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ROLE OF ULTRASONOGRAPHY IN THE DIAGNOSIS OF ACUTE APPENDICITIS AMONG YOUNG ADULTS VISITING MARDAN MEDICAL COMPLEX: A CROSS-SECTIONAL STUDY

Original Research

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ABSTRACT

Background: Acute appendicitis is one of the most frequent surgical emergencies worldwide and remains clinically challenging due to its variable presentation. Early and accurate diagnosis is essential to prevent complications such as perforation, abscess formation, and peritonitis. Ultrasonography (USG) is widely recognized as a radiation-free, rapid, and cost-effective imaging modality, especially beneficial for young adults and pregnant women. Despite its routine use, variations in operator expertise and patient characteristics necessitate continuous evaluation of its diagnostic performance in different clinical settings.

Objective: To determine the diagnostic role of ultrasonography in identifying acute appendicitis among young adults presenting to Mardan Medical Complex.

Methods: A descriptive cross-sectional study was conducted over six months at the Radiology Department of Mardan Medical Complex. A total of 132 young adults clinically suspected of acute appendicitis were enrolled through non-probability convenience sampling. Ultrasonographic examinations were performed using Toshiba Xario 100 equipped with a 5–10 MHz transducer, employing the graded-compression technique for optimal visualization. Data were recorded using a structured proforma and analyzed using SPSS version 22.0. Descriptive statistics were computed for demographic and sonographic variables, while chi-square tests were applied to assess associations, with significance set at $p < 0.05$.

Results: Among 132 participants, 30.3% were male and 69.7% female, with a mean age of 24.13 ± 3.9 years. The appendix was successfully visualized in 92.4% of patients. Sonographic abnormalities included enlarged appendix in 59.1%, wall thickening in 22.7%, perforation in 11.4%, and normal appendix in 6.8%. Additional findings comprised free fluid in 43.2%, abscess in 30.3%, and intestinal obstruction in 27.3%. No significant association was observed between appendix appearance and age, gender, or weight ($p > 0.05$).

Conclusion: Ultrasonography demonstrated strong diagnostic utility for evaluating acute appendicitis in young adults and should be prioritized as the first-line imaging modality, particularly in resource-limited healthcare settings.

Keywords: Acute Appendicitis; Appendix; Diagnostic Imaging; Emergency Care; Ultrasonography; Young Adults; Sonographic Findings.

INTRODUCTION

Acute appendicitis is one of the most common surgical emergencies worldwide, particularly affecting adolescents and young adults, and continues to pose a diagnostic challenge despite advances in clinical assessment and imaging modalities (1). Its symptoms frequently overlap with other causes of acute abdominal pain, including mesenteric adenitis, gastroenteritis, and gynecological conditions, which often leads to diagnostic uncertainty and delays in timely intervention (2). Early and accurate diagnosis is critical, as untreated or late-recognized appendicitis can rapidly progress to perforation, peritonitis, sepsis, and prolonged hospitalization, substantially increasing patient morbidity and healthcare burden. In recent years, attention has shifted toward improving diagnostic pathways to minimize unnecessary appendectomies while preventing missed cases, underscoring the need for reliable, rapid, and accessible diagnostic tools (3,4). Ultrasonography has emerged as a preferred first-line imaging modality for suspected appendicitis due to its non-invasive nature, absence of ionizing radiation, widespread availability, and cost-effectiveness. It provides real-time visualization of the appendix, peri-appendiceal tissues, and potential complications, making it particularly advantageous in young adults for whom radiation exposure should be minimized (5-7). The graded-compression technique, a well-established sonographic method, enhances diagnostic accuracy by gradually displacing bowel gas to improve visualization of the inflamed appendix. Despite its advantages, ultrasonography can be operator-dependent, and its sensitivity may vary based on patient body habitus and anatomical variations, highlighting the importance of evaluating its diagnostic reliability in diverse clinical settings (8-10). Given these considerations, there remains a need for context-specific evidence on the diagnostic utility of ultrasonography in resource-limited and high-volume emergency departments, such as those in Pakistan, where reliance on cost-effective and radiation-free imaging is essential for optimal patient care. Therefore, this study was designed to assess the diagnostic performance of ultrasonography in identifying acute appendicitis among young adults presenting to Mardan Medical Complex, with the objective of determining its accuracy and clinical value within this population.

