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Research Article

Ultrasound In the Diagnosis of Acute Appendicitis at Tertiary Care Teaching Centre

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Abstract: ***Introduction***: Acute appendicitis is one of the most common causes of acute abdominal pain requiring surgical intervention. Accurate and timely diagnosis is crucial to minimize complications such as perforation and peritonitis. Ultrasound has emerged as a valuable, non-invasive imaging modality in diagnosing acute appendicitis, particularly in scenarios where clinical diagnosis is challenging. This study aims to evaluate the diagnostic accuracy of ultrasound in detecting acute appendicitis in a sample size of 90 patients presenting with suspected appendicitis at a tertiary care hospital. ***Materials and Methods***: This prospective observational study was conducted at a tertiary care teaching hospital over six months. A total of 90 patients presenting with acute abdominal pain and clinical suspicion of appendicitis were included in the study. Patients of all genders aged 10 years and above. Clinical suspicion of acute appendicitis based on symptoms (right lower quadrant pain, fever, nausea, etc.) and physical examination (e.g., McBurney's point tenderness) were included. The sonographic diagnosis was categorized as positive, negative, or equivocal for appendicitis. All patients subsequently underwent surgical evaluation, and appendectomy specimens were subjected to histopathological examination, which served as the gold standard for diagnosis. ***Results***: An enlarged appendix (>6 mm) was the most frequent finding (64.4%), followed by non- compressibility (58.9%). Periappendiceal fat stranding and free fluid were less common but still significant markers of inflammation. Sensitivity (84.6%): Ultrasound correctly identified 84.6% of patients with acute appendicitis, indicating its ability to detect true positive cases effectively. Specificity (78.3%): Ultrasound correctly ruled out acute appendicitis in 78.3% of patients without the condition, though some false positives were noted. PPV (91.3%): High predictive value of a positive ultrasound suggests reliable confirmation of appendicitis when ultrasound findings are positive. NPV (66.7%): The lower negative predictive value emphasizes the risk of missed diagnoses in cases of negative ultrasound, particularly in atypical presentations. ***Conclusion***: Ultrasound is an effective first-line imaging modality in diagnosing acute appendicitis, offering high sensitivity and specificity. Its non-invasive nature and lack of radiation make it particularly suitable for vulnerable populations such as children and pregnant women. While limitations exist, the integration of ultrasound with clinical and laboratory findings can significantly improve diagnostic efficiency, reducing negative appendectomy rates and associated complications.

Keywords: Acute Appendicitis, Ultrasound, McBurney's point tenderness .

INTRODUCTION

Acute appendicitis is a common surgical emergency, with an estimated lifetime risk of 7-8%. Delayed or inaccurate diagnosis can lead to complications such as perforation, abscess formation, and increased morbidity.[1] While clinical evaluation remains the cornerstone for diagnosis, imaging modalities like ultrasound (USG), computed tomography (CT), and magnetic resonance imaging (MRI) have enhanced diagnostic accuracy, reducing negative appendectomy rates. [2]

Acute appendicitis has a lifetime incidence of about 7%. It is rare in infants less than 2 years old when the appendix is funnel-shaped. Maximum incidence is around 20 years old which coincides with peak appendiceal lymphoid tissue. [3] Older adults have a higher incidence of perforation and underlying appendiceal tumour. [4] Appendicitis is the most frequent non-obstetric emergency in pregnancy and is associated with 10% foetal mortality and 0.5% maternal mortality. The gravid uterus may prevent the omentum from walling off the appendix. [5]

The classical presentation consists of referred periumbilical pain (T10) which within a day or two localises to McBurney's point in the right iliac fossa and is associated with rebound tenderness, fever, nausea, vomiting, tachycardia, raised bilirubin and inflammatory markers and other signs of peritonitis. [6] This progression is unhelpful in children who often present with vague and non-specific signs and symptoms. It also relies on the appendix being in the right iliac fossa, however, the appendix can be located anywhere in the abdomen and even in the thorax and groin. [7]

Ultrasound, being non-invasive, radiation-free, and widely available, is particularly valuable in pediatric and pregnant populations. [8] The characteristic ultrasound findings of acute appendicitis include an enlarged, non-compressible appendix with a diameter exceeding 6 mm,

increased periappendiceal echogenicity, and associated free fluid. [9] However, operator dependency and limitations in obese patients or those with atypical presentations pose challenges. [10].

