Evaluation of Different Treatments for Appendiceal Abscess in Children

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Abstract

Introduction: Despite the high incidence of appendicitis, the diagnosis is often delayed in children. A delayed diagnosis may lead to perforation and formation of an abscess. The treatment of an appendiceal abscess is still a debatable subject and studies have not agreed on what strategy to use. Some prefer immediate operation, whereas others advocate conservative management with or without interval appendectomy. The aim of this study was to evaluate patients treated for appendicular abscess, in order to possibly identify the best treatment algorithm.

Method: Medical charts of pediatric patients (<18 years of age) treated for appendiceal abscess between January 2010 and August 2014 were retrospectively studied. The patients were divided into groups based on the type of management; conservative or surgical treatment. Preoperative patient parameters, abscess characteristics, and outcome were evaluated.

Results: There was no difference in age, gender, or preoperative data between the surgically and conservatively managed patients. Among the patients diagnosed before the onset of treatment, there was a significantly poorer outcome in the surgically managed group, with a significantly longer duration of hospital stay: 8.5 (range 5-60) days compared to 6 (range 2–10) days ($p=0.02$), and significantly more complications: 36% compared to 0% ($p=0.04$). Further, treatment failure seemed to be more common in surgically managed patients with a rate of 25% compared to 0%, however, this was not statistically significant.

Conclusion: Conservative management seems to be more beneficial than early surgical intervention in children with appendiceal abscess. Larger, prospective studies with randomization of patients are needed.

Keywords

Appendectomy; Appendicitis; Appendiceal Abscess; Children

Research Article

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Abbreviations

ANC: Absolute Neutrophil Count; CRP: C-reactive Protein; ER: Emergency Room; WBC: White Blood Cell Count; N/A = not applicable

Introduction

Appendicitis is the most common disease requiring emergent abdominal surgery in children [1]. The lifetime risk of developing appendicitis is 8.7% for boys and 6.7% for girls [2]. Despite its high incidence, the diagnosis is often delayed in children [1]. This can partly be explained by children often presenting with more diffuse symptoms compared to the adult population, making the disease more difficult to diagnose. The most common atypical features include absence of fever; and as much as one third of the pediatric patients have absence of pain in the right lower quadrant. The diagnosis might also be delayed owing to the difficulty to carry out a proper examination of the pediatric patients and difficulties in communication [3]. A delayed diagnosis may lead to perforation and abscess formation [1]. It is shown that appendicitis exacerbated by perforation or abscess, referred to as complicated appendicitis, continues to be a common occurrence in the younger child. In children less than 4 years of age, more than 50% have a perforated appendicitis at presentation [4]. The perforation rate increases in frequency as the age of the patient decreases and the duration of symptoms lengthens. Perforation leads to increase in the hospital length of stay and rate of abscess formation [5,6].

The treatment of an appendicular abscess is still a debatable subject and studies disagree on what strategy to use. Some pediatric surgeons prefer immediate operation [7], whereas others advocate conservative management with interval appendectomy [8,9]. Some authors also support conservative management without late interval appendectomy [10]. The decision on what treatment to use is complicated by the difference in presentation. Patients can present with a nearly asymptomatic right lower quadrant mass, or with clinical signs of toxicity or diffuse peritonitis [11]. While the treatment of the latter is straightforward with the patient proceeding directly to the operating room [12], the optimal treatment of the relatively asymptomatic child with appendicular abscess remains controversial [7-10]. The aim of this study was to evaluate patients with appendicular abscess, collect information on the outcome at a single center to enable benchmarking, and to possibly identify the best treatment algorithm.

Material and Method

Settings and Children

This is a retrospective study of pediatric patients using the prospectively collected database of all children admitted to the

Department of Pediatric Surgery or to the Department of Surgery at Skåne University Hospital, Sweden. The center covers an area with 700 000 inhabitants, with access to free health care. Therefore, any drop-out due to socioeconomic effects is unlikely.