METHODS

The study was conducted as a descriptive cross-sectional investigation in the Radiology Department of Mardan Medical Complex, Khyber Pakhtunkhwa, Pakistan, over a period of six months. A total of 132 young adults who presented with clinical suspicion of acute appendicitis were enrolled through non-probability convenience sampling. All participants who were referred for ultrasonography by the surgical or emergency teams and fell within the young adult age range were eligible for inclusion. Patients with a prior history of appendectomy, known abdominal malignancy, or incomplete clinical or imaging records were excluded to maintain diagnostic accuracy and eliminate potential confounders. Each patient underwent a standardized ultrasonographic examination performed by qualified radiology personnel using the graded-compression technique, allowing consistent evaluation of appendix morphology and peri-appendiceal changes (11). Data were collected prospectively using a structured proforma that recorded demographic variables, clinical presentation, and ultrasonographic findings. All ultrasonography scans were interpreted according to predefined diagnostic criteria for acute appendicitis, including appendiceal diameter, wall thickness, compressibility, and associated inflammatory features. Ethical approval was obtained from the Institutional Review Board of Mardan Medical Complex and written informed consent was secured from all participants prior to enrolment, ensuring adherence to ethical research standards and patient autonomy. Data analysis was carried out using SPSS version 22.0. Descriptive statistics such as frequencies, percentages, and means were computed to summarize the demographic and clinical characteristics of the study population. The chi-square test was applied to determine associations between categorical variables and ultrasonographic findings, with a significance level set at $p < 0.05$. All findings were interpreted in the context of the study design and the diagnostic purpose of ultrasonography.

RESULTS

The study included 132 young adults with a mean age of 24.13 ± 3.9 years. The sample predominantly comprised females, who constituted 69.7% of the participants, while males represented 30.3%. Among female participants, 18.9% were pregnant, whereas 81.1% were non-pregnant. These distributions reflect the demographic characteristics of individuals presenting with clinically suspected acute appendicitis during the study period. Ultrasonography findings demonstrated variation in the visualization and appearance of the

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appendix. A proportion of participants had the appendix clearly visualized on ultrasound, while others showed non-visualization, consistent with common sonographic limitations. The ultrasonographic appearance of the appendix varied across patients, with some demonstrating typical features of acute inflammation and others showing normal or inconclusive appearances. Additional findings, including peri-appendiceal fluid, bowel gas interference, or secondary inflammatory signs, were observed in a subset of cases, contributing to the diagnostic assessment. Ultrasonography successfully visualized the appendix in the majority of participants, with 122 patients demonstrating a clearly visualized appendix, while non-visualization occurred in 10 cases. Among those with a visualized appendix, enlarged appendices were the most frequently noted abnormality (78 cases), followed by thickened walls in 30 patients and perforation in 15 patients. Only 9 participants exhibited a normal sonographic appearance of the appendix. Additional ultrasonographic findings further supported inflammatory processes, including free intraperitoneal fluid in 57 patients, abscess formation in 40 patients, and features of intestinal obstruction in 36 patients.