This study evaluates the diagnostic performance of ultrasound in acute appendicitis by correlating sonographic findings with surgical and histopathological outcomes in a cohort of 90 patients. The study aims to underscore the strengths and limitations of ultrasound, contributing to evidence-based diagnostic algorithms.

MATERIALS AND METHODS

This prospective observational study was conducted at a tertiary care teaching hospital over six months. A total of 90 patients presenting with acute abdominal pain and clinical suspicion of appendicitis were included in the study.

Inclusion Criteria: Patients of all genders aged 10 years and above. Clinical suspicion of acute appendicitis based on symptoms (right lower quadrant pain, fever, nausea, etc.) and physical examination (e.g., McBurney's point tenderness).

Exclusion Criteria: Patients with a prior history of appendectomy. Cases with inconclusive clinical or imaging findings where alternative diagnoses were established.

Procedure: All patients underwent a standardized ultrasound examination performed by experienced radiologists using high-frequency linear probes. Key ultrasound findings included:

- Appendix diameter > 6 mm.
- Non-compressibility of the appendix.
- Presence of periappendiceal fat stranding or free fluid.

The sonographic diagnosis was categorized as positive, negative, or equivocal for appendicitis. All patients subsequently underwent surgical evaluation, and appendectomy specimens were subjected to histopathological examination, which served as the gold standard for diagnosis.

Data Analysis: Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of ultrasound were calculated by comparing findings with histopathological results. Statistical analyses were performed using appropriate software.

RESULTS

Out of the 90 patients included in the study, 65 cases were confirmed as acute appendicitis based on histopathological examination. The key findings are summarized in the following tables.

Table 1: Diagnostic Performance of Ultrasound

Parameter	Value
Sensitivity	84.6%
Specificity	78.3%
Positive Predictive Value (PPV)	91.3%
Negative Predictive Value (NPV)	66.7%

In table 1, Sensitivity (84.6%): Ultrasound correctly identified 84.6% of patients with acute appendicitis, indicating its ability to detect true positive cases effectively. Specificity (78.3%): Ultrasound correctly ruled out acute appendicitis in 78.3% of patients without the condition, though some false positives were noted. PPV (91.3%): High predictive value of a positive ultrasound suggests reliable confirmation of appendicitis when ultrasound findings are positive. NPV (66.7%): The lower negative predictive value emphasizes the risk of missed diagnoses in cases of negative ultrasound, particularly in atypical presentations.

Table 2: Patient Demographics

Demographics	Frequency (%)
Male	50 (55.6%)
Female	40 (44.4%)
Age (Mean ± SD)	28.6 ± 12.4

In table 2, the study had a nearly balanced gender distribution, with a slightly higher prevalence among males (55.6%). The mean age of 28.6 years reflects that acute appendicitis predominantly affects young adults.

Table 3: Clinical Symptoms and Signs

Clinical Features	Frequency (%)
Right lower quadrant	85 (94.4%)

pain	
Nausea/Vomiting	65 (72.2%)
Fever	40 (44.4%)

In table 3, the most common symptom was right lower quadrant pain (94.4%), underscoring its diagnostic importance. Nausea/vomiting and fever were also significant but less frequent, aligning with common clinical presentations.

Table 4: Sonographic Findings

Ultrasound Findings	Frequency (%)
Enlarged appendix (>6 mm)	58 (64.4%)
Non-compressibility	53 (58.9%)
Periappendiceal fat stranding	30 (33.3%)
Free fluid	20 (22.2%)

In table 4, an enlarged appendix (>6 mm) was the most frequent finding (64.4%), followed by non-compressibility (58.9%). Periappendiceal fat stranding and free fluid were less common but still significant markers of inflammation.

