

Comparison of Ultrasound and CT Imaging in the Diagnosis of Acute Appendicitis

Shishir Kumar Jha¹, Md Shamim Ahmed², Indresh Vikram Singh³, Rajeeb Adhikari⁴

¹Junior Resident, Department of Radiodiagnosis and Imaging, Narayan Medical College and Hospital, Jamuhar, Sasaram, Bihar

²Head of Department, Department of Radiodiagnosis and Imaging, Narayan Medical College and Hospital Jamuhar, Sasaram, Bihar

³Junior Resident, Department of Radiodiagnosis and Imaging, Narayan Medical College and Hospital Jamuhar, Sasaram

⁴Junior Resident, Department of Diagnostic and Interventional Radiology, AIIMS, Rishikesh

Received: 11-07-2025 / Revised: 10-08-2025 / Accepted: 11-09-2025

Corresponding Author: Dr. Shishir Kumar Jha

Conflict of interest: Nil

Abstract:

Background: Acute appendicitis is a common surgical emergency that requires prompt diagnosis to prevent complications such as perforation, abscess, and peritonitis. While clinical evaluation is essential, imaging modalities like ultrasonography (USG) and computed tomography (CT) play a critical role in improving diagnostic accuracy.

Aim: To compare the diagnostic accuracy of USG and CT in patients with suspected acute appendicitis.

Methods: A prospective observational study was conducted on 60 patients presenting with clinical suspicion of acute appendicitis at Narayan Medical College and Hospital, Jamuhar, Sasaram, from December 2023 to June 2025. All patients underwent abdominal USG followed by contrast-enhanced CT. Imaging findings were compared with intraoperative and histopathological results where surgery was performed. Data were analyzed using SPSS version 23.0. Sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy of USG and CT were calculated.

Results: Among 60 patients, USG detected appendicitis in 50 patients, with a sensitivity of 88.5%, specificity of 50%, and overall accuracy of 83.3%. CT identified appendicitis in 54 patients, with a sensitivity of 96.3%, specificity of 66.7%, and overall accuracy of 93.3%. CT outperformed USG in all diagnostic parameters, particularly in cases with atypical presentation or inconclusive USG findings.

Conclusion: CT demonstrated superior diagnostic performance compared to USG in detecting acute appendicitis. While USG remains a valuable first-line imaging modality due to its safety and accessibility, CT should be considered for confirmation, especially in equivocal or complicated cases.

Recommendations: A combined imaging approach is recommended: initial evaluation with USG followed by CT when USG findings are inconclusive or complications are suspected. This strategy optimizes diagnostic accuracy while minimizing unnecessary radiation exposure.

Keywords: Acute appendicitis, Ultrasonography, Computed tomography, Diagnostic accuracy, Imaging.

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Introduction

Acute appendicitis (AA) is one of the most common surgical emergencies worldwide, characterized by inflammation of the vermiform appendix. It affects approximately 7–8% of the population during their lifetime and remains a leading cause of emergency abdominal surgery [1]. The condition often presents with right lower quadrant abdominal pain, nausea, vomiting, anorexia, and localized tenderness, but clinical presentation can be variable, particularly in children, elderly patients, and pregnant women [2]. Prompt diagnosis is crucial, as delayed treatment increases the risk of complications, including perforation, abscess formation, peritonitis, and

sepsis, which are associated with significant morbidity and mortality [3].

Traditionally, the diagnosis of acute appendicitis has relied heavily on clinical evaluation supported by laboratory tests, including leukocyte counts and inflammatory markers such as C-reactive protein (CRP). However, atypical presentations and overlapping symptoms with other abdominal conditions, such as gastroenteritis, urinary tract infection, and gynecological disorders, make clinical diagnosis challenging [4]. Consequently, imaging modalities have become integral to the

diagnostic workup, improving accuracy and reducing unnecessary surgeries.

(USG) is commonly employed as the first-line imaging tool due to its non-invasive nature, lack of ionizing radiation, availability, and cost-effectiveness. It can identify a dilated, non-compressible appendix, periappendiceal fluid, and increased vascularity [5]. However, USG has limitations, including operator dependency, reduced sensitivity in obese patients, and difficulty visualizing retrocecal appendices [6]. In contrast, (CT) offers high sensitivity and specificity in diagnosing acute appendicitis. CT can accurately detect appendiceal inflammation, perforation, abscess formation, and alternative diagnoses, making it particularly useful in equivocal cases [7]. Despite concerns regarding radiation exposure, modern low-dose CT protocols have mitigated these risks, enhancing the safety profile of CT imaging [8].

