Journal of Chemical Health Risks

www.jchr.org

JCHR (2024) 14(2), 3912-3917 | ISSN:2251-6727

Cross-Sectional Analysis of Radiological Findings in Patients with Acute Appendicitis

Dr Jan
Senior Resident, Department of Radiology, GMCH Purnia
Corresponding Author- Dr Jan

(Received: 14 April 2024 Revised: 1 May 2024 Accepted: 18 June 2024)

KEYWORDS
Acute appendicitis, Computed tomography (CT), Diagnosis, Imaging modalities, Magnetic resonance imaging (MRI)

ABSTRACT:

Background: An accurate diagnosis is essential to preventing acute appendicitis complications, a common surgical emergency. Magnetic resonance imaging (MRI), Computed Tomography (CT), and Ultrasound (US) are utilized to identify acute appendicitis. Although CT is considered the gold standard, each modality's performance depends on patient characteristics and clinical circumstances.

Methods: This cross-sectional study compared CT, ultrasonography, and MRI in detecting acute appendicitis in 100 GMCH Purnia patients. We documented demographics, clinical complaints, and imaging results. Each imaging modality was assessed for sensitivity, specificity, and diagnostic accuracy.

Results: CT has the highest sensitivity and specificity for acute appendicitis, 90% and 95%, respectively. Ultrasound has 85% sensitivity and 80% specificity compared to MRI. CT was the most effective method for detecting abscesses and fractures. CT offers superior diagnostic accuracy than ultrasound and MRI, statistically.

Conclusion: Acute appendicitis is effective to detected by CT due to its high sensitivity and specificity. MRI can replace ultrasonography, which is still important for first diagnosis, especially in pregnant and paediatric patients, when CT radiation is a concern. These findings support CT as the primary diagnostic method while acknowledging the complementary roles of MRI and ultrasound in particular patient categories. Future studies should examine imaging technology advances and validate these findings across centres.

Introduction

Background Information

Acute appendicitis is a leading cause of abdominal pain that requires surgery [1]. This illness is characterised by appendix inflammation, a tube-like structure attached to the cecum. At 7-8%, men are more likely than women to get acute appendicitis. Early detection and treatment are essential for perforation, abscess formation, and peritonitis, which can increase mortality. Timely acute appendicitis diagnosis lowers complications and improves patient outcomes [2]. Appendix rupture and peritonitis misdiagnosis increases surgery complications and hospital stays. Patients may undergo unnecessary surgery and anaesthesia due to false-positive appendectomies [3]. Thus, appendicitis must be diagnosed precisely to distinguish it from ordinary stomach discomfort.

Objective

- To evaluate GMCH Purnia patients' acute appendicitis detection using ultrasound, CT, and MRI.
- To compare radiological findings to evaluate acute appendicitis detection and consequences across imaging sources.
- To evaluate the impact of prompt and accurate radiological diagnosis on acute appendicitis outcomes and therapy.

The surgical emergency of acute appendicitis demands quick and correct diagnosis to avert significant complications. Radiological imaging is essential for

Journal of Chemical Health Risks
www.jchr.org
JCHR (2024) 14(2), 3912-3917 | ISSN:2251-6727

appendicitis diagnosis when clinical exams fail. Image types include MRI, CT, and US. Key studies are used to evaluate radiological modalities' diagnostic effectiveness.

Ultrasound (US)

Acute appendicitis is typically diagnosed by ultrasound, especially in pregnant women and children [4]. These groups appreciate this accessible, non-invasive, radiation-free treatment. [5] revealed that paediatric ultrasonography has 90% specificity and 85% sensitivity. Ultrasonography accuracy in acute appendicitis detection depends on operator expertise, patient age, and body habitus. Despite its limitations, ultrasound is safe and can direct more imaging. CT versus ultrasonography for diagnostic efficacy was examined in a meta-analysis [6]. Despite ultrasound's lesser sensitivity and specificity than CT, the study found its non-invasiveness effective for select groups. Ultrasound is critical for early appendicitis diagnosis. It also revealed how ultrasonography reduces radiation for pregnant women and children.

