International Journal of Contemporary Pediatrics
Thiagarajan N et al. Int J Contemp Pediatr. 2026 Sep;13(9):1675-1680
https://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: https://dx.doi.org/10.18203/2349-3291.ijcp20262954

Original Research Article

Clinical profile, laboratory predictors, and impact of delayed presentation on disease severity in pediatric acute appendicitis

Naveena Thiagarajan*, P. Senthil Kumar, S. Kanagabharathi

Department of Pediatrics, Masonic Medical Centre for Children, Race Course, Coimbatore, Tamil Nadu, India

Received: 24 June 2026
Accepted: 04 August 2026

***Correspondence:**
Dr. Naveena Thiagarajan,
E-mail: drnaveenat91@gmail.com

ABSTRACT

Background: Acute appendicitis is the most common surgical emergency in children, often presenting with variable clinical features leading to diagnostic challenges. Early identification of disease severity is essential to prevent complications. This study aimed to evaluate the clinical profile, laboratory parameters, ultrasonographic findings, and the impact of duration of symptoms prior to presentation on disease severity in paediatric appendicitis.
Methods: This hospital-based prospective observational study was conducted over two years in a tertiary paediatric centre. Seventy-five children under 18 years with suspected acute appendicitis undergoing surgery were included. Data on clinical features, laboratory parameters, imaging findings, timing of surgery, and outcomes were analysed using appropriate statistical methods.
Results: Among 75 children, 56.0% were males, with most in the 7–12 years age group (54.7%). Simple appendicitis was observed in 68.0% and complicated in 32.0%. Abdominal pain (94.7%) and tenderness (98.7%) were predominant. Ultrasonography identified acute appendicitis in 72.0% and showed significant association with severity (p=0.0005). Complicated appendicitis had higher WBC counts (p=0.001) and lower serum sodium levels (p=0.009). Longer duration of symptoms prior to presentation (3–5 days) was associated with increased complications (50.0%) (p=0.050). Hospital stay was longer in complicated cases (p=0.0005).
Conclusion: Clinical evaluation supported by laboratory markers and ultrasonography aids in assessing disease severity. Early presentation and timely management are associated with reduced complications, while delayed presentation increases morbidity in paediatric appendicitis.

Keywords: Appendicitis, Child, Disease progression, Hyponatremia, Leukocyte count, Ultrasonography

INTRODUCTION

Acute abdominal pain is one of the most common presenting complaints in the paediatric population attending emergency departments.[1] Among these, acute appendicitis is the most frequent surgical emergency in children and a major contributor to paediatric morbidity.[2] It is also one of the leading causes of right lower quadrant pain, second only to nonspecific abdominal pain and constipation in children presenting for evaluation. The incidence of appendicitis increases with age, peaking during adolescence, and is relatively uncommon in infants and preschool children. Despite its high prevalence, the diagnosis of acute appendicitis remains challenging in the paediatric age group. Classical symptoms such as periumbilical pain migrating to the right lower quadrant, anorexia, nausea, vomiting, and localized tenderness are not consistently present, particularly in younger children, leading to diagnostic uncertainty and delay.[3]

This variability in presentation contributes to higher rates of perforation and complications in children compared to adults. Acute appendicitis is defined as inflammation of the vermiform appendix, a blind-ended tubular structure arising from the caecum, measuring approximately 4.5 cm in neonates and up to 9.5 cm in adults.[4] The condition is categorized as uncomplicated or complicated, with the

latter including perforation, gangrene, abscess formation, or fecal peritonitis, all of which are associated with increased morbidity, prolonged hospital stay, and higher healthcare burden.[5] The diagnostic difficulty in paediatric appendicitis is further compounded by atypical presentations, overlapping clinical features with other abdominal conditions, and limited communication in younger children.[6] Therefore, adjunctive investigations play a crucial role. Ultrasonography is widely used as a first-line imaging modality due to its availability, non-invasiveness, and absence of radiation, and has been shown to improve diagnostic accuracy and help identify complications.[7]

Laboratory parameters such as total leukocyte count and serum sodium levels have gained attention as potential markers for disease severity. Elevated leukocyte count is commonly associated with inflammatory processes, while hyponatremia has been increasingly recognized as a predictor of complicated appendicitis due to its association with systemic inflammatory response.[8,9] Early identification of these markers may aid in risk stratification and timely intervention. Timely diagnosis and prompt surgical management are essential in reducing complications. Delay in presentation or intervention is associated with progression to complicated appendicitis, increased postoperative morbidity, and prolonged hospital stay.[10] Appendicectomy remains the standard treatment, although management strategies may vary in complicated cases.