Several studies conducted after 2018 have emphasized the complementary roles of USG and CT in improving diagnostic accuracy. While USG is recommended as the initial imaging modality, CT is often reserved for inconclusive USG findings or complicated cases, striking a balance between safety, accessibility, and diagnostic precision [9,10].

Given the ongoing debate regarding optimal imaging strategies, this study aims to comparatively evaluate the diagnostic performance of USG and CT in patients with suspected acute appendicitis, thereby providing insights into their relative accuracy and clinical utility in contemporary practice.

Methodology

Study Design: This study was a prospective, observational, comparative study.

Study Setting: The study was conducted at Narayan Medical College and Hospital, Jamuhar, Sasaram, over a period of 18 months, from December 2023 to June 2025. All imaging and clinical assessments were performed at this tertiary care center.

Participants: A total of 60 patients presenting with clinical suspicion of acute appendicitis were enrolled in the study. All participants provided informed consent prior to inclusion.

Inclusion Criteria

- Patients of all genders aged 12 years and above.

- Patients who presented with right lower quadrant abdominal pain suspicious for acute appendicitis.
- Patients who were willing to undergo both USG and CT imaging.

Exclusion Criteria

- Patients with a history of abdominal surgery.
- Pregnant women.
- Patients with generalized peritonitis or hemodynamic instability.
- Patients who refused consent for imaging or participation.

Bias: To minimize observer bias, all USG examinations were performed by experienced radiologists, and CT scans were interpreted independently by a separate radiologist who was blinded to the USG findings. Selection bias was minimized by including all eligible consecutive patients meeting the inclusion criteria.

Data Collection: Demographic data, clinical history, physical examination findings, laboratory results, and imaging findings were collected using a structured data collection form. Both USG and CT scan findings were documented for each patient, including the presence or absence of appendicitis, complications, and alternative diagnoses.

Procedure: All enrolled patients first underwent an abdominal ultrasonography using high-frequency probes, followed by a contrast-enhanced CT scan of the abdomen and pelvis. Imaging findings were compared with intraoperative and histopathological results wherever surgery was performed. Patients who did not undergo surgery were followed up clinically for confirmation of diagnosis.

Statistical Analysis: Data were entered and analyzed using SPSS software, version 23.0. Descriptive statistics were used to summarize demographic and clinical characteristics. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy of USG and CT were calculated. Comparative analysis between the modalities was performed using chi-square tests, with a p-value <0.05 considered statistically significant.

Results

A total of 60 patients were included in the study. Among them, 35 (58.3%) were male and 25 (41.7%) were female. The mean age of the participants was 28.5 ± 9.2 years (range 12–55 years). Most patients (40%) were in the age group of 21–30 years.

Table 1: Age and Gender Distribution

Age Group (years)	Male (n)	Female (n)	Total (n)	Percentage (%)
12–20	8	6	14	23.3
21–30	15	9	24	40
31–40	7	5	12	20
41–50	3	3	6	10
51–60	2	2	4	6.7
Total	35	25	60	100

The highest incidence of suspected appendicitis was observed in the 21–30 years age group. There was a slight male predominance.

Clinical Presentation: The most common symptom was right lower quadrant pain (100%), followed by nausea/vomiting (70%), fever (50%), and anorexia (40%). Tenderness at McBurney's point was observed in 80% of cases.

Table 2: Clinical Symptoms of Participants

Symptom	Number of Patients (n)	Percentage (%)
Right lower quadrant pain	60	100
Nausea/Vomiting	42	70
Fever	30	50
Anorexia	24	40
Tenderness at McBurney's point	48	80

Most patients presented with classic symptoms of appendicitis, with pain being universal among all participants.

Imaging Findings

(USG) Findings: USG detected acute appendicitis in 50 out of 60 patients. Among these, 46 were true positives confirmed by surgery, and 4 were false positives. USG failed to detect appendicitis in 6 patients who were later confirmed to have the condition on CT and surgery.