Table 5: Comparison of Ultrasound and Histopathology

Diagnosis	Ultrasound Positive	Ultrasound Negative
Histopathology Positive	59	13
Histopathology Negative	6	12

In table 5, Ultrasound demonstrated strong correlation with histopathological results, with 59 true positives and only 6 false positives. However, 13 cases were false negatives, indicating limitations in detecting certain presentations of appendicitis.

Table 6: Negative Appendectomy Rates

Category	Frequency (%)
Negative Appendectomy	6 (6.7%)
Positive Appendectomy	84 (93.3%)

In table 6, the low negative appendectomy rate (6.7%) reflects improved surgical decision-making when guided by ultrasound findings, minimizing unnecessary surgeries

DISCUSSION

The findings of this study reinforce the diagnostic utility of ultrasound in acute appendicitis, demonstrating an overall sensitivity of 84.6% and specificity of 78.3%. These values are consistent with previous studies, highlighting ultrasound as a reliable, non-invasive imaging modality for this common surgical emergency. [12]

The diagnostic performance of ultrasound was particularly robust in cases with typical clinical presentations. The positive predictive value of 91.3% underscores its utility in confirming the diagnosis when findings are suggestive of appendicitis. However, the relatively lower negative predictive value (66.7%) indicates that a negative ultrasound does not definitively exclude the diagnosis, especially in patients with persistent symptoms. [13]

The false-negative cases in this study primarily involved patients with atypical presentations or those with a retrocecal appendix, underscoring the limitations of ultrasound in specific anatomical or clinical scenarios. [14] False positives were less frequent but occurred in cases of other inflammatory conditions mimicking appendicitis, such as mesenteric lymphadenitis. [15]

Operator dependency remains a notable limitation of ultrasound, with diagnostic accuracy heavily influenced by the experience of the radiologist. Training and standardization of ultrasound protocols are essential to minimize interobserver variability and enhance diagnostic consistency. [16]

Comparison with histopathological results, the gold standard, revealed that while ultrasound has limitations, its advantages of being readily available, cost-effective, and free from radiation make it an ideal first-line modality, especially in resource-limited settings. [17] In equivocal cases, the addition of CT or MRI can improve diagnostic accuracy, particularly in obese patients or those with atypical clinical features. [18]

The integration of ultrasound findings with clinical and laboratory data, such as leukocytosis or elevated C-reactive protein, further enhances diagnostic precision. Combining these modalities into a scoring system could reduce the reliance on advanced imaging and unnecessary surgical interventions. [19]

Overall, ultrasound's role in improving patient outcomes is significant. Its use in reducing negative appendectomy rates, as evidenced by the low rate (6.7%) in this study, contributes to better resource utilization and minimizes patient morbidity.

CONCLUSION

Ultrasound is an effective first-line imaging modality in diagnosing acute appendicitis, offering high sensitivity and specificity. Its non-invasive nature and lack of radiation make it particularly suitable for vulnerable populations such as children and pregnant women. While limitations exist, the integration of ultrasound with clinical and laboratory findings can significantly improve diagnostic efficiency, reducing negative appendectomy rates and associated complications. Further studies with larger sample sizes and advanced imaging techniques are recommended to refine diagnostic algorithms.