Therefore, the present study was undertaken to evaluate the clinical profile of acute appendicitis in children, along with laboratory parameters, ultrasonographic findings, and the impact of duration of symptoms prior to presentation on disease severity and outcomes.

METHODS

This hospital-based prospective observational study was conducted at Masonic Medical Centre for Children, a 100-bedded paediatric referral hospital in Coimbatore, over a period of two years from October 2017 to October 2019. Informed consent was obtained from the parents or guardians prior to enrolment.

Inclusion criteria

All children under 18 years of age presenting with clinical and/or radiological features suggestive of acute appendicitis requiring surgical intervention were included in the study.

Exclusion criteria

Children with underlying comorbid conditions that could interfere with the clinical presentation, perioperative management, or duration of hospital stay were excluded. Patients who were not fit for surgery or whose guardians did not provide consent were also excluded.

Sample size calculation

The sample size was calculated using the formula

$$N = Z^2P(1-P)/E^2$$

with a confidence level of 95% (Z=1.96), expected prevalence of 5%, and margin of error of 5%, yielding a minimum sample size of 73.

After obtaining informed consent from parents or guardians, data were collected using a structured proforma. Information regarding demographic details, clinical presentation, duration of symptoms, laboratory investigations, imaging findings, time interval between symptom onset and surgery, intraoperative findings, postoperative complications, duration of hospital stay, and outcomes were recorded.

Patients were followed up for the development of postoperative complications such as intra-abdominal abscess, fecal peritonitis, and adhesive obstruction during the study period. The time interval analysed in this study refers to the duration from onset of symptoms to surgical intervention, representing delay in presentation rather than in-hospital delay

Statistical analysis

Descriptive statistics such as frequency and percentage were used for categorical variables, while mean and standard deviation were used for continuous variables. Chi-square test or Fisher's exact test was used for categorical variables as appropriate, and unpaired Student's t-test was used for continuous variables. A p value <0.05 was considered statistically significant.

RESULTS

A total of 75 children with appendicitis were included in the study. Males were slightly more common than females, and over half of the patients belonged to the 7–12-year age group. Simple appendicitis constituted the majority of cases (68%), while complicated appendicitis accounted for 32% (Table 1).

Abdominal pain was the predominant presenting symptom, occurring in nearly all patients, followed by vomiting and fever. Clinical examination revealed tenderness in almost every child, whereas abdominal distension and palpable mass were uncommon findings (Table 2).

Ultrasonography most frequently demonstrated features of acute appendicitis. Findings suggestive of disease progression, including abscess formation and perforation, were observed exclusively in the complicated appendicitis group. A significant association was found between ultrasonographic findings and disease severity (p=0.0005) (Table 3). Laboratory evaluation showed that

children with complicated appendicitis had significantly higher white blood cell counts and lower serum sodium levels compared with those with simple appendicitis (p=0.001 and p=0.009) (Table 4). The duration between symptom onset and surgery was associated with disease severity. Patients presenting within 24 hours were more likely to have simple appendicitis, whereas delayed presentation, particularly 3–5 days after symptom onset, was more frequently associated with complicated appendicitis (p=0.050) (Table 5). Complicated appendicitis was associated with a significantly longer hospital stay than simple appendicitis (7±2.06 vs. 4±1.47 days, p=0.0005) (Table 6). Postoperative complications were infrequent overall. Although complications occurred more often in the complicated appendicitis group than in the simple appendicitis group, the difference was not significant (p=0.238) (Table 7).

