Clinical Characteristics And Outcome Of Acute Appendicitis In Children Up To Five Years Of Age

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How to cite this article:
Jonuzi A, Merdovic A, Ćetković A, Milišić E, Zvizdić Z. Clinical characteristics and outcome of acute appendicitis in children up to five years of age. Iranian Journal of Pediatric Surgery 2025; 11(1): 10 – 22.

DOI: https://doi.org/10.22037/irjps.v11i1.46035

Abstract

Introduction: The diagnosis of acute appendicitis in children up to the age of five is very difficult because the child at this age is not able to adequately express the discomfort and pain and the clinical picture in this period is atypical. The aim of this study is to evaluate the clinical characteristics and outcomes of treatment in children under five years of age who underwent appendectomy because of acute appendicitis.

Materials and Methods: A retrospective, clinical study was conducted, which included 92 patients under the age of five who underwent appendectomy in the period from 01.01.2010. to 31.12.2021.

received: 18 August 2024
accepted: 9 January 2024
Published online: 20 May 2025

at the clinic for pediatric surgery of the clinical center of the university of Sarajevo. Patients were divided into two groups depending on the intraoperative finding: uncomplicated and complicated appendicitis groups. Comparisons between groups were made based on demographic data, inflammatory and blood picture parameters recorded at admission, clinical history, type of treatment and treatment outcome as well as frequency and type of complications.

Results: Of 1428 appendectomies in this period, 92 (6.44%) were performed in children younger than five years. Of these, 71 (77.2%) patients had complicated appendicitis. A statistically significant association was found between increased leukocyte count ($p = 0.035$) and CRP ($p < 0.01$) in the complicated appendicitis group. Median body temperature (37.5 °C and 38.4 °C; $p < 0.01$), symptom duration (24h and 48h; $p < 0.004$) and duration of hospitalization (5 days and 8 days; $p<0.001$) were significantly elevated in complicated compared to uncomplicated appendicitis. The most common symptoms were: pain (96.74%) and vomiting (85.87%). Postoperative complications were reported in 8 (8.70%) cases. There was no mortality.

Conclusion: The clinical presentation of acute appendicitis for children aged five years or younger is often unusual, and establishing the proper diagnosis is often delayed. Early diagnosis and prompt surgical intervention can reduce morbidity and mortality rates associated with complicated appendicitis.

Keywords

- Acute appendicitis
- Children
- Complications

Introduction

Acute appendicitis (AA) is the most common surgical disease in children, and its incidence is reported to be increasing.[1] In children under 5 years of age, the incidence is estimated to be approximately 1.1 per 10,000 cases. [2] The diagnosis of acute appendicitis has classic clinical appearance only in one third of all patients. Clinical appearance in the in the patients younger than five years of age is often atypical, and misdiagnosis in this age group is not rare, which can lead to an increased rate of perforation. [3] The delay in the diagnosis of acute appendicitis has been attributed to nonspecific presentations, overlap of symptoms with many other common childhood illnesses, together with inability child to express and difficult abdominal examination in this age group. Misdiagnosis rate ranges from 28 to 57% in children between the age of 2 and 12-year-old and approaches to nearly 100% in children younger than 2 years.[4]

A recent study showed a significant increase of perforation in relation with age as follows: 100% < 1 year; 100% 1–2 years; 83,3% 2–3 years; 71,4% 3–4 years; 78,6% 4–5 years and 47,3% 5 years.[2] The most frequent diagnosis in young children who are primarily examined in the context of abdominal pain with vomiting and diarrhea and in whom acute appendicitis is finally diagnosed is acute gastro-enteritis.[5] Besides diagnosis and treatment delay, appendicitis occurs on a particular terrain in children characterized by the fragility of the appendicular wall and by the relative immaturity of the large omentum. This makes the condition more critical and more prone to complications in a younger patient.[6]

The aim of this retrospective study was to analyze the incidence of primary symptoms, clinical- and laboratory parameters and complications of preschool children younger than 5 years of age in whom acute appendicitis was diagnosed.

Materials and Methods

We retrospectively searched the comprehensive clinical database of the Clinical Center University of Sarajevo, Bosnia and Herzegovina for pediatric patients less than 5 years old with the main diagnosis of acute appendicitis who underwent surgery between 2010 and 2021. All surgeries were performed as emergency procedures.

Inclusion criteria: all children of both genders younger than 5 years of age operated for acute appendicitis between January 2010 until December 2021 in our department. Exclusion criteria: all children who did not fit the inclusion criteria or in whom the patient file was incomplete.

Demographics, preoperative, intraoperative, and postoperative data were collected from patient's medical records and added to Microsoft Excel for further analysis. The patients presented with common symptoms of acute appendicitis, including right lower quadrant pain, fever, anorexia, nausea, and vomiting. The biological findings, such as leukocytosis and elevated C-reactive protein, were taken to consideration during the diagnosis of the selected patients.

