



CLINICAL AND DIAGNOSTIC FEATURES OF ACUTE APPENDICITIS IN CHILDREN AND OUTCOMES OF SURGICAL TREATMENT

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ABSTRACT

Acute appendicitis is one of the most common surgical emergencies in children, and its early diagnosis and timely surgical treatment are essential for preventing complications. This article analyzes the main clinical manifestations of acute appendicitis in children, the possibilities of laboratory and instrumental diagnostics, and the outcomes of surgical treatment. Age-related features of the disease, abdominal pain, nausea, vomiting, changes in body temperature, and local abdominal signs are evaluated as important diagnostic criteria. The diagnostic value of ultrasonography and laboratory parameters is also considered. Surgical outcomes are assessed according to the duration of postoperative recovery and the frequency of postoperative complications. Early diagnosis and the appropriate choice of surgical management can improve treatment effectiveness and reduce the risk of complicated forms of acute appendicitis in children.

Relevance of the problem

Acute appendicitis remains one of the most common causes of emergency abdominal surgery in children. Although the disease is well known, early diagnosis can still be difficult because clinical symptoms vary with age and do not always follow the classic pattern. Younger children may present with nonspecific abdominal pain, vomiting, fever, irritability, or loss of appetite, which may delay the correct diagnosis and increase the risk of complicated appendicitis [1, 2].

The main clinical problem is to distinguish acute appendicitis from other causes of abdominal pain and, at the same time, to identify whether the disease is uncomplicated or



complicated. Clinical examination alone may not always provide enough information. For this reason, current studies increasingly combine the patient's symptoms with laboratory findings and imaging results. The use of integrated clinical, laboratory, and ultrasound criteria can improve diagnostic confidence and help surgeons choose the most appropriate treatment strategy [3, 4].

Ultrasonography has an important role in children because it does not expose the patient to ionizing radiation and can be repeated when necessary. Recent studies have shown high diagnostic accuracy of ultrasound for pediatric appendicitis, particularly when the appendix is clearly visualized. However, ultrasound is operator-dependent, and its ability to distinguish uncomplicated from complicated appendicitis may be lower than its ability to confirm the diagnosis itself [5, 6].

Modern evidence also shows that certain ultrasound findings, including an enlarged appendiceal diameter, appendicolith, surrounding inflammatory changes, periappendiceal fluid, and altered periappendiceal fat, may help identify complicated disease. When ultrasound findings are uncertain, CT or MRI can provide additional diagnostic information, although CT use in children should be limited because of radiation exposure [7, 8].

Treatment of pediatric acute appendicitis has also changed in recent years. Laparoscopic appendectomy remains an important and widely used treatment method, with good postoperative outcomes and the possibility of early discharge in appropriately selected children. Large contemporary studies have reported increasing use of same-day discharge after laparoscopic appendectomy for non-perforated appendicitis without a corresponding increase in adverse outcomes. At the same time, non-operative treatment with antibiotics has become an alternative option for selected children with uncomplicated appendicitis. However, available studies show that treatment failure and recurrent appendicitis remain important concerns. A recent systematic review found that although conservative treatment can be initially successful, a considerable proportion of children eventually require appendectomy during follow-up [9, 10, 11].

Another important issue is the outcome of surgical treatment in complicated appendicitis. Children with perforation, abscess formation, or extensive local inflammation generally have longer hospital stays and a higher risk of postoperative complications than patients with uncomplicated disease. Therefore, timely diagnosis and correct differentiation between simple and complicated appendicitis are directly related to treatment results [7, 12].

Thus, the study of clinical manifestations, laboratory markers, imaging findings, and surgical outcomes of acute appendicitis in children remains relevant. A combined diagnostic approach may shorten the time to diagnosis, reduce unnecessary surgery and excessive imaging, allow complicated cases to be recognized earlier, and improve the choice of treatment for each child [3, 5, 8].

Objective of the study



To assess the clinical and diagnostic features of acute appendicitis in children and to evaluate the outcomes of surgical treatment, with particular attention to early diagnosis, the identification of complicated forms, and postoperative recovery.

Materials and methods

The study was conducted at the Department of Pediatric Surgery of the Andijan Regional Children's Multidisciplinary Medical Center between 2022 and 2025. A total of 120 children aged 3-17 years who were treated for acute appendicitis were included. The diagnosis was based on medical history, clinical examination, complete blood count, and abdominal ultrasonography. The duration and localization of abdominal pain, nausea, vomiting, body temperature, abdominal wall tension, and local peritoneal signs were evaluated. According to intraoperative findings and histopathological examination, the patients were divided into uncomplicated and complicated appendicitis groups. Surgical treatment was performed using open or laparoscopic appendectomy. Treatment outcomes were assessed by postoperative recovery time, length of hospital stay, and the occurrence of complications.

Results

A total of 120 children treated for acute appendicitis were included in the analysis. Their clinical, laboratory, ultrasonographic, operative, and postoperative findings were evaluated. The patients were 3-17 years old, with a mean age of 10.6 ± 3.4 years. Among them, 67 were boys and 53 were girls, accounting for 55.8% and 44.2%, respectively.