Study Design

All pediatric patients (< 18 years of age) treated for appendicitis between January 2010 and August 2014 were retrospectively searched for using ICD-10 procedure codes (JAK00, JEA00, JEA01, JEA10) and ICD-10 diagnostic codes (K35.2, K35.3, K35.8). The diagnosis of appendicular abscess was based on the radiology findings and/or the operative findings. All patients with a walled off abscess found either during surgery or by radiology were included. The initial decision to operate or perform percutaneous drainage was at the discretion of the attending surgeon, as was the decision to choose non-operative management. The medical records were examined and the following characteristics were registered: age, gender, the time from onset of symptoms to seeking care, presence of diarrhea, fever and general peritonitis; white blood cell count (WBC), absolute Neutrophil count (ANC), the level of C-reactive protein (CRP), vital parameters (respiratory rate, oxygen saturation, heart rate, systolic blood pressure); size, location and number of abscesses; presence of an Appendicolith, type of treatment used (operation, percutaneous drainage or conservative), treatment failure, length of hospital stay, and complications. Patients were divided into groups based on the type of management (conservative or surgical treatment). Further subgroups were created of the patients undergoing appendectomy, based on when the diagnosis was set (pre- or postoperatively). The groups were compared to each other in three ways: a) the preoperatively diagnosed surgical group to the conservatively treated group; b) the preoperatively diagnosed surgical group to the per-operatively diagnosed surgical group, and c) all surgically managed patients compared to the conservatively treated group.

Definitions

The time from onset of symptoms to seeking care was estimated in hours based on information from the caregivers. Fever was considered present if it was either measured in the emergency room (ER) or if fever above 38 degrees was included in the patient history. The WBC and ANC were analyzed according to age, as were the vital parameters (Table 1). Sepsis was defined as present if two or more of the following criteria were met; a) fever above 38degrees or temperature less than 36 degrees, b) tachypnea, c) tachycardia, d) leukocytosis. Conservative treatment was defined as management with antibiotics without any surgical intervention such as operation or percutaneous drainage. Patients were considered to have a treatment failure if the abscess did not respond to treatment, or if new abscesses developed during treatment. Complications included intestinal obstruction, formation of pleural fluid, and wound infection. Reoperation was defined as new surgery or drainage. The length of hospital stay was defined as number of days the patient had a bed in the hospital during the first stay, including days with home permissions and excluding an interval appendectomy.

Ethical Consideration

This study was performed according to the Helsinki declaration and approved by the Regional Ethical Review Board (registration number 2010/49). The data were anonymized prior to calculations, and are presented in such a way that it is impossible to identify any single patient. Therefore, it was not necessary to obtain approval from the individual patient's guardians. Intention to treat was the main diagnostic strategy and used for all patients. All evaluations, treatments, and procedures described in this report were standard of care. No protocols were exercised that would have required appropriate informed consent or approval of an institutional review board.

Statistical Consideration

Statistical analyses were performed by using SPSS Statistics. Categorical variables were compared using the Fisher exact test. The Mann-Whitney U test was used to compare nonparametric, continuous variables. A p-value of < 0.05 was considered significant.

Results and Discussion

Study Population

A total of 49 patients were diagnosed with appendicular abscess during the study period. Among them, 28 patients were found to have an abscess during the operation and the remaining 21 patients were diagnosed by means of radiology before the start of treatment. These 21 patients formed the main study population and were further divided into two main groups: the surgical group (N=8) with patients operated on with appendectomy or with a percutaneous drainage of the abscess; and the conservatively treated group (N=13) with patients only

Table 1: Reference interval for vital parameters according to age.

Age (years)	RR	SBP (mmHg)	Pulse* (bpm)
1-2	< 35	> 80	< 130
3 – 5	< 24	> 80	< 115
6-11	< 20	> 90	< 110
12 - 18	< 20	> 90	< 100

*The pulse is compensated with 10 bpm/degree above 38°C.
RR: Respiratory Rate; SBP: Systolic Blood Pressure; bpm: Beats Per Minute

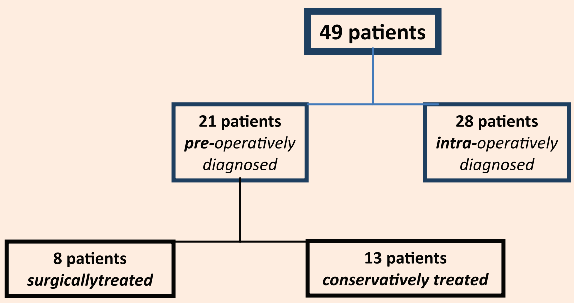

Figure 1: Flow chart over patient groups.