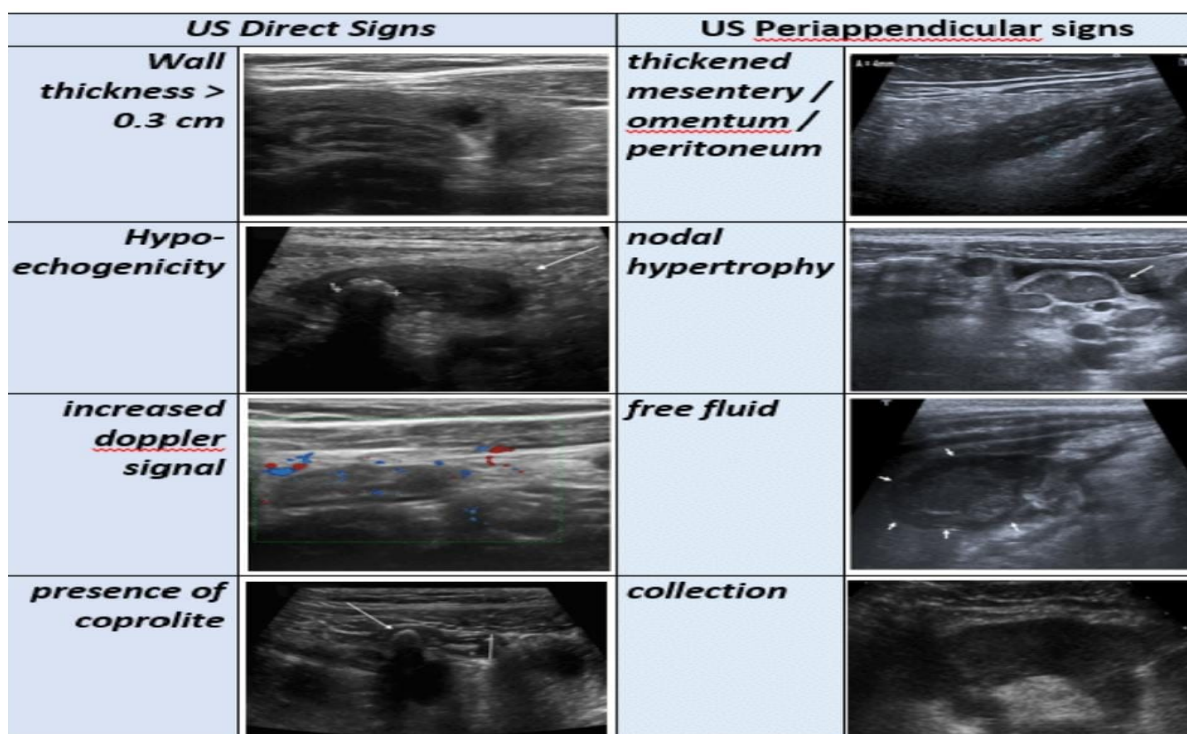
**Figure 1: Main US Finding in Acute appendicitis**

Table 3: USG Diagnostic Accuracy

USG Finding	Appendicitis Present (n)	Appendicitis Absent (n)	Total (n)
Positive	46	4	50
Negative	6	4	10
Total	52	8	60

USG Performance Metrics:

- Sensitivity = $46 / 52 \times 100 = 88.5\%$
- Specificity = $4 / 8 \times 100 = 50\%$
- (PPV) = $46 / 50 \times 100 = 92\%$
- (NPV) = $4 / 10 \times 100 = 40\%$
- Accuracy = $(46+4)/60 \times 100 = 83.3\%$

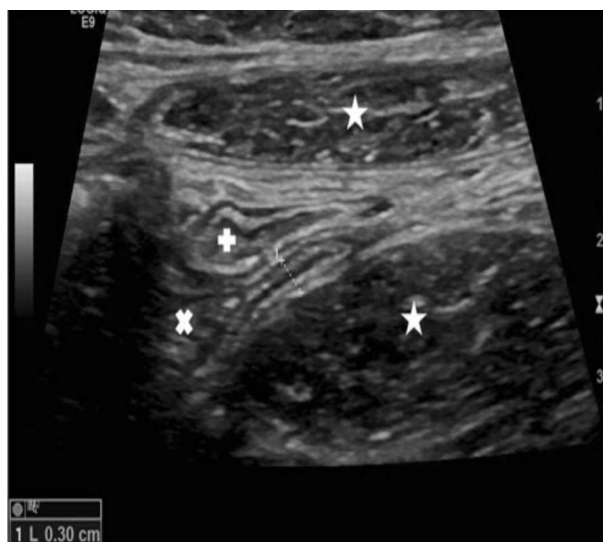


Figure 2: Longitudinal real-time US scan of a normal appendix. Diameter 0.3 cmpsoas muscle, *rectus muscle, x caecum, +terminal ileum**

