

ULTRASONOGRAPHIC EVALUATION OF ACUTE ABDOMINAL PAIN IN CHILDREN: SPECTRUM OF FINDINGS AND CLINICAL CORRELATES IN AN INDIAN TERTIARY-CARE SETTING

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ABSTRACT

Background: Acute abdominal pain is a common pediatric presentation with a wide spectrum of medical and surgical causes. Ultrasonography is particularly useful in children because it provides rapid evaluation without ionizing radiation. This study evaluated the spectrum of ultrasonographic findings and their clinical and laboratory correlates in children presenting with acute abdominal pain. **Materials and Methods:** This hospital-based cross-sectional observational study included 150 children aged 5–18 years presenting with acute, non-traumatic abdominal pain and undergoing abdominal ultrasonography. Demographic characteristics, clinical presentation, laboratory parameters, urinalysis, and sonographic findings were recorded and analysed using appropriate statistical tests. **Results:** The mean age was 6.6 ± 2.7 years, and 52.7% were males. Generalized abdominal pain was the commonest presentation (66.0%), while nausea/vomiting (40.7%) and fever (26.7%) were the predominant associated symptoms. Free intraperitoneal fluid was the most frequent sonographic abnormality (7.3%), followed by acute appendicitis (5.3%), renal/ureteric calculi (3.3%), intestinal obstruction (2.7%), and intussusception (2.7%). Appendicitis was significantly associated with right lower quadrant pain ($p=0.021$) and CRP >20 mg/L ($p=0.028$). Renal calculi were significantly associated with haematuria ($p=0.002$) and proteinuria ($p=0.006$). **Conclusion:** Ultrasonography is a useful first-line, radiation-free imaging modality for evaluating pediatric acute abdominal pain. Integration of sonographic findings with pain localization, inflammatory markers, and urinalysis may facilitate timely and clinically relevant diagnosis.

INTRODUCTION

Acute abdominal pain is one of the most frequent and diagnostically challenging presentations in pediatric emergency practice. Its causes range from transient, self-limiting gastrointestinal disorders to potentially life-threatening surgical conditions requiring urgent intervention. The diagnostic challenge is greater in children because symptoms may be nonspecific, younger children may have difficulty localizing or describing pain, and the spectrum of differential diagnoses varies considerably with age and sex.^[1,2] Delayed diagnosis may increase the risk of complications, whereas unnecessary investigations and surgical exploration may expose children to avoidable morbidity and healthcare costs.^[3]

Imaging therefore plays an important role when clinical assessment alone does not establish a confident diagnosis. Ultrasonography (USG) is particularly suitable for children because it is non-invasive, widely available, relatively inexpensive, repeatable, and does not involve ionizing radiation.^[4,5] It permits simultaneous assessment of the gastrointestinal, hepatobiliary, urinary and pelvic structures and can identify conditions such as acute appendicitis, intussusception, bowel obstruction, mesenteric lymphadenitis, renal calculi and gynaecological abnormalities.^[6,7] The uploaded reference study similarly emphasizes ultrasound as a radiation-free first-line investigation with applications across several causes of pediatric acute abdominal pain.

These advantages are particularly relevant in the Indian healthcare setting, where patient volumes are

high and access to advanced cross-sectional imaging may vary considerably between tertiary centres and peripheral hospitals. Earlier Indian work by Mishra et al. highlighted the role and limitations of imaging, particularly ultrasonography, in children presenting with an acute abdomen.^[8] Khalid et al., in an Indian prospective study of 146 pediatric patients, demonstrated that ultrasonography could establish or support the diagnosis in a substantial proportion of children and could influence subsequent management.^[9]

Acute appendicitis remains an especially important diagnostic consideration. Indian investigators have increasingly examined the integration of sonographic findings with clinical and biochemical parameters. Nandan et al., studying Indian children with lower abdominal pain, emphasized that ultrasonography should be interpreted together with clinical assessment rather than used in isolation.^[10] Banerjee et al. evaluated ultrasonographic findings together with inflammatory markers for identifying complicated pediatric appendicitis.^[11] More recently, Vig et al. from AIIMS Jodhpur reported high diagnostic performance of ultrasonography for pediatric appendicitis, although differentiation between uncomplicated and complicated disease was less reliable.^[12]

Despite these studies, Indian data describing the overall spectrum of sonographic abnormalities among children presenting with acute abdominal pain, rather than focusing exclusively on appendicitis, remain comparatively limited. Disease patterns, referral practices, availability of imaging and thresholds for requesting ultrasonography may differ across healthcare settings. Local data are therefore necessary to determine the diagnostic yield of abdominal ultrasonography and identify clinical or laboratory features associated with important sonographic abnormalities.