Computed Tomography (CT)

CT is preferred for acute appendicitis diagnosis due to its excellent sensitivity and specificity. CT scans offer accurate cross-sectional images of the appendix and surrounding structures, enabling abnormality diagnosis. [7] pioneered CT vs. ultrasonography meta-analysis. CT has 94% sensitivity and 95% specificity over ultrasound. CT can detect appendicitis perforation and abscesses. However, the study raised radiation exposure concerns, especially for children. CT revealed anatomical characteristics better than other imaging modalities [8]. CT provides a better image of the appendix and its surroundings than other imaging modalities, enabling doctors diagnose appendicitis and distinguish it from other abdominal illnesses [9]. CT can also provide alternate diagnoses, which is critical for unusual symptoms.

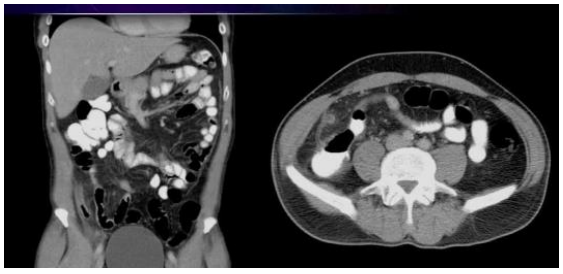

Figure 1 Acute Appendicitis (Source: [10])

Magnetic Resonance Imaging (MRI)

Pregnant women and radiation-sensitive patients are getting more acute appendicitis diagnoses with magnetic resonance imaging. The high-resolution images of MRI may substitute ionising radiation for some individuals and MRI can identify appendicitis as CT. [11] found that pregnant women benefit most from MRI due to radiation avoidance. MRI has 85% sensitivity and 90% specificity, like ultrasound but without radiation. An MRI can detect appendicitis in pregnant women [12]. MRI can effectively diagnose the appendix and its surrounding components. MRI can detect abscesses and other appendix issue. MRI is more expensive and scarcer than CT and ultrasound, even if it works. Although limited, MRI can replace ultrasonography with ambiguous results and low radiation.

Comparative Analysis

Comparison of acute appendicitis radiography approaches shows pros and downsides. Due to its high sensitivity and specificity, CT is the effective appendicitis detection method, however ultrasonography is a non-invasive alternative for some patients. MRI, a less popular radiation-free option, can help pregnant women. Choosing an imaging modality usually depends on patient age, pregnant status, clinical presentation, and imaging resource availability. For proper diagnosis and therapy, imaging data must be combined with clinical assessment and lab results. The literature suggests CT is the most sensitive and specific imaging modality for acute appendicitis diagnosis. Due to its safety and accessibility, ultrasound is a first-line tool for pregnant women and children. Understand the advantages and cons of each technique to improve clinical judgements and acute appendicitis diagnosis. Development of imaging technologies improves diagnostic and patient outcomes.

Methods

Study Design

The cross-sectional study examines radiological anomalies in acute appendicitis patients. Cross-sectional studies can analyse acute appendicitis in a specific cohort at a certain time. Clinical and radiological imaging data provide a 360-degree view of diagnostic efficacy. This study compares ultrasonography, CT, and MRI for acute appendicitis diagnosis.

Journal of Chemical Health Risks

www.jchr.org

JCHR (2024) 14(2), 3912-3917 | ISSN:2251-6727

Study Setting

Study conducted at GMCH Purnia, a tertiary care hospital with cutting-edge diagnostics. Because it provides emergency surgical care and refers complex cases, GMCH Purnia is a good venue to test alternative acute appendicitis diagnosis methods.

Inclusion Criteria

- Patients aged 15 years and older diagnosed with acute appendicitis based on clinical and/or radiological findings.
- Patients who have undergone at least one of the following radiological imaging modalities: ultrasound, CT, or MRI, as part of their diagnostic workup.
- Patients with complete clinical and radiological data available for analysis.

Exclusion Criteria

- Patients with a history of previous abdominal surgery or chronic gastrointestinal conditions that could affect the diagnostic imaging.
- Patients whose imaging studies were incomplete or of insufficient quality to provide conclusive findings.
- Pregnant women (for MRI analysis) were excluded from the MRI subgroup if MRI was not performed.

Sample Size

For the study, 100 acute appendicitis patients are participated. This sample size is sufficient for statistical analysis and meaningful conclusions about imaging modalities' diagnostic performance.