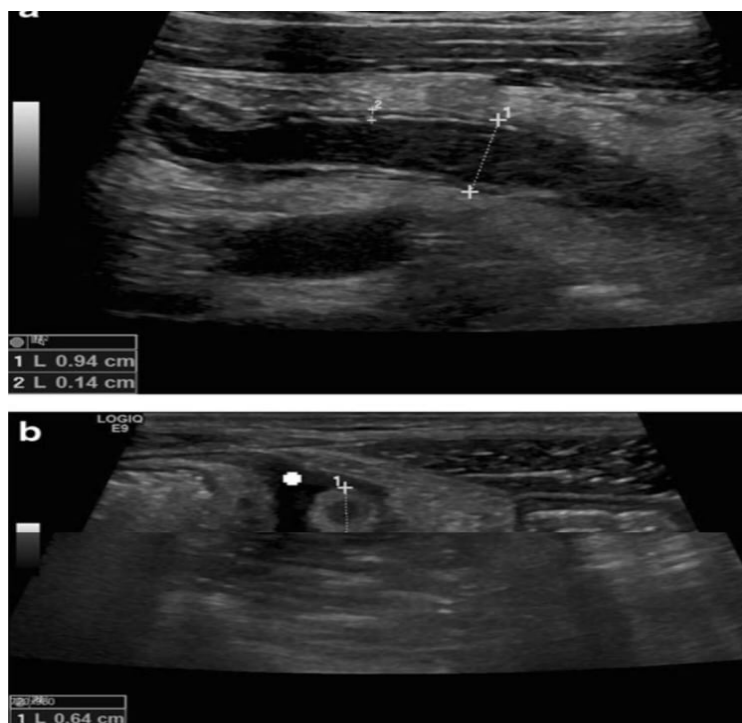


Figure 3: Longitudinal (a) and transverse (b) real-time US scan of acute appendicitis with thickening of the wall (crosses 2). Target-sign, diameter>6mm (crosses 1) and free fluid surrounding the appendix (+)

(CT) Findings: CT scan detected acute appendicitis in 54 out of 60 patients. Among these, 52 were true positives, and 2 were false positives. CT missed

appendicitis in 2 patients, which were later confirmed surgically.