The present study was undertaken to evaluate the spectrum and frequency of ultrasonographic findings in children presenting with acute abdominal pain at an Indian tertiary-care centre and to determine their association with selected demographic, clinical and laboratory parameters.

MATERIALS AND METHODS

This hospital-based cross-sectional observational study was conducted in the Department of Pediatrics of World College of Medical Sciences & Research & Hospital, Jhajjar, Haryana from January 2025 to March 2026. A total of 150 children aged 5–18 years presenting with acute, non-traumatic abdominal pain and undergoing abdominal ultrasonography were included (Figure 1). Patients with abdominal trauma, known chronic abdominal pathology, inconclusive ultrasonography, or incomplete records were excluded.

Demographic details, clinical presentation, relevant laboratory parameters (haemoglobin, WBC count,

CRP, BUN, serum creatinine, and urinalysis), and ultrasonographic findings were recorded. Abdominal ultrasonography was performed using high-resolution linear and curvilinear transducers with systematic evaluation of the abdominal and pelvic organs. Standard sonographic criteria were applied for appendicitis, intussusception, bowel obstruction, mesenteric lymphadenitis, and other abnormalities.

Data were analysed using IBM SPSS Statistics version 25.0. Continuous variables were expressed as mean $\pm$ SD or median (IQR) and categorical variables as frequency and percentage. Appropriate t-test/Mann–Whitney U and Chi-square/Fisher's exact tests were used, with $p < 0.05$ considered statistically significant. Institutional Ethics Committee approval was obtained, and patient confidentiality was maintained.

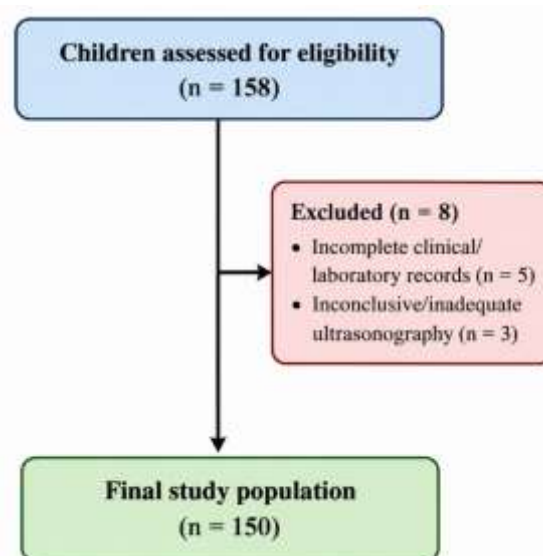


Figure 1: Flow diagram showing selection of pediatric patients presenting with acute abdominal pain and included in the final analysis

RESULTS

total of 150 children presenting with acute abdominal pain were included in the study. The mean age was 6.6 ± 2.7 years, with a slight male predominance comprising 79 (52.7%) males and 71 (47.3%) females. Most participants belonged to the younger age groups, with 80.0% aged ≤ 10 years, as depicted in Figure 2. The baseline haematological, biochemical and urinary parameters are summarized in Table 1. The mean haemoglobin level was 11.9 ± 1.5 g/dL and the mean total leukocyte count was $10,410 \pm 3,880$ cells/ μ L, while the median CRP level was 14.8 mg/L. Haematuria was the most frequent urinary abnormality.

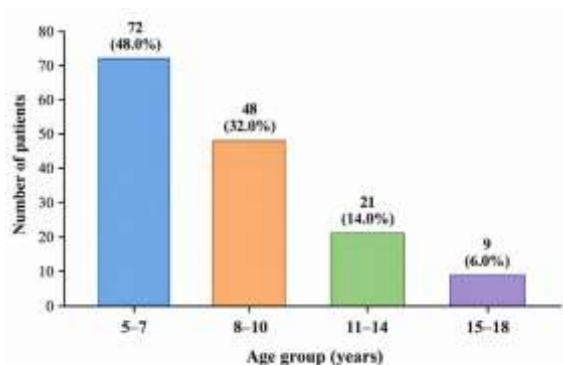


Figure 2 caption: Age-wise distribution of children presenting with acute abdominal pain (n=150)