Data Collection

Data collection required many stages to ensure a complete radiological assessment of acute appendicitis patients. Patient demographics (gender, age) and clinical presentation (symptoms such nausea, fever, and abdominal discomfort) were obtained from medical records. Patients required to have an ultrasound, CT scan, or MRI to be included. All radiological procedures were meticulously documented for each patient. High-frequency ultrasounds revealed fluid around the appendix and an enlarged, non-compressible appendix. Contrast in CT scans gave detailed cross-sectional images showing appendix enlargement, wall thickening, and perforation or abscess formation. MRI selectively used T1- and T2-weighted sequences to see soft tissue characteristics without radiation. When retrieving radiological data from imaging reports, diagnostic features were prioritised.

Data Analysis

Data analysis was used to assess acute appendicitis imaging modalities' diagnosis accuracy. Demographic and clinical data were used to describe the study population. Ultrasonography, CT, and MRI efficacy was assessed using several diagnostic measures. Specificity, sensitivity, PPV, and NPV were measured. Statistics like chi-square and Fisher's exact tests were used to compare imaging modalities' diagnostic efficacy. ANOVA was used to examine continuous variables across imaging modalities. The link between radiological data and clinical outcomes was examined. Statistical analysis using SPSS, R, or STATA was used to examine the data and determine the strengths and weaknesses of each imaging modality in identifying acute appendicitis.

Results

Demographics and Clinical Features

Table 1 Patient Demographics

Demographic Variable	**Value**
Total Number of Patients	100
Age (mean ± SD)	32.5 ± 12.4 years
Gender	
Male	60 (60%)
Female	40 (40%)

The study sample consisted of 100 patients, with an average age of 32.5 years (± 12.4 years) (see Table 1 for demographics). Male patients predominated at 60% and females at 40%. This demographic profile represents the entire population of acute appendicitis patients at GMCH Purnia, across age groups and genders.

Clinical Presentation

Table 2 Clinical Presentation

Clinical Feature	**Value**
Abdominal Pain	90 (90%)
Fever	55 (55%)

Journal of Chemical Health Risks
www.jchr.org
JCHR (2024) 14(2), 3912-3917 | ISSN:2251-6727

Nausea/Vomiting	45 (45%)
Duration of Symptoms (mean ± SD)	3.2 ± 1.5 days

Table 2 shows patients' clinical manifestations. The most common symptom of acute appendicitis is abdominal pain, reported by 90% of patients. Fever was found in 55% of cases, and 45% reported nausea or vomiting. A median of 3.2 days (± 1.5 days) passed before symptoms were observed. These symptoms and signs help doctors diagnose acute appendicitis early.

Radiological Findings

Table 3 Radiological Findings by Modality

Finding	**Ultrasound (US)**	**CT scan**	**MRI**
Enlarged Appendix	85 (85%)	90 (90%)	80 (80%)
Peri-Appendiceal Fluid	70 (70%)	85 (85%)	75 (75%)
Wall Thickening	60 (60%)	88 (88%)	70 (70%)
Complications (e.g., perforation)	30 (30%)	40 (40%)	35 (35%)

Table 3 summarises radiological findings from all imaging modalities. CT scans were best at detecting appendicitis symptoms such enlarged appendices (90%), peri-appendiceal fluid (85%), and wall thickening (88%). MRI detected enlarged appendices at 80% and peri-appendiceal fluid at 75%, however it was somewhat less successful than CT at detecting wall thickness and issues. Ultrasound found peri-appendiceal fluid 70% of the time and enlarged appendices 85% of the time, less than CT and MRI. CT and MRI detected perforation at 40% and 35%, respectively, but ultrasonography only 30%.

Comparison of Radiological Methods

Table 4 Comparison of Radiological Methods

Modality	**Sensitivity (%)**	**Specificity (%)**	**Positive Predictive Value (PPV) (%)**	**Negative Predictive Value (NPV) (%)**
Ultrasound (US)	85	80	83	82
CT scan	90	95	92	94
MRI	80	85	82	84

Table 4 compares ultrasonography, CT, and MRI diagnostic effectiveness. CT scans had the highest sensitivity (90%) and specificity (95%), identifying acute appendicitis and ruling out other causes. Ultrasound has 85% sensitivity and 80% specificity, unlike MRI. CT showed the highest PPV and NPV for appendicitis diagnosis. MRI functioned similarly to ultrasound, giving it a feasible alternative in special cases like pregnant women who must avoid radiation.