A retrospective chart review (RCR) of 92 consecutive pediatric patients (< 5 years old) who had undergone appendectomy (open or laparoscopic) due to AA (International Classification of Diseases Tenth Revision, code K35) was conducted. Based on intraoperative macroscopic appearance and postoperative histopathology, the patients were divided into two groups: those with simple AA (uncomplicated appendicitis group) and those with complicated AA (complicated appendicitis group). Uncomplicated AA was defined as simple (catarrhal and phlegmonous) or gangrenous without perforation, similar to American Association for the Surgery of Trauma (AAST) grades I and II (19). AA with perforation or abscess formation was defined as complicated AA (AAST grades III– V) .[7]

Statistical analysis

The mean and median were used to measure central tendency, the standard deviation and range as measures of dispersion for continuous variables. The values of categorical variables were presented as numbers or percentages. The quantitative variables were expressed as mean ± standard deviation and compared across the follow‑up using Wilcoxon's test, Shapiro-Wilk test and Mann-Whitney U test. All statistical assays were performed using the Statistical Package for the Social Sciences (SPSS) IBM Version 22.0. Statistical significance was accepted at the $p < 0.05$ level.

Result

A total of 1428 confirmed pathology specimens with acute appendicitis were examined, of which 92 (6.44%) corresponded to patients under 5 years of age.

The demographic and laboratory findings of the entire cohort are shown in **(Table 1)**. Of the 92 pediatric patients with confirmed AA, 21/92 (22.8%) had uncomplicated AA and 71/92 (77.2%) patients presented with complicated AA. There were 52 males (56.52%) and 40 females (43.48%); the duration of symptoms was 12 to 96 h; the body temperature range at admission was 37.3 to 39.0 °C. Patients with complicated appendicitis were significantly younger and had higher body temperature. Comparison of pre-operative duration of simptoms, laboratory results, median WBC, CRP level were significantly higher (DS 48 h versus 24 h(p=0.004);WBC: 18.1 versus 13.3 [*109/L] (p=0.035); CRP: 84.3 versus 9.9 [mg/L] (p <0.01) in patients with complicated appendicitis than that with the uncomplicated appendicitis. Of the 92 included children, 8 (8.70%) developed post-operative complications **(Table 2)**. In children with uncomplicated appendicitis, 1 out of 21 (4.76%) children had a wound infection. Of the children with complicated appendicitis, 7 out of 71 (9.8%) (p =0.831) children developed a complication (wound infection, intra-abdominal abscess, ileus etc.). Each of the complications required some form of treatment and, in most cases, an extended hospital stay. Median length of stay, for children with uncomplicated appendicitis was 5 days. For complicated appendicitis, median length of stay was 8.0 days. There was no mortality.

Table 1. The demographic,clinical and laboratory data of patients included in the study

Parameter	All patients (n=92)	Group 1 Uncomplicated AA (n=21)	Group 2 Complicated AA (n=71)	p values
Age Median (IQR)	4.3 (3.03 - 4.09)	4.06 (3.3 - 4.2)	4.02 (2.6 – 4.03)	0.172
Male	52 (56.52)	11 (52.38)	41 (57.75)	0.66
Female	40 (43.48)	10 (47.62)	30 (42.25)	0.66
Leukocyte count (×109/L) Median (IQR)	17.29 (12.5 – 21.5)	13.3 (11.09 – 19.3)	18.1 (13.7 – 22.8)	0.035
CRP (mg/dl) Median (IQR)	67.45 (24.7 – 127.8)	9.9 (10.7 – 81.8)	84.3 (50.5 – 163.2)	<0.01
Neutrophilis(%) Median (IQR)	79.3 (72.1 – 84.4)	77.7 (71.3 – 81.9)	79.4 (69.6 – 85.1)	0.402
Limphocites(%) Median (IQR)	15.05 (10.1 – 20.2)	14.3 (11.5 – 20.5)	15.1 (9.9 – 22.6)	0.922
NLR Median (IQR)	5.13 (3.5 – 8.7)	5.43 (4.1 – 7.2)	5.08 (3.5 – 10.4)	0.809
Sodium (mmol/l) Median (IQR)	135.0 (133.0 – 138.0)	134.0 (133.3 – 136.9)	135.0 (133.1 – 137.8)	0.681
Temperature(°C) Median (IQR)	38.2 (37.3 – 39.0)	37.5 (36.8 – 37.4)	38.4 (37.7 – 39.05)	<0.01
Duration of symptoms (DS)(h) Median (IQR)	24 (24 - 48)	24 (12.6 – 34.8)	48 (20.0 – 96.77)	0.004
Pain in abdomen n (%)	89 (96.74)	21 (100.0)	68 (95.7)	0.208
Vomiting n(%)	79 (85.8)	16 (76.2)	63 (88.7)	0.168ž
Diarrhea n(%)	20 (21.7)	2 (9.5)	18(25.3)	0.098
Constipation n(%)	11 (11.9)	1 (4.7)	10 (14.1)	0.207
Anoreksia n(%)	1 (1.09)	0 (0.00)	1 (1.4)	0.470
Hospitalization (days) Median (IQR)	7.0 (5.0 – 12.3)	5.0 (4.2 – 5.3)	8.0 (6.03 – 13.7)	<0.001