Table 1: Baseline demographic and laboratory characteristics (n=150)	
Parameter	Value
Age, years, mean $\pm$ SD	6.6 $\pm$ 2.7
Male	79 (52.7%)
Female	71 (47.3%)
Haemoglobin, g/dL, mean $\pm$ SD	11.9 $\pm$ 1.5
WBC count, cells/ μ L, mean $\pm$ SD	10,410 $\pm$ 3,880
CRP, mg/L, median (IQR)	14.8 (5.2–31.6)
BUN, mg/dL, mean $\pm$ SD	12.5 $\pm$ 5.6
Serum creatinine, mg/dL, mean $\pm$ SD	0.60 $\pm$ 0.38
Proteinuria	6 (4.0%)
Haematuria	11 (7.3%)
Pyuria	7 (4.7%)
Bacteriuria	5 (3.3%)

Table 2: Distribution of abdominal pain according to anatomical location

Site of pain	n	%
Generalized	99	66.0
Right lower quadrant	23	15.3
Periumbilical	15	10.0
Left lower quadrant	4	2.7
Hypogastric	5	3.3
Epigastric	4	2.7
Total	150	100.0

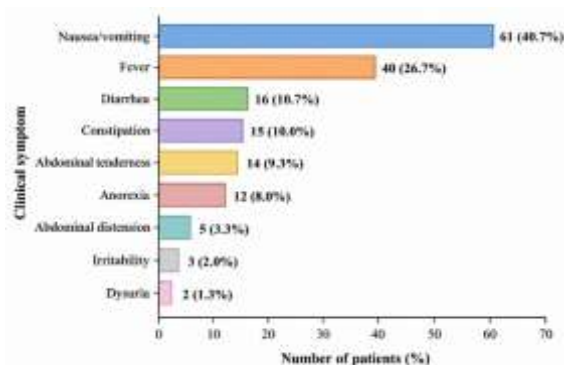


Figure 3 caption: Frequency of associated clinical symptoms among children presenting with acute abdominal pain.

Generalized abdominal pain was the predominant presentation, reported in 99 (66.0%) patients, followed by right lower quadrant (RLQ) pain in 23 (15.3%) and periumbilical pain in 15 (10.0%) patients (Table 2). The mean duration of symptoms was 2.9 ± 2.2 days. Among associated clinical manifestations, nausea/vomiting was the most frequent (40.7%), followed by fever (26.7%). Diarrhoea, constipation, abdominal tenderness and anorexia were less frequent, while dysuria and irritability were uncommon (Figure 3).

Abdominal ultrasonography demonstrated a varied spectrum of gastrointestinal, urinary and hepatobiliary abnormalities. Free intraperitoneal fluid was the most frequent individual sonographic finding, detected in 11 (7.3%) patients, followed by acute appendicitis in 8 (5.3%). Other clinically relevant abnormalities included renal/ureteric calculi, intestinal obstruction, intussusception, mesenteric lymphadenitis, hydronephrosis and hepatobiliary abnormalities (Table 3). The proportion of patients demonstrating an abnormal ultrasonographic examination showed an increasing trend across successive age groups, from 27.8% among children aged 5–7 years to 55.6% among those aged 15–18 years. [Figure 4]

Table 3: Spectrum of abnormal sonographic findings

Sonographic finding	n	% of total cohort
Abdominal free fluid	11	7.3
Acute appendicitis	8	5.3
Renal/ureteric calculus	5	3.3
Intestinal obstruction	4	2.7
Intussusception	4	2.7
Mesenteric lymphadenitis	3	2.0
Reactive abdominal lymph nodes	3	2.0
Hydronephrosis	2	1.3

Cholecystitis/gallbladder pathology	2	1.3
Inguinal hernia	2	1.3
Ovarian/adnexal pathology	2	1.3
Other miscellaneous abnormalities*	5	3.3

*Includes less frequent hepatobiliary, urinary bladder, renal and intestinal abnormalities.

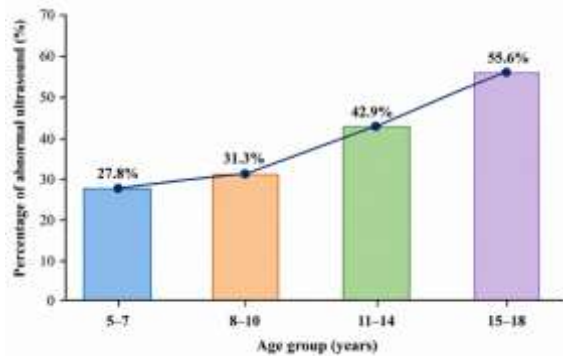


Figure 4 caption: Proportion of patients with abnormal abdominal ultrasonography according to age group.