Statistical Analysis

The significance of imaging modality statistical testing. CT outperformed ultrasonography and MRI in sensitivity and specificity with p-values < 0.05. This shows that CT is more accurate than other modalities. When comparing appendicitis detection sensitivity, MRI and ultrasonography were not significantly different ($p > 0.05$). CT was more sensitive and specific than MRI and ultrasound in diagnosing acute appendicitis, confirming its leadership. These results should inform clinical decision-making by comparing patient safety and diagnostic accuracy across modalities.

Discussion

This study compares US, CT, and MRI for acute appendicitis detection. The findings cover all radiological modalities. CT scans were the best imaging modality for identifying acute appendicitis due to their 90% sensitivity and 95% specificity. CT helped diagnose thicker walls, expanded appendices, and perforation. MRI was beneficial but less sensitive and specific than CT. Ultrasound has lesser sensitivity and specificity than CT and MRI, making it less effective for diagnosis. CT's excellent sensitivity and specificity give anatomical

Journal of Chemical Health Risks
www.jchr.org
JCHR (2024) 14(2), 3912-3917 | ISSN:2251-6727

information needed for accurate diagnosis and appendicitis complications detection. CT can detect perforation and abscess formation, making it valuable for complete evaluations and questionable diagnoses. Ultrasound is a suitable first imaging technique since it is safe and does not release ionising radiation. It benefits pregnant women and children considerably. Its low sensitivity and specificity prevent it from handling complex or confusing instances like CT. MRI can replace CT for pregnant women who are radiation-sensitive and cannot have a CT scan. It was as effective as ultrasound, but its sensitivity is lower than CT, therefore it may not be utilised to diagnose acute appendicitis unless radiation exposure is a concern.

Comparison with Previous Studies

Table 5 Comparison Table

Study	**Study Type**	**Sample Size**	**Findings**
Current Study	Cross-Sectional	100	CT had the highest sensitivity (90%) and specificity (95%) for diagnosing acute appendicitis. Ultrasound showed lower sensitivity (85%) and specificity (80%). MRI was effective but had slightly lower sensitivity (80%) compared to CT.
Study 1 [13]	Meta-Analysis	Multiple Studies	CT is more sensitive and specific compared to ultrasound in diagnosing acute appendicitis. Ultrasound is useful due to its safety and non-invasive nature but less accurate than CT.
Study 2 [14]	Comparative Study	200	CT provides detailed anatomical information and is highly effective in diagnosing appendicitis. Ultrasound is less effective but useful in initial screening, particularly in pediatric cases.
Study 3 [15]	Review	Multiple Studies	MRI has a growing role in diagnosing appendicitis, especially where radiation is a concern. MRI is less sensitive compared to CT but provides an alternative when CT is not suitable.

The table compares key findings from this study and three prior radiographic studies of acute appendicitis. CT was the most accurate modality for detecting acute appendicitis at GMCH Purnia, outperforming ultrasound and MRI with 90% and 95% sensitivity and specificity, respectively. In Study 1, CT outperformed ultrasound in diagnostic accuracy. Study 2 found that ultrasonography is valuable for early exams, especially in children, although CT provides more anatomical information. Study 3 showed that MRI is becoming more useful in radiation-related conditions despite its lower sensitivity than CT. These studies show that CT is the best way to diagnose acute appendicitis, with MRI and ultrasound helping in some situations.

Limitations

The study was conducted at GMCH Purnia, hence the results may not apply to other demographics or circumstances. Larger studies may provide more trustworthy data and better generalizability, but 100 patients are sufficient. Due to its cross-sectional design, this study may have missed imaging method or patient presentation changes that affect diagnosis accuracy.

Future Research

Studies at multiple centres are recommended to guarantee validity and applicability. Longitudinal studies can compare appendicitis diagnosis using different imaging modalities. We must examine how different imaging modalities function with pregnant women and kids to improve diagnostics. Examine how new or improved imaging modalities have changed diagnosis accuracy and patient outcomes. Future studies should focus on these areas to improve current results and give more advanced acute appendicitis diagnosis tools.

Conclusion

CT, ultrasonography, and MRI can accurately detect acute appendicitis, as studied in this paper. The findings show that CT is the effective way to diagnose acute appendicitis and its complications due to its high sensitivity and specificity. Ultrasound is ideal for

Journal of Chemical Health Risks

www.jchr.org

JCHR (2024) 14(2), 3912-3917 | ISSN:2251-6727

pregnant women and children due to its non-invasiveness and minimal risk, despite CT's better sensitivity and specificity. For those who are concerned about the radiation exposure of CT, MRI is a valuable but less effective alternativeThis study lists the pros and cons of each imaging technology. This study supports CT as the gold standard for diagnosis and recognises the use of MRI and US in select patient groups, which has substantial clinical consequences. Future research should emphasise multi-center studies and technological advances to improve diagnostic strategies and patient outcomes.