When the patients were analyzed by age, acute appendicitis was most frequently observed in children aged 8-12 years. This group included 49 patients, or 40.8% of the total. Children aged 13-17 years accounted for 39 cases (32.5%), while 32 patients (26.7%) were 3-7 years old.

Table 1.

Distribution of patients by age and sex

Parameter	Number of patients, n	%
3-7 years	32	26.7
8-12 years	49	40.8
13-17 years	39	32.5
Boys	67	55.8
Girls	53	44.2
Total	120	100

The time from the onset of symptoms to hospital admission was also analyzed. Forty-six children (38.3%) were admitted within the first 12 hours, 42 children within 12-24 hours, 23 patients within 24-48 hours, and 9 children more than 48 hours after the beginning of symptoms. Complicated appendicitis was observed more often among children who were admitted later. In particular, gangrenous and perforated forms were more common in patients who presented to



the hospital more than 24 hours after the onset of abdominal pain. Abdominal pain was the most common clinical symptom and was present in all 120 patients. Migration of pain from the epigastric or periumbilical region to the right lower abdominal quadrant was observed in 82 children, corresponding to 68.3%. Loss of appetite was reported in 88 patients, nausea in 79, fever in 72, and vomiting in 61 children. Local tension of the abdominal wall in the right iliac region was found in 76 patients, while signs of peritoneal irritation were detected in 43 children.

Table 2.

Main clinical manifestations of acute appendicitis

Clinical feature	n	%
Abdominal pain	120	100
Migration of pain to the right iliac region	82	68.3
Loss of appetite	88	73.3
Nausea	79	65.8
Fever	72	60.0
Vomiting	61	50.8
Local abdominal wall tension	76	63.3
Peritoneal signs	43	35.8

Clinical symptoms were more variable in younger children. In patients aged 3-7 years, it was often difficult to determine the exact location of pain. Irritability, crying, vomiting, fever, and refusal to eat were more common in this age group. In older children, the localization of pain in the right iliac region and the presence of peritoneal signs were easier to identify. Laboratory findings were useful for assessing the severity of inflammation. Leukocytosis was detected in 91 patients. In children with uncomplicated appendicitis, the mean leukocyte count was $12.1 \pm 2.8 \times 10^9/L$, whereas in complicated appendicitis it increased to $16.4 \pm 3.6 \times 10^9/L$. The neutrophil percentage was also higher in complicated cases. It averaged $71.8 \pm 6.2\%$ in uncomplicated appendicitis and $82.6 \pm 7.1\%$ in complicated appendicitis. C-reactive protein showed a similar tendency and was clearly higher in patients with complicated disease.

Table 3.

Laboratory findings in uncomplicated and complicated appendicitis

Parameter	Uncomplicated appendicitis	Complicated appendicitis
Leukocytes, $\times 10^9/L$	12.1 ± 2.8	16.4 ± 3.6
Neutrophils, %	71.8 ± 6.2	82.6 ± 7.1
C-reactive protein, mg/L	18.6 ± 9.4	54.7 ± 22.3
Body temperature,	37.5 ± 0.4	38.2 ± 0.6



°C		
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Abdominal ultrasonography was performed in all 120 children. An appendiceal diameter greater than 6 mm was found in 96 patients. Thickening of the appendiceal wall was detected in 83 children, inflammatory changes in the surrounding tissues in 68, free fluid in 39, and appendicolith in 17 patients. In complicated appendicitis, periappendiceal fluid, inflammatory infiltration of the surrounding fat, and poorly defined appendiceal contours were observed more frequently. These findings showed that ultrasonography was useful not only for confirming the diagnosis but also for estimating the severity of the inflammatory process.

Table 4.

Main ultrasonographic findings

Ultrasound finding	n	%
Appendix diameter >6 mm	96	80.0
Wall thickening	83	69.2
Inflammatory changes in surrounding tissues	68	56.7
Free fluid	39	32.5
Appendicolith	17	14.2
Periappendiceal infiltration	26	21.7

According to intraoperative findings and histopathological examination, 82 patients had uncomplicated appendicitis, while 38 children had complicated appendicitis. Thus, uncomplicated forms accounted for 68.3% of cases and complicated forms for 31.7%. Phlegmonous appendicitis was the most common morphological form and was diagnosed in 59 patients. Catarrhal appendicitis was found in 23 children, gangrenous appendicitis in 21, and perforated appendicitis in 17 patients.

Table 5.