Table 4: Factors associated with sonographically diagnosed acute appendicitis

Parameter	Appendicitis present	Appendicitis absent	p-value
RLQ pain present (n=23)	4 (17.4%)	19 (82.6%)	0.021
RLQ pain absent (n=127)	4 (3.1%)	123 (96.9%)	
CRP >20 mg/L (n=25)	4 (16.0%)	21 (84.0%)	0.028
CRP ≤20 mg/L (n=125)	4 (3.2%)	121 (96.8%)	
WBC >12,000/μL (n=45)	5 (11.1%)	40 (88.9%)	0.071
WBC ≤12,000/μL (n=105)	3 (2.9%)	102 (97.1%)	

A significant association was also observed between urinary abnormalities and sonographically detected renal calculi (Table 5). Renal calculi were detected in 27.3% of children with haematuria compared with 1.4% without haematuria ($p=0.002$). Similarly, calculi were more frequent in children with

proteinuria than in those without proteinuria (33.3% vs 2.1%; $p=0.006$). Overall, these findings demonstrate meaningful associations between selected clinical and laboratory parameters and specific ultrasonographic abnormalities in children presenting with acute abdominal pain.

Table 5: Association of urinary findings with sonographically detected renal calculi

Urinary parameter	Renal calculus present	No renal calculus	p-value
Haematuria present (n=11)	3 (27.3%)	8 (72.7%)	0.002
Haematuria absent (n=139)	2 (1.4%)	137 (98.6%)	
Proteinuria present (n=6)	2 (33.3%)	4 (66.7%)	0.006
Proteinuria absent (n=144)	3 (2.1%)	141 (97.9%)	

DISCUSSION

The present study evaluated the clinical and sonographic spectrum of acute abdominal pain in 150 children and demonstrated the utility of ultrasonography in identifying gastrointestinal, urinary, and hepatobiliary abnormalities. Most patients were ≤10 years of age, with a slight male predominance. Generalized abdominal pain was the commonest presentation, while nausea/vomiting and fever were the predominant associated symptoms. These findings reflect the heterogeneous and often nonspecific presentation of acute abdominal pain in children described by Kim et al.^[1] and highlight the importance of systematic clinical and imaging evaluation.

Free intraperitoneal fluid was the most frequent sonographic abnormality (7.3%), followed by acute

appendicitis (5.3%), renal/ureteric calculi, intestinal obstruction, and intussusception. Khalid et al.^[9] in an Indian prospective study, similarly demonstrated the diagnostic contribution of ultrasonography across a broad range of pediatric acute abdominal conditions. Variations in the frequencies of individual abnormalities between studies may be attributable to differences in age distribution, referral patterns, inclusion criteria, and regional disease profiles. An increasing proportion of abnormal ultrasonographic examinations was observed with advancing age, rising from 27.8% in children aged 5–7 years to 55.6% among those aged 15–18 years. This finding suggests that age should be considered when interpreting sonographic abnormalities and formulating differential diagnoses in children with acute abdominal pain.

Acute appendicitis was significantly associated with RLQ pain ($p=0.021$) and CRP >20 mg/L ($p=0.028$),

whereas leukocytosis showed a nonsignificant association. Nandan et al. (10) emphasized that ultrasonography should be interpreted in conjunction with clinical assessment rather than in isolation in Indian children with suspected appendicitis. Similarly, Banerjee et al,^[11] found that combining inflammatory markers with sonographic parameters improved prediction of complicated appendicitis. Vig et al,^[12] reported high sensitivity and specificity of ultrasonography for diagnosing pediatric appendicitis, while noting lower sensitivity for differentiating uncomplicated from complicated disease.

Renal calculi were significantly associated with haematuria ($p=0.002$) and proteinuria ($p=0.006$), supporting the complementary role of urinalysis when urinary pathology is suspected. Overall, our findings support ultrasonography as a practical first-line, radiation-free imaging modality for pediatric acute abdominal pain. Its diagnostic usefulness is greatest when sonographic findings are integrated with pain localization, clinical examination, inflammatory markers, and urinalysis, thereby facilitating timely diagnosis while limiting unnecessary radiation exposure.

CONCLUSION

Abdominal ultrasonography is a valuable first-line imaging modality for evaluating acute abdominal pain in children, enabling detection of a wide spectrum of gastrointestinal, urinary, and hepatobiliary abnormalities without radiation exposure. In the present study, RLQ pain and elevated CRP were significantly associated with acute appendicitis, while haematuria and proteinuria were associated with renal calculi. Integrating ultrasonographic findings with clinical localization

and relevant laboratory parameters may improve diagnostic accuracy and facilitate timely management of pediatric acute abdominal pain.

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