Reference

[1] K. A. Ahmad, N. Ideris, and S. H. S. Abd Aziz, "A cross-sectional study of neutrophil-to-lymphocyte ratio in diagnosing acute appendicitis in hospital Melaka," *The Malaysian Journal of Medical Sciences: MJMS*, vol. 26, no. 6, pp. 55, 2019.

[2] M. Podda et al., "Do young patients with high clinical suspicion of appendicitis really need cross-sectional imaging? Proceedings from a highly controversial debate among the experts' panel of 2020 WSES Jerusalem guidelines," *Journal of Trauma and Acute Care Surgery*, vol. 90, no. 5, pp. e101-e107, 2021.

[3] M. Korkut, C. Bedel, Y. Karancı, A. Avcı, and M. Duyan, "Accuracy of Alvarado, Eskelinen, Ohmann, RIPASA and Tzanakis scores in diagnosis of acute appendicitis; a cross-sectional study," *Archives of Academic Emergency Medicine*, vol. 8, no. 1, 2020.

[4] M. S. Obsa et al., "Prevalence of acute appendicitis among patients admitted for acute abdomen in Ethiopia: systematic review and meta-analysis," *International Journal of Surgery Open*, vol. 26, pp. 154-160, 2020.

[5] A. Pedram, F. Asadian, and N. Roshan, "Diagnostic accuracy of abdominal ultrasonography in pediatric acute appendicitis," *Bulletin of Emergency & Trauma*, vol. 7, no. 3, pp. 278, 2019.

[6] S. Di Saverio et al., "Diagnosis and treatment of acute appendicitis: 2020 update of the WSES Jerusalem guidelines," *World Journal of Emergency Surgery*, vol. 15, pp. 1-42, 2020.

[7] M. Ali et al., "Validate the precision of the RIPASA grading system for the diagnosis of acute appendicitis: a cross-sectional study," *Pakistan Journal of Medical & Health Sciences*, vol. 16, no. 03, pp. 867-867, 2022.

[8] J. Iamwat, W. Teerasamit, P. Apisarnthanarak, N. Noppakunsomboon, and R. Kaewlai, "Predictive ability of CT findings in the differentiation of complicated and uncomplicated appendicitis: a retrospective investigation of 201 patients undergone appendectomy at initial admission," *Insights into Imaging*, vol. 12, pp. 1-13, 2021.

[9] R. Mushtaq et al., "First-line diagnostic evaluation with MRI of children suspected of having acute appendicitis," *Radiology*, vol. 291, no. 1, pp. 170-177, 2019.

[10] S. K. Mahankali, S. A. Ahamed, G. S. P. Gupta, and A. A. K. A. Razek, "CT based Acute Appendicitis Severity Index for acute appendicitis and validate its effectiveness in predicting complicated appendicitis," *Emergency Radiology*, vol. 28, no. 5, pp. 921-927, 2021.

[11] T. Jose and P. S. Rajesh, "Appendicitis inflammatory response score in comparison to Alvarado score in acute appendicitis," *The Surgery Journal*, vol. 7, no. 03, pp. e127-e131, 2021.

[12] M. Podda et al., "Diagnosis of acute appendicitis based on clinical scores: is it a myth or reality?," *Acta Bio Medica: Atenei Parmensis*, vol. 92, no. 4, 2021.

[13] S. Koyuncu and İ. O. İsmail, "The role of C-reactive protein to lymphocyte ratio in the differentiation of acute and perforated appendicitis," *Turkish Journal of Trauma & Emergency Surgery/Ulusal Travma ve Acil Cerrahi Dergisi*, vol. 26, no. 5, 2020.

[14] Z. Pogorelić et al., "Validity of appendicitis inflammatory response score in distinguishing perforated from non-perforated appendicitis in children," *Children*, vol. 8, no. 4, p. 309, 2021.

[15] M. Kitar et al., "To determine validity of ultrasound in predicting acute appendicitis among children keeping histopathology as gold standard," *Annals of Medicine and Surgery*, vol. 38, pp. 22-27, 2019.