



Unexpected findings after surgery for suspected appendicitis rarely change treatment in pediatric patients; Results from a cohort study☆☆☆



Ramon R. Gorter^{a,b,*}, Paul van Amstel^a, Johanna H. van der Lee^c, Patick van der Voorn^d,
Roel Bakx^a, Hugo A. Heij^a

^a Paediatric Surgical Centre of Amsterdam, Emma Children's Hospital AMC & VU University Medical Centre, P.O. Box 22660, 1100DD Amsterdam, The Netherlands

^b Department of Surgery, Red Cross Hospital, Vondellaan 13 1942 LE, Beverwijk, The Netherlands

^c Paediatric Clinical Research Office, Division Woman and Child, Academic Medical Centre, Meibergdreef 9, 1105AZ Amsterdam, The Netherlands

^d Department of Pathology, VU University Medical Centre, De Boelelaan 1117, 1081HV Amsterdam, The Netherlands

ARTICLE INFO

Article history:

Received 1 September 2016

Received in revised form 21 February 2017

Accepted 25 February 2017

Key words:

Unexpected findings

Appendicitis

Appendectomy

ABSTRACT

Background: To determine if non-operative treatment is safe in children with acute appendicitis, we evaluated the incidence of unexpected findings after an appendectomy in children, and the influence they have on subsequent treatment.

Methods: A historical cohort study (January 2004–December 2014) was performed including children, aged 0–17 years, who underwent an appendectomy for the suspicion of acute appendicitis. Patients were divided based upon histopathological examination. Unexpected findings were reviewed, as well as the subsequent treatment plan.

Results: In total 484 patients were included in this study. In the overall group, unexpected findings were noted in 10 (2.1%) patients of which two patients intra-operatively with a non-inflamed appendix (Ileitis terminalis N = 1 and ovarian torsion N = 1) and in 8 patients on histopathological examination. The latter group consisted of 4 patients with concomitant simple appendicitis (parasitic infection N = 3 and Walthard cell rest N = 1), two with concomitant complex appendicitis (carcinoid N = 1 and parasitic infection N = 1) and two patients with a non-inflamed appendix (endometriosis N = 1 and parasitic infection N = 1). Treatment was changed in 4 patients (<1%).

Conclusions: Results from this study corroborate the safety of non-operative strategy for acute simple appendicitis, as the occurrence of unexpected findings was low, with extremely few necessary changes of the treatment plan because of serious findings.

Type of study: Prognosis study.

Level of evidence: Level 2 (retrospective cohort study).

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Recently, pilot-studies have been published investigating the safety and effectiveness of non-operative treatment for acute simple appendicitis in children with promising results [1–4]. Benefits of this treatment strategy reported are avoidance of an appendectomy with its associated complications, avoidance of anesthesia, quick return to school, reduced costs and potentially better quality of life [1–4]. In children, short-term data demonstrated success rates above the 80% with non-operative

treatment, although it was reduced to 62% at one year follow up in the only study reporting long-term follow-up [2]. Several concerns have been raised regarding this new treatment strategy such as the risk of recurrent appendicitis as well as the risk of missing a complex appendicitis. Additionally, there is concern of missing other types of pathology such as a malignancy when no operation and subsequent histological examination is performed. The reported prevalence of an underlying unexpected malignancy first identified because of appendicitis ranges from 0.2–0.5% in children to 1.6% in adults [6–10]. The eventual negative consequences of missing a malignancy might be one of the reasons why some surgeons are reluctant to adopt this treatment strategy.

In 2010, the Netherlands Association of Surgery implemented a national guideline promoting preoperative imaging studies to confirm the diagnosis of appendicitis in order to reduce the amount of negative appendectomies [11]. Potential positive consequences of this guideline are not only a reduction in the rate of negative appendectomies, but also the rate of unexpected findings.

* Conflict of interest: none.

☆☆ This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

* Corresponding author at: Paediatric Surgical Centre of Amsterdam, Emma Children's Hospital AMC and VU University Medical Centre, P. O. Box 22660, 1100 DD, Amsterdam, The Netherlands. Tel.: +31 20 444 2424; fax: +31 20 444 2135.

E-mail addresses: rr.gorter@vumc.nl, rgorter@rkz.nl (R.R. Gorter), p.van.amstel@student.vu.nl (P. van Amstel), j.h.vanderlee@amc.uva.nl (J.H. van der Lee), jp.vanderVoorn@vumc.nl (P. van der Voorn), r.bakx@amc.uva.nl (R. Bakx), hugo.heij@icloud.com (H.A. Heij).

The main aim of this study was to assess the occurrence, type and consequences of unexpected findings during appendectomy and subsequent histopathological examination of the appendix in children undergoing an appendectomy for the suspicion of an acute appendicitis, with specific attention to those children with simple appendicitis. The ultimate goal is to estimate how frequently unexpected findings are indicative of serious disease with potential detrimental effects for these patients. Secondly we wanted to investigate if the implementation of our national guideline led to a reduction in negative appendectomies and unexpected findings.