Table 1: Baseline Characteristics of Participants

Variable	**Value**
Age (Mean ± SD)	24.13 ± 3.9
Gender	
Male	30.3%
Female	69.7%
Pregnancy	
Pregnant	18.9%
Non-Pregnant	81.1%

Table 2: Sonographic Characteristics of Participants

Parameter	**Finding**	**Frequency (n)**	**Percentage (%)**
Appendix Visualization	Visualized	122	92.4%
	Not Visualized	10	7.6%
Appearance of Appendix	Enlarged	78	59.1%
	Thickened	30	22.7%
	Perforated	15	11.4%
	Normal	9	6.8%
Additional Sonographic Findings	Free Fluid	57	43.2%
	Abscess	40	30.3%
	Intestinal Obstruction	36	27.3%

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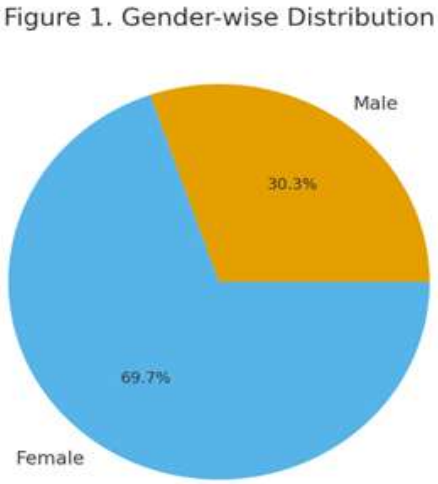