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Table 2: Patient demographics.

	Surgical treatment	Conservative treatment	p-value
Patients	8	13	
Age (median (range), years))	8 (3 - 14)	4 (1 - 13)	0.14*
Sex (Male/Female)	5/3	7/6	N/A**

Values are given as the absolute number (n) and percentage of patients,* Mann Whitney U-test, ** Fisher's exact test, two-tailed.

Table 3: Preoperative data.

	Surgical treatment (N = 8)	Conservative treatment (N = 13)	p-value
Duration of symptoms (median (range), h)	108 (72-264)	144 (72 - 168)	0.64*
Leukocytosis (n(%))	7 (88)	9 (69)	0.61**
Neutrophilia (n (%))	5 (83)[a]	10 (91)[b]	N/A**
General peritonitis (n (%))	4 (50)	4 (31)	0.65**
Diarrhea (n (%))	5 (63)	4 (31)	0.20**
CRP (median, (range)g/L)	199 (74-288)	129 (21 - 437)	0.25*
Sepsis (n (%))	8 (100)	10 (77)	N/A*
Hypotension (n (%))	0 (0)	0 (0)	N/A*

Values are given as the absolute number (n) and percentage of patients, CRP: C-reactive protein, a: only 6 patients with data, b: only 11 patients with data, * Mann Whitney U-test, ** Fisher's exact test, two-tailed.

treated with antibiotics (Figure 1). No patients were excluded from our study. There were no significant differences between the surgical group and the conservatively treated group regarding age or gender (Table 2).

Clinical Presentation

No significant differences were found between the surgical group and the conservatively treated group when comparing preoperative data such as duration of symptoms, leukocytosis, neutrophilia, CRP-levels, presence of general peritonitis, diarrhea, sepsis, and hypotension (Table 3). Approximately 50% in both groups had an Appendicolith. Further, the abscess characteristics were similar between the two groups, with no significant difference in size, number, or location of the abscesses (Table 4).

Surgeons and Operation Technique

Six surgeons were involved in the treatment of the included children. Since the operation technique can affect the data this was standardized. Diagnostic laparoscopy is the gold standard when appendicitis is suspected, and is practiced by all the surgeons. However, if an abscess is found during the diagnostic laparoscopy, the operation is converted to open surgery, hence; all the patients were operated on with open appendectomy. Regarding the surgical management of the abscess, it was never irrigated with antibiotics added to the irrigation. The drain was not left in as a routine; however, a few patients received a drain.

Antibiotic Usage

All the patients were on the same antibiotic protocol, previously published by our center [13]. They were all treated initially during the same period of time and with the same antibiotics. If complications occurred or the clinical picture revealed a more severe infection/inflammation, the antibiotic treatment was prolonged. Upon discharge, all the patients were prescribed the same oral antibiotics, scheduled for at least 7 days.

Postoperative Characteristics

Treatment failure occurred in 25% of the patients in the surgical group and in none of the patients in the conservatively treated group. However, these data did not reach statistical significance (p=0.133). Complications occurred in three patients; two had postoperatively an accumulation of pleural fluid, and one child had intestinal obstruction. These three patients belonged to

Table 4: Abscess characteristics.

	Surgical treatment (N = 8)	Conservative treatment (N = 13)	p-value
Appendicolith (n (%))	4 (50)	6 (46)	N/A**
Multiple abscesses (n (%))	3 (38)	2 (15)	0.33**
Abscess size (median (range), cm^3)	60 (8.25-323)[a]	39 (1.5-96.6)[b]	0.44*
Localization of abscess (n (%))			
RLQ:	3 (38)	9 (69)	0.20**
Pelvic:	3 (38)	2 (15)	0.33**
Other:	2 (25)	2 (15)	0.62**

Values are given as the absolute number (n) and percentage of patients, a: Only 7 patients with data, b: Only 12 patients with data, * Mann Whitney U-test, ** Fisher's exact test, two-tailed.