Table 1: Demographic profile and disease classification.

Variables	Category	N (%)
Sex	Male	42 (56)
	Female	33 (44)
Age group (in years)	<1	2 (2.7)
	1–3	3 (4)
	3–6	17 (22.6)
	7–12	41 (54.7)
	13–18	12 (16)
Type of appendicitis	Simple	51 (68)
	Complicated	24 (32)

Table 2: Clinical profile-symptoms and signs.

Variables	Category	N (%)
Abdominal pain	Yes	71 (94.7)
	No	4 (5.3)
Fever	Yes	45 (60.0)
	No	30 (40.0)
Vomiting	Yes	59 (78.7)
	No	16 (21.3)
Diarrhoea	Yes	18 (24.0)
	No	57 (76.0)
Abdominal distension	Yes	3 (4.0)
	No	72 (96.0)
Tenderness	Yes	74 (98.7)
	No	1 (1.3)
Palpable mass	Yes	3 (4.0)
	No	72 (96.0)

Table 3: Ultrasonography findings and association with severity.

USG findings	Simple N (%)	Complicated N (%)	P value
Acute appendicitis	48 (94.1)	6 (25.0)	0.0005
Appendicitis with abscess	0	7 (29.2)	
Perforated appendix with abscess	0	5 (20.8)	
Fecolith with mass	0	1 (4.2)	
Subacute appendicitis	1 (2.0)	0	
Other findings	2 (3.9)	5 (20.8)	

Table 4: Laboratory parameters in simple vs complicated appendicitis.

Parameters	Group	N	Mean±SD	P value
WBC count	Simple	51	11216.59±4575.61	0.001
	Complicated	24	15530.83±5241.76	
Serum sodium	Simple	51	140.69±1.82	0.009
	Complicated	24	138.58±3.48	

Table 5: Time from symptom onset to surgery vs severity.

Time intervals	Simple N (%)	Complicated N (%)	P value
<24 hours	17 (33.3)	2 (8.3)	0.050
24–48 hours	16 (31.4)	9 (37.5)	
3–5 days	13 (25.5)	12 (50.0)	
>5 days	5 (9.8)	1 (4.2)	

Table 6: Duration of hospital stay.

Groups	N	Mean±SD (days)	P value
Simple	51	4±1.47	0.0005
Complicated	24	7±2.06	

Table 7: Postoperative complications.

Complications	Simple N (%)	Complicated N (%)	Total N (%)	P value
No	50 (98.0)	22 (91.7)	72 (96.0)	0.238
Yes	1 (2.0)	2 (8.3)	3 (4.0)	

DISCUSSION

Acute appendicitis is the most common surgical emergency in children, with variable clinical presentation and risk of complications. This study aimed to evaluate the clinical profile, laboratory parameters, and timing of surgery in paediatric appendicitis. Findings showed predominance in school-aged males, significant association of leucocytosis and hyponatremia with severity, and increased complications with delayed surgical intervention.

In the present study, the clinical profile, laboratory parameters, and timing of surgery in paediatric acute appendicitis were evaluated and compared with existing literature. A male predominance was observed, which is consistent with previous studies by Oguntola et al and Teo et al who reported male-to-female ratios of 1.1:1 and 1.04:1 respectively.[11,12] while Lin et al reported a higher ratio of 1.6:1.[13] Appendicitis was most commonly seen in school-aged children, similar to findings by Lee et al whereas Boom et al observed a higher incidence among adolescents.[14,15] The distribution of simple and complicated appendicitis in this study is also comparable with the classification described by Okamoto et al and findings by Pham et al.[16,3]

The clinical presentation in this study was consistent with established patterns, with abdominal pain being the predominant symptom, similar to Lameris et al who reported abdominal pain in 86% of cases.[17] In contrast, Alloo et al identified vomiting as the most common symptom. Other symptoms such as diarrhea and fever have shown variability across studies, with Alloo et al reporting diarrhea in 40% of cases.[18] On clinical examination, tenderness was the most consistent sign, as also observed by Lameris et al, Alloo et al and Bickell et al reinforcing its diagnostic importance in paediatric appendicitis.[17-19] Ultrasonography demonstrated high utility in diagnosing appendicitis and identifying complications. Kaneko et al reported that ultrasonography could correctly predict disease severity in 88.2% of paediatric cases. Complicated appendicitis was associated with findings such as abscess formation and perforation, which were absent in simple cases, highlighting the role of imaging in early risk stratification and management planning.[20] This is consistent with our findings, where USG showed a significant association with disease severity (p=0.0005).

