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Article

Ultrasound vs CT in diagnosing appendicitis in pediatric age group

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Abstract: *Background: Accurate diagnosis of appendicitis in children is challenging because clinical symptoms often overlap with other abdominal conditions. Imaging modalities such as ultrasound and computed tomography are widely used to improve diagnostic accuracy. Objective: To compare the diagnostic performance of ultrasound and computed tomography in detecting appendicitis in the pediatric age group. Methods: This was a hospital-based cross-sectional diagnostic accuracy study conducted at Rai Medical College Sargodha from August 2024 to August 2025 including 285 pediatric patients presenting with clinical suspicion of acute appendicitis. Results: The mean age of patients was 10.6 ± 2.9 years, and appendicitis was confirmed in 198 patients (69.5%). Ultrasound demonstrated sensitivity of 84.8%, specificity of 79.3%, and diagnostic accuracy of 83.2%. CT scan showed higher sensitivity (92.9%), specificity (89.7%), and diagnostic accuracy (91.6%). The combined imaging strategy using ultrasound followed by CT achieved the highest sensitivity of 96.5% and diagnostic accuracy of 94.7%. Conclusion: CT provides higher diagnostic accuracy than ultrasound for pediatric appendicitis. However, ultrasound remains an appropriate first-line imaging modality, while CT should be used selectively in inconclusive cases to improve diagnostic precision*

Keywords: Pediatric appendicitis; Ultrasonography; Computed tomography; Diagnostic accuracy

INTRODUCTION

Children are the most affected by acute appendicitis, which is the most prevalent surgical emergency in the children's population and is a frequent cause of acute abdominal pain that needs a quick diagnosis and treatment [1]. Delayed diagnosis can result in severe complications like perforation, peritonitis, and the formation of an intra-abdominal abscess, which are major complications that contribute greatly to the morbidity in children [2]. Nevertheless, clinical diagnosis among the pediatric patients may be tricky since they have symptoms that are not typical and could be similar to other ailments in the abdomen such as gastroenteritis, mesenteric adenitis, or urinary tract infections [3]. Imaging is therefore an important aspect in enhancing diagnostic accuracy and management. Ultrasonography (US) is widely recommended as the initial imaging modality of choice in children due to its non-invasiveness, widespread availability, and lack of ionizing radiation exposure [4]. Non-compressible enlarged appendix and inflammatory changes of the periappendiceal tissue can be detected with the help of grated compression ultrasound [5]. Although these exist, the sensitivity of ultrasound to diagnostics can be affected by the dependency of the operator and incapability to visualize the appendix in obese patients or when the bowel gas is observed [6].

Computed tomography (CT) has greater anatomical detail and has been reported to have better sensitivity and specificity in the detection of appendicitis and its complications [7]. CT is sensitive enough to identify enlargement of the appendage, inflammation around, abscess, and other causes of abdominal pain [8]. Nevertheless, the issue of radiation exposure in children has made clinicians to restrict the use of CT and apply it in situations that have ultrasound results that are not conclusive [9]. The recent diagnostic approaches focus on the staged-imaging technique, in which ultrasound is performed and CT is performed occasionally when necessary [10]. Earlier studies have revealed that such a method has great diagnostic accuracy and has limited radiation exposure in children [11]. Imaging has also enhanced the accuracy of ultrasound in the diagnosis of appendicitis [12]. However, the comparative diagnostics of ultrasound and CT remain to be tested in other clinical environments [13]. Adequate imaging is required to ensure proper diagnosis of appendicitis as well as minimizing the negative appendectomy rates and enhancing patient outcomes [14]. The knowledge of the relative diagnostic value of ultrasound and CT can hence be used to optimise diagnostic pathways in pediatric appendicitis [15].

Objective: To compare the diagnostic performance of ultrasound and computed tomography in detecting appendicitis in the pediatric age group.

Methodology

This was a hospital-based cross-sectional diagnostic accuracy study conducted at Rai Medical College Sargodha from August 2024 to August 2025, including 285 pediatric patients presenting with clinical suspicion of acute appendicitis. Children admitted to the emergency department or pediatric surgery unit with symptoms such as right lower abdominal pain, fever, nausea, vomiting, or leukocytosis were enrolled consecutively during the study period to compare the diagnostic accuracy of ultrasonography and computed tomography in detecting appendicitis.

Inclusion Criteria

- Children aged 5–15 years presenting with clinical features suggestive of acute appendicitis.
- Patients who underwent both abdominal ultrasound and CT scan as part of diagnostic evaluation.
- Patients whose diagnosis was confirmed by surgical findings or clinical follow-up.

Exclusion Criteria

- Patients with previous appendectomy.
- Children with known chronic gastrointestinal diseases or abdominal malignancy.
- Patients with incomplete clinical or imaging records.

