate general practitioners and all public hospitals in the region.

All data were prospectively put into our computerized notes database (Take Care™, GCM, Germany) and our computerized theater log

Table 1

A classification of acute appendicitis and the corresponding gross and microscopic appearances. From Carr NJ "The pathology of acute appendicitis" (2000), with permission.

Pattern	Gross	Microscopic	Significance
Acute intraluminal inflammation	No visible changes	Luminal accumulation of neutrophils only; no ulceration or transmural infiltrate	Probably none
Acute mucosal inflammation (catarrhal inflammation)	No visible changes	Neutrophils within mucosa and mucosal ulceration, with or without intraluminal neutrophils	May not be responsible for patient's symptoms; consider infective enteritis
Acute mucosal and submucosal inflammation	No visible changes	As above with neutrophils in submucosa	May not be responsible for patient's symptoms; consider infective enteritis
Suppurative acute appendicitis (phlegmonous appendicitis)	May be in apparent grossly; dull serosa; dilatation and congestion of surface vessels; fibrinopurulent serosal exudate in well-developed cases; appendix may be increased in diameter and/or dilated	Defined as neutrophilic infiltration of mucosa, submucosa, and muscularis propria; transmural inflammation; extensive ulceration, and intramural abscesses common; vascular thrombosis	An accepted cause of appendicitis-type symptoms
Gangrenous acute appendicitis (necrotizing acute appendicitis)	Appendiceal wall friable; purple, green, or black	Transmural inflammation with areas of necrosis; extensive mucosal ulceration	Perforation will complicate untreated gangrenous appendicitis
Periappendicitis	May appear normal or serosa may be dull, congested, and show an exudate	Inflammation of serosa and subserosa; infiltrate extends no further than outer muscularis propria	The cause probably lies outside the appendix
Increased mural eosinophils	No visible changes	>10 eosinophils/mm ² in muscularis propria in the absence of any other changes	Unknown; possibly an early event in appendicitis, possibly of no significance; consider parasite or eosinophilic enteritis

Note: Before diagnosing acute intraluminal, mucosal, and submucosal inflammation, thorough sampling for histology to exclude inflammation of muscularis propria should be performed.

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