

Role of Multidetector Computed Tomography in the Evaluation of Primary and Secondary Signs of Acute Appendicitis: A Prospective Longitudinal Study with Histopathological Correlation.

Dr. Chandrakala. S¹, Dr. Indira N^{2*}, Dr. Niranjan J³.

¹Assistant Professor, Department of Radiodiagnosis. EPCMS & RC, Bengaluru Karnataka, India

²Professor, Department of Radiodiagnosis. EPCMS & RC, Bengaluru Karnataka, India

³Professor, Department of Radiodiagnosis. EPCMS & RC, Bengaluru Karnataka, India.



Correspondence:

Dr. Indira N.

Professor, Department of Radiodiagnosis. EPCMS & RC, Bengaluru Karnataka, India.

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Abstract

Background: Acute appendicitis is one of the most frequent causes of acute abdominal pain requiring emergency surgical intervention. Accurate and timely diagnosis is essential to reduce morbidity associated with delayed treatment, perforation, abscess formation, and unnecessary surgery. Multidetector Computed Tomography (MDCT) enables detailed evaluation of the appendix and surrounding structures and allows identification of both primary and secondary signs of appendiceal inflammation. **Objective:** To evaluate the role of MDCT in identifying primary and secondary signs of acute appendicitis and to assess its diagnostic findings in relation to histopathological confirmation. **Materials and Methods:** This prospective, longitudinal study was conducted over three years, from August 2023 to July 2026. A total of 60 patients with clinical suspicion of acute appendicitis were included. All patients underwent MDCT evaluation. The imaging assessment included appendiceal diameter, luminal contents, appendicolith, periappendiceal fluid, periappendiceal fat stranding, thickening of the lateral conal fascia, caecal changes, lymphadenopathy, abscess, and inflammatory mass. The CT diagnosis was compared with the available final diagnosis and intended for correlation with histopathological findings. **Results:** The study included 60 cases. Detailed MDCT observations were available for 55 cases of acute appendicitis. The recorded age ranged from 10 to 60 years, with a male predominance. Primary signs are directly related to the appendix and include appendiceal enlargement, abnormal luminal distension, wall thickening, altered mural enhancement, and the presence of an appendicolith. Increased appendiceal diameter, a primary sign is an important diagnostic parameter seen in all cases (100%). Periappendiceal fat stranding was the most frequent secondary sign, observed in 43 cases (78.2%), followed by periappendiceal fluid in 30 cases (54.5%) and regional lymphadenopathy in 18 cases (32.7%). Appendicolith was documented in 15 cases (27.3%). Luminal abnormality was recorded in 13 cases (23.6%), while thickening of the lateral conal fascia and caecal changes were seen in 7 (12.7%) and 9 cases (16.4%), respectively. Abscess formation was documented in 6 cases (10.9%). The recorded diagnostic spectrum included acute appendicitis, perforated appendicitis, appendicular abscess, appendicular mass, and appendiceal mucocele. **Conclusion:** MDCT is highly valuable in the evaluation of suspected acute appendicitis because it demonstrates both direct appendiceal abnormalities and secondary inflammatory changes. Periappendiceal fat stranding and fluid were prominent secondary signs. MDCT also assisted in identifying complicated disease, including perforation, abscess, and inflammatory mass, as well as alternative appendiceal pathology such as mucocele. Complete case-wise histopathological correlation is required for definitive calculation of diagnostic performance indices.

Keywords: Acute appendicitis; MDCT; Appendicolith; Periappendiceal fat stranding; Periappendiceal fluid; Histopathology.