Data Collection

Demographic and clinical data such as age, gender, duration of symptoms, characteristics of abdominal pain, fever, vomiting, and laboratory results were recorded with the help of a structured proforma after the parents or guardians gave their consent. The patients initially were exposed to abdominal ultrasonography by employing a graded compression technique, which was carried out by a skilled radiologist. Such findings like the appendiceal diameter more than 6 mm, non-compressibility, periappendiceal fluid, and higher echogenicity of the surrounding fat were reported. Patients were then subjected to contrast-enhanced CT scan when it was clinically necessary or the results of ultrasound were not definite. The CT results such as an appendiceal enlargement, thickening of the walls, fat strands straining along the periappendiceal areas, and abscess formation were noted. In cases that were operated, intraoperative observations and histopathological analysis confirmed final diagnosis of appendicitis, whereas clinical follow-up confirmed final diagnosis in non-operated cases.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 26. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequency and percentage. Diagnostic performance of ultrasound and CT was evaluated by calculating sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy. Chi-square test was used to compare diagnostic outcomes between imaging modalities. A p-value <0.05 was considered statistically significant.

Results

A total of 285 pediatric patients were included with a mean age of 10.6 ± 2.9 years. The most common age group was 9–12 years (119, 41.8%), followed by 13–15 years (88, 30.9%) and 5–8 years (78, 27.4%). Males accounted for 164 patients (57.5%) and females for 121 (42.5%). The mean symptom duration was 28.4 ± 10.7 hours. Right lower quadrant pain was present in 251 patients (88.1%), nausea or vomiting in 182 (63.9%), fever in 167 (58.6%), and leukocytosis in 196 patients (68.8%).

Table 1. Demographic and Clinical Characteristics of Pediatric Patients (N = 285)

Variable	Category	n (%) / Mean ± SD
Age (years)	Mean age	10.6 ± 2.9
Age Group	5–8 years	78 (27.4%)
Age Group	9–12 years	119 (41.8%)
Age Group	13–15 years	88 (30.9%)
Gender	Male	164 (57.5%)
Gender	Female	121 (42.5%)
Duration of Symptoms (hours)	Mean duration	28.4 ± 10.7
Right Lower Quadrant Pain	Present	251 (88.1%)
Fever	Present	167 (58.6%)
Nausea/Vomiting	Present	182 (63.9%)
Leukocytosis (>10,000/mm³)	Present	196 (68.8%)
Final Diagnosis	Appendicitis confirmed	198 (69.5%)
Final Diagnosis	Non-appendicitis	87 (30.5%)

An appendiceal diameter >6 mm was observed in 164 appendicitis cases (82.8%) compared with 18 non-appendicitis cases (20.7%) (p <0.001). A non-compressible appendix was detected in 171 appendicitis patients (86.4%) and 21 non-appendicitis patients (24.1%). Periappendiceal fluid was present in 92 cases (46.5%) versus 11 cases (12.6%), while echogenic periappendiceal fat was observed in 118 (59.6%) versus 16 (18.4%).

Table 2. Ultrasound Findings in Pediatric Patients with Suspected Appendicitis

Ultrasound Parameter	Overall (N=285) n (%)	Appendicitis (n=198) n (%)	Non-Appendicitis (n=87) n (%)	p-value
Appendiceal diameter >6 mm	182 (63.9%)	164 (82.8%)	18 (20.7%)	<0.001
Non-compressible appendix	192 (67.4%)	171 (86.4%)	21 (24.1%)	<0.001
Periappendiceal fluid	103 (36.1%)	92 (46.5%)	11 (12.6%)	<0.001
Echogenic periappendiceal fat	134 (47.0%)	118 (59.6%)	16 (18.4%)	<0.001
Appendicolith detected	49 (17.2%)	44 (22.2%)	5 (5.7%)	0.001
Enlarged mesenteric lymph nodes	73 (25.6%)	51 (25.8%)	22 (25.3%)	0.931

Appendiceal enlargement >6 mm was detected in 182 appendicitis patients (91.9%) compared with 9 non-appendicitis patients (10.3%). Appendiceal wall thickening was present in 168 cases (84.8%) versus 12 cases (13.8%). Periappendiceal fat stranding occurred in 156 patients (78.8%) versus 10 patients (11.5%), and periappendiceal fluid collection in 88 patients (44.4%) versus 7 patients (8.0%). Abscess formation was identified in 29 appendicitis cases (14.6%) and 2 non-appendicitis cases (2.3%).

Table 3. CT Scan Findings in Pediatric Patients with Suspected Appendicitis

CT Parameter	Overall (N=285) n (%)	Appendicitis (n=198) n (%)	Non-Appendicitis (n=87) n (%)	p-value
Appendiceal enlargement (>6 mm)	191 (67.0%)	182 (91.9%)	9 (10.3%)	<0.001
Appendiceal wall thickening	180 (63.2%)	168 (84.8%)	12 (13.8%)	<0.001
Periappendiceal fat stranding	166 (58.2%)	156 (78.8%)	10 (11.5%)	<0.001
Periappendiceal fluid collection	95 (33.3%)	88 (44.4%)	7 (8.0%)	<0.001
Abscess formation	31 (10.9%)	29 (14.6%)	2 (2.3%)	0.002
Appendicolith detected	59 (20.7%)	53 (26.8%)	6 (6.9%)	<0.001

Ultrasound showed sensitivity of 84.8%, specificity of 79.3%, PPV of 90.6%, NPV of 69.8%, and accuracy of 83.2%. CT showed higher sensitivity (92.9%), specificity (89.7%), PPV (95.3%), NPV (84.9%), and accuracy (91.6%). CT also performed better in early appendicitis (sensitivity 91.3%) and complicated appendicitis (94.1%), while the combined imaging approach achieved the highest sensitivity (96.5%) and diagnostic accuracy (94.7%).