Figure 1 Gender-wise Distribution

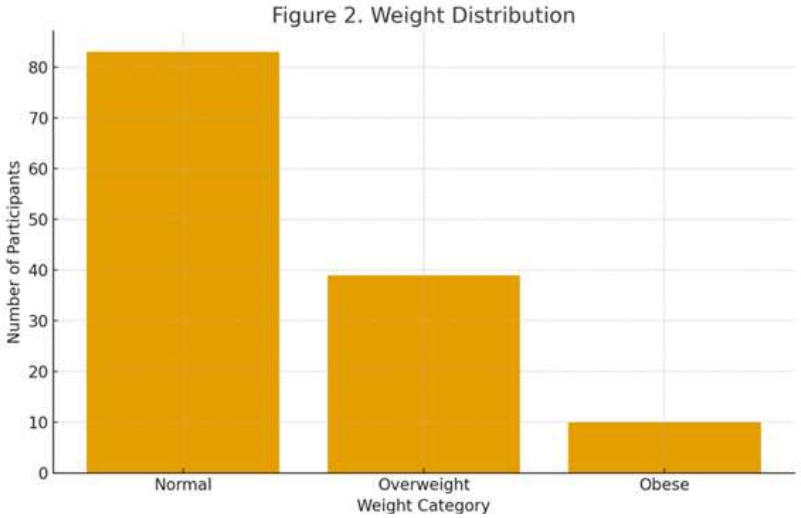

Figure 1 Weight Distribution

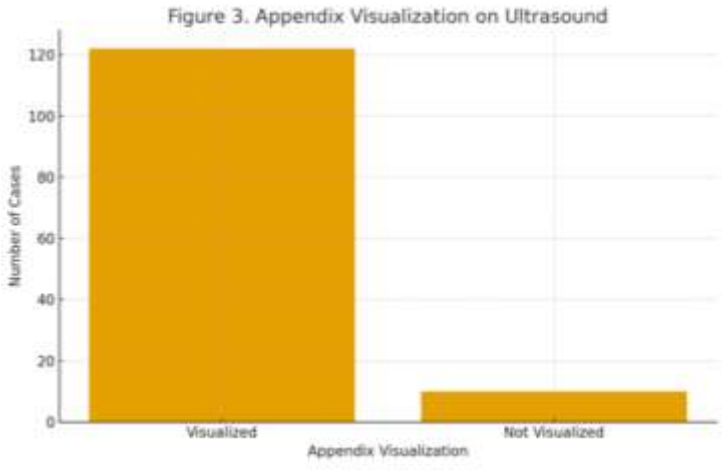

Figure 3 Appendix Visualization on Ultrasound

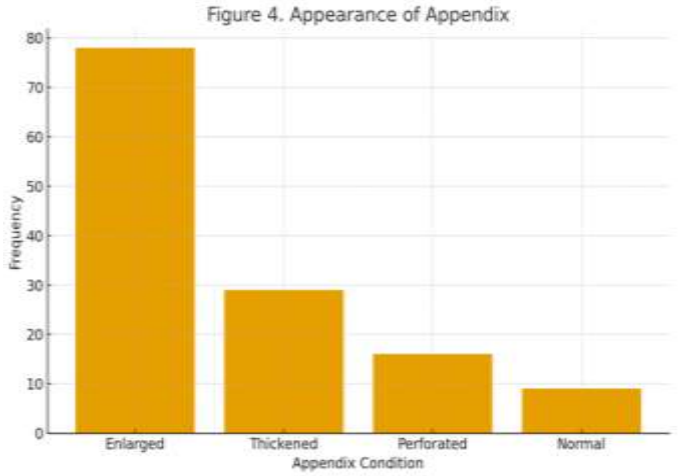

Figure 4 Appearance of Appendix

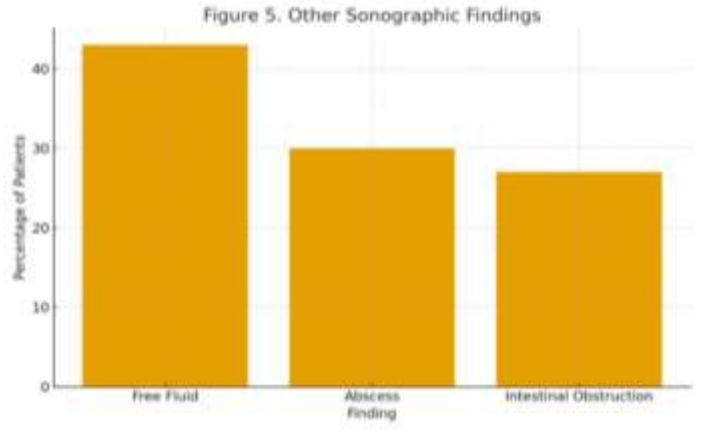

Figure 5 Other Sonographic Findings

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DISCUSSION

The findings of the present study indicate that ultrasonography served as a reliable and clinically meaningful diagnostic tool for evaluating suspected acute appendicitis in young adults. The ability to visualize the appendix in more than 92% of patients reflected a strong diagnostic yield and aligned with international evidence reporting visualization rates between 85% and 95%. This high rate of visualization strengthened the credibility of sonographic assessment in settings where radiation-free, rapid, and cost-effective imaging is essential. The predominance of enlarged and thickened appendices among visualized cases further supported the utility of ultrasound in identifying key inflammatory features consistent with acute appendicitis (12-14). Secondary findings, including free fluid, abscess formation, and signs of intestinal obstruction, contributed additional diagnostic value by highlighting associated complications and aiding clinical decision-making. When interpreted alongside previous literature, these findings reinforced the established role of ultrasonography as a dependable first-line imaging modality for suspected appendicitis. Earlier research conducted by various authors also demonstrated that ultrasound provides high diagnostic accuracy, particularly when performed using graded compression techniques and interpreted by experienced radiology personnel (15-18). The safety profile of ultrasonography remained an important advantage, especially for pregnant patients and young adults for whom radiation exposure poses significant long-term risks (19). The present study echoed these observations and further emphasized its feasibility in routine emergency practice.