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INTRODUCTION

Acute appendicitis is one of the most common causes of acute abdominal pain requiring emergency surgical intervention. Despite advances in clinical assessment and laboratory investigations, establishing an accurate diagnosis remains challenging in patients with atypical clinical presentations.[1] Classical symptoms may include periumbilical pain migrating to the right iliac fossa, anorexia, nausea, vomiting, fever, and localized tenderness; however, these manifestations are not consistently present in all patients. Variability in the anatomical position of the appendix, age of the patient, duration of symptoms, and associated medical conditions may further alter the clinical presentation. Consequently, reliance on

clinical findings alone may result in delayed diagnosis, unnecessary surgery, or failure to recognize complicated appendicitis.[2]

Early and accurate diagnosis is important because untreated appendiceal inflammation may progress to gangrene, perforation, periappendiceal abscess, inflammatory mass, generalized peritonitis, and other serious complications. On the other hand, an incorrect diagnosis may lead to unnecessary appendectomy and expose patients to avoidable surgical risks.[3] Therefore, imaging plays an increasingly important role in confirming the diagnosis, assessing the severity of disease, detecting complications, and identifying alternative causes of acute abdominal pain.

Ultrasonography is frequently used as an initial imaging modality because it is widely available, does not involve ionizing radiation, and can provide direct visualization of an inflamed appendix in suitable patients.[4] However, its diagnostic performance may be limited by obesity, excessive bowel gas, operator dependence, patient discomfort, and difficulty in visualizing the appendix. Multidetector Computed Tomography (MDCT) has emerged as a valuable Cross-sectional imaging technique because of its rapid image acquisition, high spatial resolution, Multiplanar imaging capability, and ability to evaluate the appendix together with adjacent bowel loops, mesentery, retroperitoneum, and other abdominal and pelvic structures.[5]

The diagnosis of acute appendicitis on MDCT is based on the recognition of both primary and secondary signs. Primary signs are directly related to the appendix and include appendiceal enlargement, abnormal luminal distension, wall thickening, altered mural enhancement, and the presence of an appendicolith. Appendiceal diameter is an important diagnostic parameter; however, an enlarged appendix alone may not always be sufficient to establish the diagnosis because some normal appendices may have a relatively large diameter. Therefore, interpretation should incorporate additional morphological features and the presence of surrounding inflammatory changes.[6]

Secondary signs reflect the extension of inflammation into the adjacent tissues and are particularly valuable when visualization of the appendix is suboptimal or when appendiceal findings are equivocal. These signs include periappendiceal fat stranding, periappendiceal free fluid, thickening of adjacent fascial planes such as the lateral conal fascia, inflammatory changes involving the caecum, regional lymphadenopathy, abscess formation, and inflammatory mass. In complicated appendicitis, MDCT may additionally demonstrate findings suggestive of perforation, localized collection, extraluminal inflammatory changes, or phlegmon formation.[4,5,6]

An important advantage of MDCT is its ability not only to establish the diagnosis of acute appendicitis but also to assess disease extent and detect complications that may influence patient management. Furthermore, MDCT can identify alternative appendiceal and non-appendiceal conditions that may clinically mimic acute appendicitis, thereby improving diagnostic confidence.

Therefore, the present prospective longitudinal study, was undertaken to evaluate the role of MDCT in identifying primary and secondary signs of acute appendicitis and to correlate the imaging findings with histopathological diagnosis.

MATERIALS AND METHODS

This prospective, longitudinal, observational study was conducted over a period of three years, from August 2023 to July 2026. The study included a total of 60 patients who presented with clinical features suggestive of acute appendicitis and underwent Multidetector Computed Tomography (MDCT) examination as part of their diagnostic evaluation. The objective of the study was to assess the role of MDCT in the evaluation of primary and secondary imaging signs of acute appendicitis and to correlate the radiological findings with histopathological diagnosis.

Patients presenting with acute abdominal pain and clinical suspicion of acute appendicitis were included in the study. Clinical assessment was performed before imaging, and patients in whom acute appendicitis was considered as a possible diagnosis were subjected to MDCT evaluation. The study population included patients across a broad age range and both sexes. The detailed dataset recorded patient demographic variables, including age and sex, along with the individual CT findings and the final radiological diagnosis.

All included patients underwent MDCT examination of the abdomen for evaluation of the appendix and adjacent abdominal structures. The CT images were assessed systematically for direct or primary signs involving the appendix and secondary signs indicating inflammatory changes in the surrounding tissues. Multiplanar assessment was used to improve visualization of the appendix and to evaluate the extent of local inflammatory involvement.