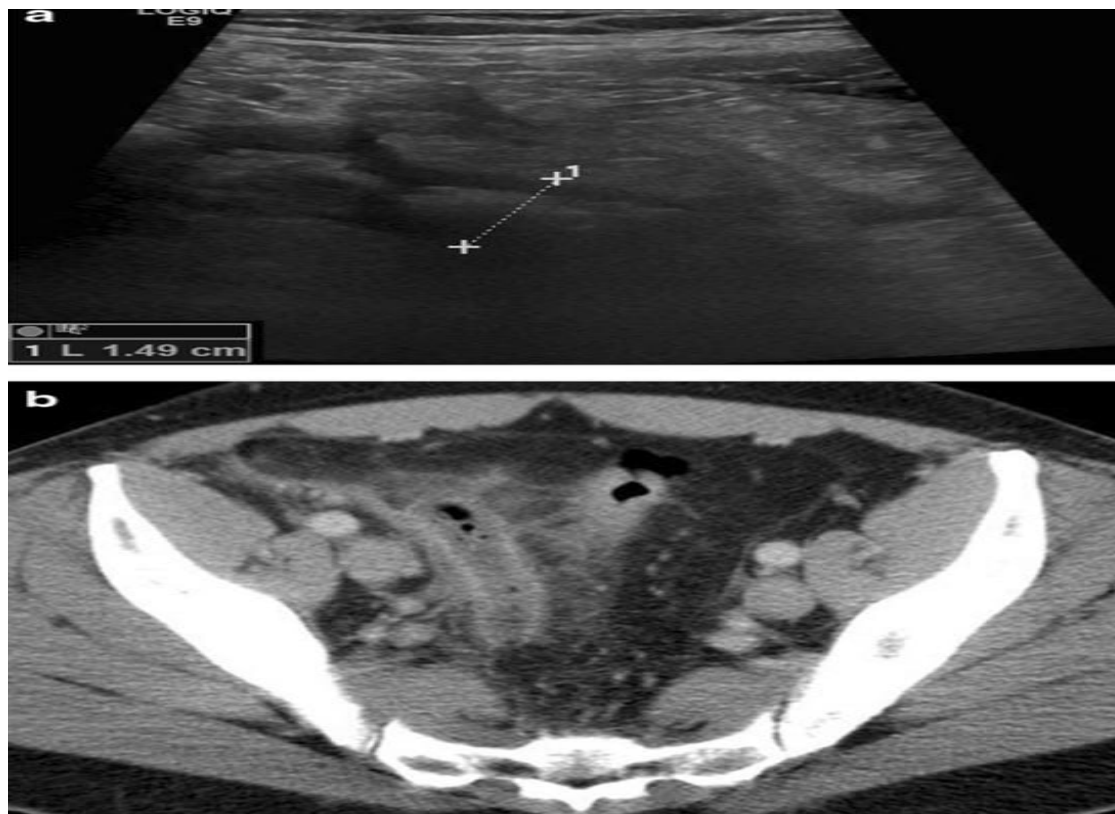


Figure 4: US and CT in acute appendicitis. 45-years-old male patient with pain in the right lower quadrant and increased inflammation parameters (white blood cell count and C-reactive protein elevation). a US real-time scan: local pain in combination with some fluid and thickened appendix, only seen in part (between crosses). B contrast – enhanced CT: Thickened appendix, mesenteric infiltration around the appendix, Inflammatory thickening of the sigmoid colon.

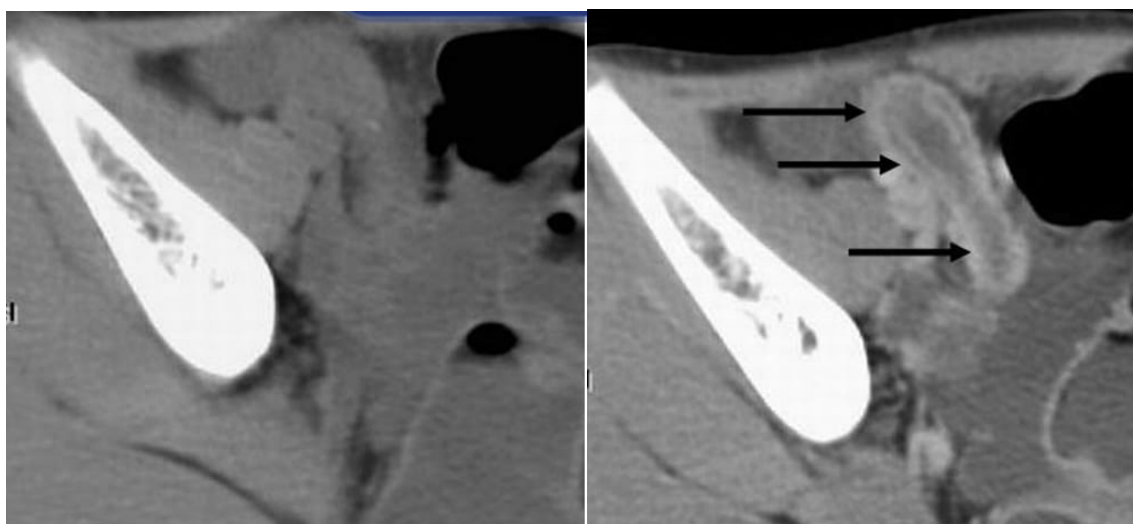


Figure 5: A & B -6-year-old girl with acute appendicitis. CT scan obtained before (A) and (B) IV contrast administration illustrate benefit of IV contrast material in different cases. Unenhanced scan is indeterminately visualized. Enhanced scan shows dilated appendix with thickened, hyperenhancing wall (Arrows, B). Notice mural stratification of appendix wall.

Table 4: CT Diagnostic Accuracy

CT Finding	Appendicitis Present (n)	Appendicitis Absent (n)	Total (n)
Positive	52	2	54
Negative	2	4	6
Total	54	6	60

CT Performance Metrics:

- Sensitivity = $52 / 54 \times 100 = 96.3\%$
- Specificity = $4 / 6 \times 100 = 66.7\%$
- Positive Predictive Value (PPV) = $52 / 54 \times 100 = 96.3\%$
- Negative Predictive Value (NPV) = $4 / 6 \times 100 = 66.7\%$

- Accuracy = $(52+4)/60 \times 100 = 93.3\%$

CT scan demonstrated higher sensitivity, specificity, and overall accuracy compared to USG, making it a more reliable diagnostic tool for acute appendicitis in this study.