REFERENCES

1. Andersson RE. "The natural history and traditional management of appendicitis revisited: spontaneous resolution and predominance of prehospital perforations imply that a correct diagnosis is more important than an early diagnosis." World J Surg. 2007.
2. Lee JH, et al. "Accuracy of ultrasonography in the diagnosis of acute appendicitis compared with that of computed tomography." Korean J Radiol. 2008.
3. Rosen MP, et al. "ACR Appropriateness Criteria® Right Lower Quadrant Pain—Suspected Appendicitis." J Am Coll Radiol. 2011.
4. Eng KA, Abadeh A, Ligocki C, Lee YK, Moineddin R, AdamsWebber T, Schuh S, Doria AS (2018) Acute Appendicitis: A Meta-Analysis of the Diagnostic Accuracy of US, CT, and MRI as Second-Line Imaging Tests after an Initial US. Radiology 288(3):717–727
5. Chisthi MM, Surendran A, Narayanan JT (2020) RIPASA and air scoring systems are superior to alvarado scoring in acute appendicitis: Diagnostic accuracy study. Ann Med Surg (Lond) 59:138–142
6. Scott AJ, Mason SE, Arunakirinathan M, Reissis Y, Kinross JM, Smith JJ (2015) Risk stratifcation by the Appendicitis Infammatory Response score to guide decision-making in patients with suspected appendicitis. Br J Surg 102(5):563–572
7. Dirks K, Calabrese E, Dietrich CF, Gilja OH, Hausken T, Higginson A, Hollerweger A, Maconi G, Maaser C, Nuernberg D et al (2019) EFSUMB Position Paper: Recommendations for Gastrointestinal Ultrasound (GIUS) in Acute Appendicitis and Diverticulitis. Ultraschall Med 40(2):163–175
8. Clanton J, Subichin M, Drolshagen K, Daley T, Firstenberg MS (2013) Fulminant Clostridium difcile infection: An association with prior appendectomy? World J Gastrointest Surg 5(8):233–238
9. Zhang L, Hu C, Zhang Z, Liu R, Liu G, Xue D, Wang Z, Wu C, Wu X, She J et al (2023) Association between prior appendectomy and the risk and course of Crohn's disease: A systematic review and meta-analysis. Clin Res Hepatol Gastroenterol 47(3):102090
10. Hofmann JC, Trimborn CP, Hofmann M, Schroder R, Forster S, Dirks K, Tannapfel A, Anthuber M, Hollerweger A (2021) Classifcation of acute appendicitis (CAA): treatment directed new classification based on imaging (ultrasound, computed tomography) and pathology. Int J Colorectal Dis 36(11):2347–2360
11. Kim HC, Yang DM, Lee CM, Jin W, Nam DH, Song JY, Kim JY (2011) Acute appendicitis: relationships between CT-determined severities and serum white blood cell counts and C-reactive protein levels. Br J Radiol 84(1008):1115–1120
12. Kus CC, Ilgin C, Yegen C, Demirbas BT, Tuney D (2022) The role of CT in decision for acute appendicitis treatment. Diagn Interv Radiol 28(6):540–546
13. Gorter RR, Eker HH, Gorter-Stam MA, Abis GS, Acharya A, Ankersmit M, Antoniou SA, Arolfo S, Babic B, Boni L et al: Diagnosis and management of acute appendicitis. EAES consensus development conference 2015. Surg Endosc 2016, 30(11):4668–4690.
14. Terasawa T, Blackmore CC, Bent S, Kohlwes RJ (2004) Systematic review: computed tomography and ultrasonography to detect acute appendicitis in adults and adolescents. Ann Intern Med 141(7):537–546
15. Karul M, Berliner C, Keller S, Tsui TY, Yamamura J (2014) Imaging of appendicitis in adults. Rofo 186(6):551–558
16. Tyler PD, Carey J, Stashko E, Levenson RB, Shapiro NI, Rosen CL (2019) The Potential Role of Ultrasound in the Work-up of Appendicitis in the Emergency Department. J Emerg Med 56(2):191–196
17. Mostbeck G, Adam EJ, Nielsen MB, Claudon M, Clevert D, Nicolau C, Nyhsen C, Owens CM (2016) How to diagnose acute appendicitis: ultrasound frst. Insights Imaging 7(2):255–263
18. Aspelund G, Fingeret A, Gross E, Kessler D, Keung C, Thirumoorthi A, Oh PS, Behr G, Chen S, Lampl B et al (2014) Ultrasonography/MRI versus CT for diagnosing appendicitis. Pediatrics 133(4):586–593
19. Bhangu A, Soreide K, Di Saverio S, Assarsson JH, Drake FT (2015) Acute appendicitis: modernunderstanding of pathogenesis, diagnosis, and management. Lancet 386(10000):1278–128.