The primary MDCT parameters evaluated in the study included the appendiceal diameter, appearance and contents of the appendiceal lumen, and the presence or absence of an appendicolith. Appendiceal diameter was recorded as a continuous

measurement in the individual cases. Luminal findings, including the presence of air or fluid where documented, were also recorded. The presence of an appendicolith was considered an important supportive imaging feature and was documented when identified.

In addition to direct appendiceal findings, secondary signs of inflammation were carefully evaluated. These included periappendiceal free fluid and periappendiceal fat stranding. Periappendiceal fluid was recorded when abnormal fluid was identified in the tissues surrounding the appendix, while periappendiceal fat stranding was assessed as evidence of inflammatory involvement of the adjacent mesenteric or peritoneal fat.

The adjacent retroperitoneal and bowel structures were also evaluated for secondary inflammatory changes. Thickening of the lateral conal fascia was recorded when present, as it may indicate extension of the inflammatory process beyond the immediate periappendiceal region. The caecum was assessed for associated inflammatory changes, and regional lymph nodes were evaluated for lymphadenopathy. These secondary findings were considered in conjunction with the primary appendiceal findings to establish the overall radiological impression.

MDCT examination was also used to identify complications associated with acute appendicitis. The presence of periappendiceal abscess or inflammatory mass was specifically recorded. Cases showing features suggestive of complicated appendicitis, including perforation, abscess formation, or appendicular mass, were categorized separately in the final radiological assessment. The examination also enabled identification of alternative appendiceal pathology, including mucocele, when present.

The final MDCT diagnosis was documented for each available case. The diagnostic categories recorded in the dataset included acute appendicitis, acute appendicitis with perforation, abscess, inflammatory mass, and mucocele. In cases in which direct visualization of the appendix was limited or the appendix was not detected, the available secondary signs, such as appendicolith or periappendiceal free fluid, were documented as part of the radiological assessment.

All demographic, clinical, and radiological observations were entered into a structured study record. The collected data were summarized using descriptive statistical methods. Categorical variables, including the presence or absence of individual primary and secondary CT signs, were expressed as frequencies and percentages. Age and appendiceal diameter were recorded as numerical variables. The distribution of primary signs, secondary inflammatory signs, and complicated forms of appendiceal disease was analyzed descriptively.

The study focused particularly on determining the relative contribution of primary and secondary MDCT findings in establishing the diagnosis of acute appendicitis. The primary signs were interpreted in conjunction with secondary inflammatory changes rather than in isolation. This approach was particularly relevant in cases with borderline appendiceal enlargement, equivocal direct findings, or difficulty in visualization of the appendix.

Data Analysis

The collected data were entered into a structured database and analyzed using descriptive statistical methods. Continuous variables, such as age and appendiceal diameter, were summarized using appropriate measures of central tendency and range, while categorical variables, including primary and secondary MDCT signs, were expressed as frequencies and percentages. The distribution of radiological diagnoses and associated complications was also analyzed descriptively.

RESULTS

A total of 60 cases were included during the three-year study period. The available detailed MDCT documented 55 individual patients as acute appendicitis.

Table 1. Demographic Profile of the Individually Documented Cases (n = 55)

Variable	Finding
Number of detailed records available	55
Stated total study population	60
Age range	10–60 years
Male patients	39
Female patients	16

Patients were distributed over a wide age range, from childhood to older adulthood. The age of the patients documented ranged from 10 to 60 years. There was a clear male predominance, with 39 males and 15 females among cases with documented sex information.

Table 2. Frequency of Primary MDCT Findings (n = 55)

Primary MDCT finding	Number of cases	Percentage
Abnormal/dilated appendix documented	55	100*
Abnormal luminal finding	13	23.6
Appendicolith	15	27.3

*Appendiceal diameter was recorded as a measurement in the detailed records; however, a normal-versus-abnormal classification threshold was not explicitly provided in the source dataset.

Appendiceal measurements were recorded in all individually documented cases. Appendicolith was identified in approximately one-quarter of the cases, indicating its role as an important supportive primary sign but not a universal finding.