Table 5: Postoperative data.

	Surgical treatment (N = 8)	Conservative treatment (N = 13)	p-value
Hospital stay (median, (range), d)	8.5 (5 - 60)	6.0 (2 - 10)	0.02*
Treatment failure (n (%))	2 (25)	0 (0)	0.13**
Reoperation (n (%))	1 (13)	0 (0)	0.38**
Complications (n (%))	3 (36)	0 (0)	0.04**

Values are given as the absolute number (n) and percentage of patients, * Mann Whitney U-test, ** Fisher's exact test, two-tailed.

the surgical group and the difference was significant compared to the conservatively treated patients. Further, the duration of hospital stay was also significantly longer in the surgical group (Table 5).

Elective Appendectomy

Among the patients treated conservatively, 69% underwent an interval appendectomy after a median of 57 days (range 38 – 154 days). None of the patients that were treated conservatively had a recurrence. All the patients were followed up for more than one year.

Surgical Treatment For Appendiceal Abscess; Comparison of Preoperative Diagnosed Patients With Patients Diagnosed During Operation

The 28 patients with an abscess diagnosed first during the appendectomy were compared to the eight patients diagnosed before the start of the surgical treatment. There was no difference between the two groups regarding age or gender. The duration of symptoms was significantly shorter in the per-operatively diagnosed group: 96 (range 12-168) hours compared to 108 (range 72-264) hours (p-value = 0.006). The other preoperative data; leukocytosis, neutrophilia, CRP-level, presence of general peritonitis, diarrhea, presence of sepsis, and presence of hypotension; did not differ significantly between the two groups. Regarding abscess characteristics, the location of the abscess differed between the two groups. The abscesses were more frequently localized in the right lower quadrant among the per-operatively diagnosed patients (82% compared to 38%, p = 0.02), and a pelvic localization was more common among the preoperatively diagnosed patients (38% compared to 4%, p = 0.03). Complication rate was higher among the patents diagnosed preoperatively (36% vs 4%, p = 0.028). The number of treatment failures and reoperations did not differ significantly between the two groups. The duration of hospital stay was longer among the patients who were diagnosed preoperatively; 8.5 (range 5 - 60) days compared to 5.5 (range 1-31) days (p-value = 0.01).

Overall Surgically Treated Patients Compared To Conservatively Treated Patients

The patients (N = 36) who had surgical treatment, both pre- and per-operatively diagnosed were compared to the patients (N = 13) treated conservatively. The duration of symptoms among the surgically treated patients was shorter than among those treated conservatively: median 72 hours (range 12-264) compared to a median of 144 hours (range 72 – 168) (p = 0.001). There was no treatment failure in the conservatively treated group compared to 22% of the surgically treated patients; however the data did not reach statistical significance (p= 0.09).

Discussion

We studied the treatment of pediatric patients with appendicular abscesses to evaluate different treatment algorithms. The group of children studied is small. On the other hand the patients are registered prospectively and treated at one center only where all information is collected. Among the patients diagnosed before the onset of treatment, there was a significantly poorer outcome in the surgically managed group, with a significantly longer duration of hospital stay and significantly more complications than the conservatively treated patients. Furthermore, treatment failure seemed to be more common in surgically managed patients than in those conservatively treated, regardless of whether they were compared with the pre- or intra-operatively diagnosed surgical group.