Laboratory parameters showed significant association with disease severity. Elevated total leukocyte count in complicated appendicitis is consistent with findings by Sack et al, Celik et al and Zani et al all of whom demonstrated higher leukocyte counts in complicated cases.[21-23] Similarly, hyponatremia was observed to be associated with complicated appendicitis, in agreement with studies by Pham et al, Yang et al and Kim et al suggesting its potential role as a marker of severity.[3,5,24] In the study, both parameters showed statistically significant differences ($p<0.01$), reinforcing their role as severity markers.

Longer duration of symptoms prior to presentation was associated with increased disease severity. Kim et al. demonstrated that early presentation was associated with a higher proportion of simple appendicitis, whereas delayed presentation significantly increased the risk of complications.[24] Furthermore, complicated appendicitis was associated with prolonged hospital stay, as reported by Bickell et al and Kim et al reflecting increased morbidity.[19,24] Postoperative complications were more frequent in complicated appendicitis, similar to findings by Romano et al although overall outcomes remain favourable with appropriate perioperative care.[25] This is

supported by the findings, where delayed presentation showed a higher proportion of complicated appendicitis (p=0.050). Overall findings demonstrate that acute appendicitis in children predominantly affects school-aged males and commonly presents with abdominal pain and tenderness. Ultrasonography reliably identifies disease severity. Elevated leukocyte count and reduced serum sodium are associated with complicated appendicitis. Delayed presentation is linked to increased disease severity and longer hospital stay, while postoperative complications remain low.

This study is limited by its single-centre design and relatively small sample size, which may affect generalizability. Selection bias may be present as only surgically managed cases were included. Longer follow-up was not performed, limiting assessment of late postoperative outcomes and long-term complications in children.