Table 2. Complications in patients with AA

Complications	All patients (n=92)	Group 1	Group 2	p values
		Uncomplicated AA (n=21)	Complicated AA (n=71)	
Without complications	84 (91.30)	20 (95.24)	64 (90.14)	0.831
Wound infection	4 (4.35)	1 (4.76)	3 (4.22)	
Intra-abdominal abscess	1 (1.09)	0 (0.00)	1 (1.41)	
Ileus	1 (1.09)	0 (0.00)	1 (1.41)	
Urinary tract infection	1 (1.09)	0 (0.00)	1 (1.41)	
Atelectasis	1 (1.09)	0 (0.00)	1 (1.41)	

Discussion

Acute appendicitis is a major cause of morbidity in infants and children under 5 years of age because it is an infrequent condition with nonspecific symptoms, which is why its timely diagnosis is sometimes compromised.[8] Early clinical suspicion by the medical team (pediatrics and pediatric surgery) represents the mainstay for priority management.[9-11] Regarding symptoms, abdominal pain continues to be the main symptom in these patients and is associated with other symptoms such as vomiting and fever.[11] At children under 5 years of age, the symptoms of acute appendicitis are nonspecific, so the information provided by parents becomes one of the keys to a timely diagnosis.[12] Among the symptoms noted by parents, in order of frequency, were diffuse abdominal pain in 94% of the cases, followed by symptoms such as vomiting, anorexia, diarrhea, fever, and

irritability.[6] Our results are consistent with that.

In this retrospective study, we explored the predictive utility of routine laboratory tests to discriminate between complicated and noncomplicated AA in children up to five years . We found an association between preoperative WBC, CRP and complicated AA. Our study confirms that acute appendicitis in children up to five years is rare, accounting for less than 10% of all pediatric cases.[2]

Studies show that an elevated CRP together with the sensitivity of leukocytosis and neutrophilia could approach 98% for the diagnosis of appendicitis.[13-14] Acute perforated appendicitis is directly related to the onset of symptoms, progression time, delay in diagnosis, and time to surgical management with the risk of complicated appendicitis.[15] This reinforces the concept that poor clinical suspicion, the delay in having inconclusive laboratory tests done, and, therefore, a late diagnosis increase the incidence of complicated appendicitis and complications related to surgical findings.[16-17] A delay of more than 24 h for patients with symptoms has shown a higher rate of complicated appendicitis not only in children but also in adults.[18]

Several studies have shown that longer DS of AA, the more likely it was to develop perforated.[19-22] Bickell et al. [19] reported the link between the duration of the symptoms and the probability of appendiceal perforation. They concluded that the chance of perforation is low in the first 36 h of the disease and increases by 5% every 12 h thereafter. In our study we found a notable difference in the DS between the simple appendicitis and complicated appendicitis, which is why concluded that one of the reasons for high rates of complicated appendicitis in this age group could be a delayed visit to the doctor. Similar to our results, Bansal et al.[20] revealed notable differences in the DS between the groups of perforated and nonperforated appendicitis.

The differential diagnosis of acute appendicitis includes gastro-enterocolitis, mesenteric lymphadenitis, Meckel diverticulitis, inflammatory bowel disease, right lower lobe pneumonia, urinary tract infections, and intussusception, particularly in young pre-verbal children.[23] Misdiagnosis in preschool-age children ranges from 19 to 57 percent due to its atypical clinical features, resulting in a high rate of complications.[4,20] In these young

patients, perforation may already be present in 30 percent to 75 percent of children when the diagnosis is made, with young children being at higher risk.[24]

Indeed, diagnosis of appendicitis in preschool children is challenging and burdened by a high rate of misdiagnosis resulting from atypical clinical signs and by trivialization of abdominal pain in this age group.[2]

In current literature, the reported overall incidence of post-appendectomy complications in children varies. Often an incidence of around 10% is reported [25-26]; however, these numbers vary between five and 15%. [27-29] In our study postoperative complications were reported in 8 (8.70%) cases. There was no mortality.

Limitations

This study has some limitations. First, this study was retrospective, lacking the validation of prospective studies. Second, this study was a single-center study.

Conclusion

This study confirms that acute appendicitis in children less than 5 years of age is a rare condition and is still related to a high risk of morbidity, especially appendix perforation, due to the diagnostic delay.. Patient age is tied closely to the stage of acute appendicitis, so the youngest patients present with more advanced stages of disease and are at greater risk of perforation. Early diagnosis and prompt surgical intervention can reduce morbidity and mortality rates associated with complicated appendicitis.

Ethical Consideration

Ethical approval for this study was obtained by the local institutional review board (Ethical Committee of the Clinical Center, University of Sarajevo, protocol code: 51-30-5-9513/22 date of approval: 25 February 2022). The requirement for informed consent was waived due to the retrospective nature of the study.

Acknowledgment

Not applicable

Funding/Support

Not applicable

Conflict of interests

All authors declare that they have no conflict of interest

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