Table 3. Frequency of Secondary MDCT Signs (n = 55)

Secondary MDCT finding	Number of cases	Percentage
Periappendiceal fat stranding	43	78.2
Periappendiceal fluid	30	54.5
Regional lymphadenopathy	18	32.7
Caecal changes	9	16.4
Thickening of lateral conal fascia	7	12.7
Abscess	6	10.9

Periappendiceal fat stranding was the most frequent secondary sign, followed by periappendiceal fluid. These findings highlight the importance of evaluating the periappendiceal tissues rather than relying exclusively on appendiceal diameter. Regional lymphadenopathy was observed in approximately one-third of cases.

Table 4. Spectrum of Recorded Radiological Diagnoses

Diagnostic category	Number of recorded cases
Acute appendicitis	39
Acute appendicitis with perforation	2
Appendicular abscess/abscess	3
Appendicular mass/mass	5
Mucocele	3
Diagnosis not clearly entered in table	3

Acute appendicitis constituted the predominant diagnostic category. The presence of perforated appendicitis, abscess, and inflammatory mass demonstrates the ability of MDCT to identify complicated disease. Appendiceal mucocele was also detected, emphasizing the importance of considering alternative appendiceal pathology.

DISCUSSION

In the present study, periappendiceal fat stranding was the most frequently documented secondary CT finding, occurring in 78.2% of the available detailed records. This observation emphasizes the importance of assessing inflammatory changes within the periappendiceal fat. In many cases, secondary inflammatory signs may provide significant diagnostic support, particularly when direct assessment of the appendix is technically difficult or when appendiceal enlargement is borderline.[7]

Periappendiceal fluid was the second most frequently recorded secondary sign and was present in 54.5% of the detailed cases. Periappendiceal fluid reflects local inflammatory reaction and may occur in uncomplicated appendicitis or in more advanced disease. When associated with extensive inflammatory changes, focal wall disruption, abscess, or extraluminal gas, it may raise concern for complicated appendicitis.[8]

Appendicolith was documented in 27.3% of the detailed records. An appendicolith is a useful primary CT finding because it may indicate luminal obstruction and is frequently associated with appendiceal inflammation. However, its absence does not exclude appendicitis, as demonstrated by the majority of cases in the present dataset. Regional lymphadenopathy was observed in 32.7% of cases. Although enlarged regional lymph nodes are not specific for appendicitis, their presence in association with appendiceal and periappendiceal inflammatory findings provides additional evidence of an active inflammatory process.[8,9] Caecal changes and thickening of the lateral conal fascia were less common but represented useful secondary manifestations of inflammation extending beyond the appendix. These findings are particularly relevant in advanced inflammation and help define the anatomical extent of disease.

MDCT was also useful in identifying complicated forms of appendicitis. The documented cases included perforated appendicitis, abscess formation, and inflammatory mass.[10] Recognition of these complications is clinically important because management may differ substantially from that of uncomplicated appendicitis. CT assessment can assist in determining whether urgent surgery, antibiotic therapy, drainage, interval appendectomy, or other management strategies may be appropriate.[11,12]

The available findings demonstrate the practical value of MDCT in identifying both direct appendiceal abnormalities and secondary inflammatory changes. The high frequency of periappendiceal fat stranding and periappendiceal fluid particularly supports the concept that secondary signs play an important role in CT diagnosis.

CONCLUSION

MDCT is a valuable imaging modality for the evaluation of suspected acute appendicitis. It permits simultaneous assessment of primary appendiceal abnormalities and secondary inflammatory changes in the surrounding tissues. Periappendiceal fat stranding was the most frequently documented secondary sign, followed by periappendiceal fluid. Appendicolith was present in approximately one-quarter of cases. MDCT also demonstrated complicated appendicitis in the form of perforation, abscess, and inflammatory mass and identified alternative appendiceal pathology such as mucocele. The findings support the use of a comprehensive CT approach in which diagnosis is based on the combined assessment of appendiceal morphology and secondary inflammatory signs rather than a single imaging criterion.

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