1. Materials and methods

From our tertiary referral centre (two academic hospitals) we retrospectively reviewed the medical charts of all children, 0–17 years old, who underwent an appendectomy for the suspicion of an acute appendicitis between January 2004 and December 2014. The diagnostic work-up of children with suspected appendicitis depends on the year of presentation. Prior to the implementation of the national guideline in 2010, imaging studies were not performed routinely and the indication to perform an appendectomy was mainly based upon medical history, physical examination and laboratory findings. After 2010, preoperative imaging studies were performed in most patients with suspected appendicitis. Ultrasound is considered as the modality of choice (both in children and adults). In cases of inconclusive results, CT-scan (adults) or MRI (children) should be considered [11].

We excluded patients with missing operative or histopathological reports and those who underwent an appendectomy for another indication than acute appendicitis (for instance as a standard procedure during surgery for malrotation). Data were extracted using a standardized extraction form containing the following variables:

- General: Age, sex, year of presentation
- Preoperative imaging studies: Ultrasound, CT-scan, and MRI.
- Intra-operative data: Approach (laparoscopic or open), diagnosis during surgery (appendicitis, non-inflamed appendix, suspicion of malignancy etc.)
- Histopathological: Histopathological diagnosis
- Treatment: Alteration of treatment strategy after surgery and subsequent histopathological examination.

In the study period numerous surgeons and surgical residents operated on the patients. Intraoperative diagnosis was made by the operating surgeon and reported in the operation report. In case of a non-inflamed appendix during surgery the abdomen is routinely explored for additional pathology. The approach for the appendectomy was at the surgeon's discretion. In our centre the appendix is routinely sent to the department of pathology for microscopic examination. One common standardized protocol is used in both hospitals for histopathological examination of the appendix.

Based upon the histopathological examination patients were divided into three groups:

- Non-inflamed appendix: No presence of a polymorphonuclear infiltration of at least the lamina propria together with a marked increase in mononuclear and lymphoid cell numbers with or without mucosal ulceration and with or without serositis or peri-appendicitis.
- Simple appendicitis: Presence of a polymorphonuclear infiltration of at least the lamina propria together with a marked increase in mononuclear and lymphoid cell numbers with or without mucosal ulceration and with or without serositis or peri-appendicitis. No necrosis was noted.
- Complex appendicitis: Necrosis in the muscularis propria or perforation (macroscopic or microscopic) was noted.

In all three groups, unexpected findings during histopathological examination could be noted.

Table 1

Preoperative imaging studies in patients: 2004–2009.

	Simple appendicitis*	Complex appendicitis*	NIA*	Unexpected findings**
No imaging studies	41	32	2	1
Imaging studies				
Ultrasound	102	94	11	4
Ultrasound + CT	3	4	0	1
Ultrasound + MRI	0	0	0	0
CT	0	2	0	0
MRI	0	0	0	0
Total	146	132	13	6

NIA = non-inflamed appendix.

CT = computed tomography scan.

MRI = magnetic resonance imaging.

* Diagnosis based upon histopathological examination.

** Unexpected findings: Intraoperative or on histopathological examination.

Descriptive statistics were performed using SPSS version 20 (IBM, Armonk, NY, USA). The Ethics Committee of the Academic Medical Centre has provided us with a statement confirming that the Medical Research Involving Human Subjects Act (WMO) did not apply to this study and that therefore no official approval for this study was necessary by national law.

2. Results

2.1. General characteristics

In total 577 patients younger than 18 years underwent an appendectomy in this time period in our centre. We excluded 55 patients because the indication for the appendectomy was different from acute appendicitis and 38 patients because of missing data. In total 484 children could be included in the analysis, 297 who had been treated in the years 2004–2009 and 187 who had been treated in the years 2010–2014. The median (range) age was 10 (0–17) years. There was a slight male predominance of 57.4%. The laparoscopic approach was used in 255/484 patients (53%).

Preoperative imaging was performed in 221/297 patients (74.4%) and in 178/187 patients (95.2%) in the periods 2004–2009 and 2010–2014, respectively. Results regarding the preoperative imaging studies performed in each group (based upon histopathological findings) per time period are displayed in Tables 1 and 2. In addition, the preoperative imaging studies performed in children with unexpected findings (on histopathological examination or encountered intraoperatively) is also displayed in these tables.

Table 2

Preoperative imaging studies in patients: 2010–2014.

	Simple appendicitis*	Complex appendicitis*	NIA*	Unexpected findings**
No imaging studies	2	7	0	0
Imaging studies				
Ultrasound	82	64	5	3
Ultrasound + CT	0	10	0	1
Ultrasound + MRI	5	4	1	0
CT	0	2	0	0
MRI	0	1	0	0
Total	89	88	6	4

NIA = non-inflamed appendix.

CT = computed tomography scan.

MRI = magnetic resonance imaging.

* Diagnosis based upon histopathological examination.

** Unexpected findings: Intraoperative or on histopathological examination.

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