CONCLUSION

Acute appendicitis in children commonly presents with variable clinical features, making diagnosis challenging. Laboratory markers and ultrasonography are useful in assessing disease severity. Early presentation and timely management are associated with reduced complications, whereas delayed presentation is associated with increased disease severity, morbidity, and longer hospital stay. Timely diagnosis and management are essential to improve outcomes and reduce disease-related complications in paediatric patients.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Koberlein GC, Trout AT, Rigsby CK, Iyer RS, Alazraki AL, et al. ACR appropriateness criteria® suspected appendicitis-child. J Am Coll Radiol. 2019;16:252–63.
2. Kliegman RM, editor. Nelson Textbook of Pediatrics: First South Asia Edition, 3 volume set. New Delhi, India: Elsevier. 2015.
3. Pham X-BD, Sullins VF, Kim DY, Range B, Kaji AH, de Virgilio CM, et al. Factors predictive of complicated appendicitis in children. J Surg Res. 2016;206:62–6.
4. Buschard K, Kjaeldgaard A. Investigation and analysis of the position, fixation, length and embryology of the vermiform appendix. Acta Chir Scand. 1973;139:293–8.
5. Yang J, Liu C, He Y, Cai Z. Laboratory markers in the prediction of acute perforated appendicitis in children. Emerg Med Int. 2019;2019:4608053.
6. Brumer M. Appendicitis. Seasonal incidence and postoperative wound infection. Br J Surg. 1970;57:93–9.
7. Gosain A, Williams RF, Blakely ML. Distinguishing acute from ruptured appendicitis preoperatively in the pediatric patient. Adv Surg. 2010;44:73–85.
8. Rothrock SG, Pagane J. Acute appendicitis in children: emergency department diagnosis and management. Ann Emerg Med. 2000;36:39–51.
9. Puri P, Boyd E, Guiney EJ, O'Donnell B. Appendix mass in the very young child. J Pediatr Surg. 1981;16:55–7.
10. Larson DB, Trout AT, Fierke SR, Towbin AJ. Improvement in diagnostic accuracy of ultrasound of the pediatric appendix through the use of equivocal interpretive categories. AJR Am J Roentgenol. 2015;204:849–56.
11. Oguntola AS, Adeoti ML, Oyemolade TA. Appendicitis: Trends in incidence, age, sex, and seasonal variations in South-Western Nigeria. Ann Afr Med. 2010;9:213–7.
12. Teo ATK, Lefter LP, Zarrouk AJM, Merrett ND. Institutional review of patients presenting with suspected appendicitis: Patients with suspected appendicitis. ANZ J Surg. 2015;85:420–4.
13. Lin K-B, Lai KR, Yang N-P, Chan C-L, Liu Y-H, Pan R-H, et al. Epidemiology and socioeconomic features of appendicitis in Taiwan: a 12-year population-based study. World J Emerg Surg. 2015;10:42.
14. Lee SL, Stark R, Yaghoubian A, Shekherdimian S, Kaji A. Does age affect the outcomes and management of pediatric appendicitis. J Pediatr Surg. 2011;46:2342–5.
15. van den Boom AL, Gorter RR, van Haard PMM, Doornebosch PG, Heij HA, Dawson I. The impact of disease severity, age and surgical approach on the outcome of acute appendicitis in children. Pediatr Surg Int. 2015;31:339–45.
16. Okamoto T, Sano K, Ogasahara K. Receiver-operating characteristic analysis of leukocyte counts and serum C-reactive protein levels in children with advanced appendicitis. Surg Today. 2006;36:515–8.
17. Laméris W, van Randen A, Go PMNYH, Bouma WH, Donkervoort SC, Bossuyt PMM, et al. Single and combined diagnostic value of clinical features and laboratory tests in acute appendicitis. Acad Emerg Med. 2009;16:835–42.
18. Alloo J, Gerstle T, Shilyansky J, Ein SH. Appendicitis in children less than 3 years of age: a 28-year review. Pediatr Surg Int. 2004;19:777–9.
19. Bickell NA, Aufses AH Jr, Rojas M, Bodian C. How time affects the risk of rupture in appendicitis. J Am Coll Surg. 2006;202:401–6.
20. Kaneko K, Tsuda M. Ultrasound-based decision making in the treatment of acute appendicitis in children. J Pediatr Surg. 2004;39:1316–20.
21. Sack U, Biereder B, Elouahidi T, Bauer K, Keller T, Tröbs R-B. Diagnostic value of blood inflammatory

markers for detection of acute appendicitis in children. BMC Surg. 2006;6:15.
22. Celik B, Nalcacioglu H, Ozcatal M, Altuner Torun Y. Role of neutrophil-to-lymphocyte ratio and platelet-to-lymphocyte ratio in identifying complicated appendicitis in the pediatric emergency department. Ulus Travma Acil Cerrahi Derg. 2019;25:222–8.
23. Zani A, Teague WJ, Clarke SA, Haddad MJ, Khurana S, Tsang T, et al. Can common serum biomarkers predict complicated appendicitis in children. Pediatr Surg Int. 2017;33:799–805.
24. Kim DY, Nassiri N, de Virgilio C, Ferebee MP, Kaji AH, Hamilton CE, et al. Association between hyponatremia and complicated appendicitis. JAMA Surg. 2015;150:911–2.
25. Romano A, Parikh P, Byers P, Namias N. Simple acute appendicitis versus non-perforated gangrenous appendicitis: is there a difference in the rate of post-operative infectious complications. Surg Infect. 2014;15:517–20.

Cite this article as: Thiagarajan N, Kumar PS, Kanagabharathi S. Clinical profile, laboratory predictors, and impact of delayed presentation on disease severity in pediatric acute appendicitis. Int J Contemp Pediatr 2026;13:1675-80.