Table 4. Diagnostic Performance of Ultrasound and CT in Pediatric Appendicitis (N = 285)

Imaging Modality	Sensitivity (%)	Specificity (%)	Positive Predictive Value (%)	Negative Predictive Value (%)	Diagnostic Accuracy (%)
Ultrasound (Overall appendicitis detection)	84.8%	79.3%	90.6%	69.8%	83.2%
CT Scan (Overall appendicitis detection)	92.9%	89.7%	95.3%	84.9%	91.6%
Ultrasound (Early appendicitis)	82.4%	78.6%	88.9%	68.7%	81.1%
CT Scan (Early appendicitis)	91.3%	88.1%	94.2%	83.4%	90.0%
Ultrasound (Complicated appendicitis)	81.2%	77.4%	87.6%	66.9%	79.6%
CT Scan (Complicated appendicitis)	94.1%	91.6%	96.4%	87.3%	93.0%
Combined Imaging (US followed by CT)	96.5%	90.8%	96.8%	89.9%	94.7%

Discussion

This paper compared the diagnostics abilities of ultrasound and computed tomography in the diagnosis of appendicitis in children. The findings demonstrated that 198 out of 285 children (69.5%), had appendicitis, and the average age of patients was 10.6 and 2.9 respectively. Most of the patients were exhibiting right lower quadrant pain (88.1%), then nausea or vomiting (63.9%), and then fever (58.6%). A case of leukocytosis was found in 68.8%. The same clinical patterns have been documented in the past studies wherein abdominal pain, vomiting and leukocytosis were reported to be the most prevalent clinical manifestations of pediatric appendicitis [16]. This study on ultrasound showed that the ultrasound evidence is strongly related to appendicitis. In 86.4% of cases that were confirmed, a non-compressible appendix was seen and in 82.8% patients, an appendiceal diameter more than 6 mm was observed. Also prevalent among the appendicitis patients were periappendiceal fluid and echogenic periappendiceal fat. Similar findings have been found in the previous studies, which indicated the presence of such ultrasound indicators of appendicitis in childhood as the enlargement of the appendix, non-compressibility, and periappendiceal inflammation [17][18]. The CT imaging was shown to be more reliable in diagnosis than the ultrasound. Appendicitis cases exhibiting the enlargement of the appendix were found in 91.9 percent of appendicitis cases whilst peri appendiceal fat stranding and wall thickening were found in 78.8 percent and 84.8 percent of patients respectively. Complications like abscess development were also detected using CT in 14.6% cases. Other studies have reported similar findings the CT imaging has been shown to possess better visualization of the anatomy and better detection of the presence of appendiceal inflammation and complications [19].

The diagnostic accuracy analysis indicated that CT was more sensitive (92.9% and specificity at 89.7%), and specific (89.7) than ultrasound (84.8% and specificity at 79.3%). The cumulative diagnostic adherence of CT was 91.6 and ultrasound demonstrated an adherence of 83.2. The same trends have been reported in earlier studies that have shown that CT tends to be more sensitive and specific in the diagnosis of appendicitis especially in instances where ultrasound findings are inconclusive [20]. Also, the staged imaging modality with the ultrasound then the CT had the highest diagnostic performance with a sensitivity of 96.5 and the accuracy of 94.7. Past studies have also indicated that such a successive strategy of imaging can greatly enhance accuracy of diagnosis besides minimizing irrelevant radiations exposure in children patients [21]. Thus, ultrasound as the primary modality and selective CT scanning as the second option might offer an effective and less harmful route in the diagnosis of a pediatric appendicitis.

Limitations

There were a number of limitations of this research. First, it was carried out in a small sample of hospitals, thus the limiting the generalizability of the results. Second, ultrasound is operator dependent and radiologist experience differences could have affected the diagnostic accuracy. Third, the two imaging modalities were not used on all patients at the same time, which might have caused selection bias. Lastly, the study failed to determine the clinical outcome and radiation exposure effects in pediatric patients who are undergoing CT imaging in the long run.

Conclusion

It is concluded that computed tomography demonstrated higher sensitivity, specificity, and overall diagnostic accuracy compared with ultrasound in diagnosing appendicitis in the pediatric age group. Ultrasound remains a useful first-line imaging modality due to its safety and lack of radiation exposure; however, CT provides superior diagnostic reliability, particularly in inconclusive or complicated cases. A staged imaging approach using ultrasound followed by selective CT may therefore provide the most effective and safe diagnostic strategy for pediatric appendicitis

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