Morphological forms of acute appendicitis

Morphological form	n	%
Catarrhal appendicitis	23	19.2
Phlegmonous appendicitis	59	49.2
Gangrenous appendicitis	21	17.5
Perforated appendicitis	17	14.1
Total	120	100

Regarding surgical management, laparoscopic appendectomy was performed in 74 patients, whereas 46 children underwent open appendectomy. The laparoscopic approach was used more often in uncomplicated appendicitis. Open surgery was selected more frequently in cases with



perforation, diffuse peritonitis, or extensive inflammatory infiltration. Recovery was faster after laparoscopic appendectomy. Restoration of intestinal function and initiation of oral feeding occurred after an average of 1.3 ± 0.5 days and 1.4 ± 0.6 days, respectively. After open surgery, these periods were longer, reaching 1.9 ± 0.7 days and 2.0 ± 0.8 days. The mean hospital stay was 3.8 ± 1.4 days after laparoscopic appendectomy and 5.6 ± 2.1 days after open appendectomy.

Table 6.

Outcomes according to surgical approach

Parameter	Laparoscopic appendectomy	Open appendectomy
Number of patients	74	46
Recovery of intestinal function, days	1.3 ± 0.5	1.9 ± 0.7
Start of oral feeding, days	1.4 ± 0.6	2.0 ± 0.8
Length of hospital stay, days	3.8 ± 1.4	5.6 ± 2.1
Early complications, n (%)	3 (4.1%)	7 (15.2%)

The postoperative period was generally satisfactory in most patients. Early postoperative complications were recorded in 10 children. Surgical wound infection was observed in 4 patients, prolonged fever in 3, intestinal paresis in 2, and a small intra-abdominal abscess in 1 child. These complications were found mainly in children with gangrenous or perforated appendicitis who had been admitted late. Severe postoperative problems were uncommon in uncomplicated appendicitis.

Table 7.

Early postoperative complications

Type of complication	n	%
Surgical wound infection	4	3.3
Prolonged fever	3	2.5
Intestinal paresis	2	1.7
Intra-abdominal abscess	1	0.8
Reoperation	0	0
Total complications	10	8.3

A separate comparison between uncomplicated and complicated appendicitis showed clear differences between the two groups. Children with complicated appendicitis had a longer interval between the onset of symptoms and hospital admission, higher body temperature, more pronounced leukocytosis and neutrophilia, and more frequent peritoneal signs.

Ultrasound findings of free abdominal fluid were also considerably more common in complicated appendicitis. These patients had a longer hospital stay and a higher rate of postoperative complications.



Table 8.

Main differences between uncomplicated and complicated appendicitis

Parameter	Uncomplicated, n=82	Complicated, n=38
Time before admission, hours	16.8±7.3	31.6±12.4
Body temperature, °C	37.5±0.4	38.2±0.6
Leukocytes, ×10⁹/L	12.1±2.8	16.4±3.6
Peritoneal signs, n (%)	19 (23.2%)	24 (63.2%)
Free fluid on ultrasound, n (%)	16 (19.5%)	23 (60.5%)
Length of hospital stay, days	3.6±1.2	6.4±2.3
Postoperative complications, n (%)	3 (3.7%)	7 (18.4%)

The results showed that delayed hospital admission was associated with a higher frequency of complicated appendicitis. Gangrenous and perforated forms were more common among children admitted more than 24 hours after the onset of symptoms. In contrast, catarrhal and phlegmonous forms predominated among patients who were admitted earlier.

Another important finding was that clinical symptoms alone did not always accurately reflect the severity of appendicitis. This was especially true in younger children, in whom the symptoms were often less specific. In such cases, laboratory tests and ultrasonographic findings played a more important role in confirming the diagnosis. Leukocytosis, neutrophilia, elevated C-reactive protein, higher body temperature, peritoneal irritation, free fluid on ultrasound, and periappendiceal inflammatory changes were more frequently associated with complicated appendicitis. The analysis of surgical outcomes also showed that recovery after laparoscopic appendectomy was generally faster. These patients had earlier restoration of intestinal function, earlier oral feeding, shorter hospital stay, and fewer early postoperative complications.

Overall, the findings indicate that early recognition of acute appendicitis, combined assessment of clinical, laboratory, and ultrasound findings, and appropriate selection of the surgical approach may improve treatment outcomes in children. Delayed presentation remained one of the main factors associated with complicated forms of the disease.

Conclusion

Acute appendicitis in children remains a common emergency surgical condition, and the clinical presentation may vary considerably depending on the child's age and the severity of inflammation. In this study, abdominal pain was the leading symptom, while nausea, vomiting, fever, loss of appetite, local abdominal wall tension, and peritoneal signs were also frequently observed.

Complicated appendicitis was more common in children who were admitted to the hospital later after the onset of symptoms. Higher leukocyte and neutrophil counts, elevated C-reactive



protein, fever, peritoneal irritation, free fluid on ultrasonography, and periappendiceal inflammatory changes were more frequently associated with complicated forms.

Ultrasonography, together with clinical and laboratory findings, was useful for confirming the diagnosis and assessing the severity of the inflammatory process. Laparoscopic appendectomy was associated with faster recovery of intestinal function, earlier oral feeding, shorter hospital stay, and fewer early postoperative complications compared with open surgery.

Thus, early diagnosis, timely hospital admission, combined evaluation of clinical, laboratory, and ultrasound findings, and an appropriate surgical approach are important factors for improving treatment outcomes and reducing complications in children with acute appendicitis.

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