Comparative Analysis**Table 5: Comparison of USG and CT in Diagnosis of Acute Appendicitis**

Parameter	USG (%)	CT (%)
Sensitivity	88.5	96.3
Specificity	50	66.7
Positive Predictive Value	92	96.3
Negative Predictive Value	40	66.7
Overall Accuracy	83.3	93.3

CT outperformed USG in all diagnostic parameters. While USG remains useful as a first-line imaging modality, CT provides superior diagnostic reliability, particularly in equivocal or complicated cases.

Discussion

In this study of 60 patients with suspected acute appendicitis, the majority were young adults, with a mean age of 28.5 years, and a slight male predominance (58.3%). The highest incidence was observed in the 21–30 years age group. Clinically, all patients presented with right lower quadrant abdominal pain, and common associated symptoms included nausea, vomiting, fever, and anorexia. Tenderness at McBurney's point was noted in 80% of patients, reflecting classic features of acute appendicitis.

(USG) detected appendicitis in 50 patients, with 46 true positives and 4 false positives. It missed 6 cases, resulting in a sensitivity of 88.5%, specificity of 50%, and overall accuracy of 83.3%. These findings suggest that USG is a useful initial imaging modality, especially in young patients and those requiring non-invasive evaluation. However, its lower specificity and negative predictive value indicate that it may be less reliable in atypical or complicated presentations.

(CT) identified appendicitis in 54 patients, with 52 true positives and only 2 false positives, missing just 2 cases. CT demonstrated superior diagnostic performance with a sensitivity of 96.3%, specificity of 66.7%, and overall accuracy of 93.3%. These results indicate that CT is more precise than USG in confirming or ruling out appendicitis, particularly in

equivocal cases or when USG findings are inconclusive.

Comparative analysis revealed that while both imaging modalities are valuable, CT outperformed USG in all parameters, including sensitivity, specificity, positive predictive value, negative predictive value, and overall diagnostic accuracy. This highlights the complementary role of USG and CT: USG can be used as a first-line, non-invasive, radiation-free screening tool, whereas CT provides definitive diagnostic confirmation and guides management in uncertain or complicated cases.

Overall, the study underscores the importance of a combined clinical and imaging approach, with CT serving as the gold standard for accurate diagnosis of acute appendicitis in patients presenting with atypical symptoms or inconclusive USG results.

Several recent studies highlight the comparative value of ultrasound and CT imaging in diagnosing acute appendicitis. CT consistently demonstrates superior accuracy compared to ultrasound, particularly in adult and complicated cases. Aiken et al. found that CT imaging provided higher sensitivity and specificity than US, confirming its role as the gold standard for diagnosis [11]. Similarly, Grigoryan et al. reported that multidetector CT outperformed US in detecting appendicitis, especially in patients with atypical presentations or higher body mass index, where ultrasound performance was limited [12].

Nonetheless, ultrasound remains valuable as an initial diagnostic tool. Salminen et al. suggested a staged approach, beginning with US followed by CT if inconclusive, to balance diagnostic accuracy with minimizing radiation exposure [13]. In pediatric

populations, Cho et al. confirmed that US can achieve high diagnostic value when performed by experienced radiologists, reserving CT for unclear cases to avoid unnecessary radiation in children [14].

Additional evidence reinforces this approach. Park et al. demonstrated that while CT yielded higher diagnostic accuracy overall, a combined algorithm of initial US with selective CT significantly reduced radiation without compromising accuracy [15]. Similarly, Kim et al. found that US was sufficient as the primary modality in younger patients, while CT was particularly important for adults and older populations where atypical symptoms were more frequent [16]. In summary, CT remains the most accurate imaging modality for acute appendicitis across all populations, but US plays a critical role as a safe, first-line option, particularly in children, pregnant women, and in staged diagnostic pathways to reduce radiation risk

Conclusion

In this study, CT demonstrated higher sensitivity, specificity, and overall accuracy than ultrasonography in diagnosing acute appendicitis. While USG remains a useful first-line, non-invasive imaging tool, CT provides more reliable confirmation, particularly in atypical or complicated cases. A combined approach of clinical evaluation and imaging optimizes diagnosis and management of acute appendicitis.

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