We did not experience any treatment failure among the patients treated conservatively, and this is to be compared to a 25% failure rate among the operated patients with preoperatively diagnosed appendiceal abscess, and a 22% failure rate for all the patients treated surgically. This contrasts with the prospective study made by Samuel et al. where 11% of the patients did not respond to conservative management [7]. In the study by Gillick et al. as many as 15.8% of the patients did not respond to conservative treatment [12]. In the present study, the surgically treated patients had significantly more complications and longer duration of hospital stay. This also differs from the study by Samuel et al. [7] who concluded that early surgical intervention was more beneficial than non-operative management of patients since it resulted in a shorter overall length of hospital stay and reduced morbidity. Other studies have shown no difference in the duration of hospital stay [11]. We have, unlike other studies [7,11] not included the interval appendectomy in the total length of hospital stay.

Conservative management for these children is not currently what is being promoted for children in all countries and regions of the world. There are current data with much larger populations of patients promote operating on these children with shorter hospitalizations and equivalent complications to the conservative group. However, there are also several studies reporting of conservative treatment (with or without interval appendectomy) as an option to appendectomy, with similar results [14-18].

The complication rate of 36% amongst the patients treated with early surgical intervention is similar to the study made by Erdogan et al. [9] where 26% of the patients who were operated on immediately had complications and none of the patients who were treated conservatively. Another study, by Roach JP et al. [11] showed complication rate requiring readmission to the hospital of 10% in the operated patients which was significantly higher than the conservatively treated children.

In our study, no patients had any recurrence of appendicitis. A study made by Svensson et al. showed a recurrence rate of 2.4-10%, depending on whether the patients who were surgically treated within one month were excluded or not [10]. They had a median follow-up for 5.1 years whereas our follow-up ranged from 1 - 3.5 years, or until a scheduled interval appendectomy was performed. Their conclusion was that the incidence of recurrent acute appendicitis was very low after successful non-operative treatment of appendiceal abscesses in children. Therefore they doubt if there is a role for interval appendectomy as part of an institutional treatment protocol. In contrast, Erdogan et al. [9] promoted interval appendectomy after conservative treatment; they evaluated that the risk of recurrence to be 76.2%. Samuel et al. [7] have also concluded that interval appendectomy is recommended after nonsurgical treatment. Gillick et al. [12] also advocate elective appendectomy after conservative treatment of appendiceal abscess in children. They performed histological examinations of the specimens they removed at elective appendectomy and found two carcinoid tumors (out of 331 patients) that probably would not have been found so promptly otherwise. We cannot draw any conclusions regarding recurrence after conservatively treated appendiceal abscess because of the low number of patients (N = 13) in the present study, and 69% of the patients underwent an interval appendectomy.

In the present study, we found no difference in preoperative clinical data or in abscess characteristics between the surgically and the conservatively treated patients. Hence, taking into account that the parameters were retrospectively analyzed, the two groups arrived at the hospital with equally severe conditions. As with other retrospective studies, the results are dependent on accurate coding. The information collected is interpreted through several stages, which can lead to misinterpretation. Prospective studies have an advantage as the information is collected by the examiner. The patients in the present study were not randomized and were treated according to the decision of the attending surgeon. A randomization from the start reduces the risk of affecting variables that are not accounted for in the study. A bigger, randomized, prospective study is called for.

In order to avoid bias and skew the data by having more severe and sick patients who failed conservative therapy added to the surgical group, the patients who failed conservative therapy were not excluded from the study. Furthermore, the patients who failed conservative therapy and underwent surgery were not added to the surgery group data. This would make the surgical group data worse and promote the conclusion of the superiority of conservative treatment.

We did not look into the progression of the symptoms or the vital parameters after the children had left the emergency room. It would be interesting with a study with an even more thorough preoperative evaluation to evaluate which parameters influence the surgeon to choose appendectomy instead of conservative treatment. Furthermore, we had a limited number of patients in our study. However, we think that more patients only would have brought more significance to the data; for example, a significant difference in treatment failure.

Conclusion

Conservative management seems to be more beneficial than early surgical intervention in children with appendiceal abscess. The high number of per-operatively discovered appendicular abscesses suggests more use of preoperative work-up by radiology to rule out an appendiceal abscess before taking the child to appendectomy. This routine can be implemented in the clinical practice. By doing this, a conservative treatment could be selected and complications avoided. Larger, prospective studies with randomization of patients are needed.

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