However, certain limitations of the study deserve recognition. The absence of surgical or clinical confirmation limited the ability to calculate diagnostic performance indicators such as sensitivity, specificity, or predictive values. The reliance on non-probability convenience sampling introduced a risk of selection bias, which may restrict generalizability to broader populations. Operator dependency, a well-acknowledged limitation of ultrasound, may have influenced visualization rates and interpretation of subtle findings. Furthermore, inter-observer variability was not assessed, and equipment specifications were not reported, both of which could affect reproducibility of results across different clinical environments. Despite these limitations, the study demonstrated strengths, including a substantial sample size of young adults, standardized ultrasonographic assessment, and systematic documentation of both primary and secondary imaging findings. Future research would benefit from incorporating confirmatory surgical or clinical follow-up, enabling comprehensive assessment of diagnostic accuracy. Multicenter studies with blinding protocols and evaluation of inter-observer agreement would enhance methodological rigor. Comparative studies evaluating ultrasound against CT or MRI could further delineate performance differences and refine imaging algorithms for suspected appendicitis (20,21). The present study nonetheless contributes valuable evidence supporting the continued integration of ultrasonography into diagnostic pathways for acute appendicitis, particularly in resource-constrained and high-volume emergency settings where rapid, reliable, and radiation-free evaluation remains paramount.

CONCLUSION

Ultrasonography emerged as a dependable and clinically valuable tool for evaluating suspected acute appendicitis, fulfilling the study's objective of assessing its diagnostic role in young adults. Its non-invasive nature, absence of radiation exposure, and cost-effectiveness make it particularly suitable as a first-line imaging modality, especially in settings where advanced imaging resources may be limited. By enabling timely identification of inflammatory changes and associated complications, ultrasound supports more accurate clinical decision-making and helps reduce unnecessary surgical intervention. The findings underscore its practical importance in improving patient care pathways and reinforcing its continued integration into routine diagnostic practice for acute appendicitis.

AUTHOR CONTRIBUTION

Author	Contribution
Braikhna Tahir	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Aleena Umar	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing

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Author	Contribution
	Has given Final Approval of the version to be published
Savira khan	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Maham Khalid	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Muhammad Shahzeb*	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Muhammad Nauman Saleem	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

REFERENCES

1. Xiao Y, Jian G, Zhong Y, Chen J, Ye J, Chen Y, et al. Ultrasound and clinical features for differential diagnosis of low-grade appendiceal mucinous neoplasm and acute suppurative appendicitis. Med Ultrason. 2024;26(4):348-55.

2. Menon N, Kumar S, Keeler B, Pawelec K, Khanna A. A systematic review of point-of-care abdominal ultrasound scans performed by general surgeons. Surgeon. 2021;19(6):e559-e63.

3. English W, Habib Bedwani N, Smith C, Doganay E, Marsden M, Muse S, et al. Suspected appendicitis and COVID-19, a change in investigation and management-a multicentre cohort study. Langenbecks Arch Surg. 2021;406(2):357-65.

4. Khalifa M, Elhassan E, Abdel Rahim S. Schistosomal appendicitis: a case report. J Med Case Rep. 2024;18(1):283.

5. Doubova M, Cortel-LeBlanc MA, McKinnon M, Osman H, Nemnom MJ, Macdonald B, et al. Risk factors for acute appendicitis among adult patients with indeterminate ultrasound. Cjem. 2025;27(1):27-31.

6. Shieh A, Pham PK, Plouffe NA, Heyming TW. Negative Appendectomies: Evaluating Diagnostic Imaging Techniques at General versus Pediatric Emergency Departments. J Emerg Med. 2023;64(3):304-10.

7. Yalcinkaya A, Yalcinkaya A, Balci B, Keskin C, Erkan I, Yildiz A, et al. Nationwide prospective audit for the evaluation of appendicitis risk prediction models in adults: right iliac fossa treatment (RIFT)-Turkey. BJS Open. 2024;8(5).

8. Wang K, Nyandoro MG, Teoh M, Naunton-Morgan R. Emphasizing the Clinical Diagnosis of Acute Appendicitis Amidst Technological Advancements. Cureus. 2024;16(5):e60555.

9. Long B, Gottlieb M. Emergency medicine updates: Acute appendicitis in the adult patient. Am J Emerg Med. 2025;98:262-8.

10. Coccolini F, Martinez-Perez A, Licitra G, De Angelis N, Cremonini C, Strambi S, et al. Diagnostic pathways in acute appendicitis: Clinical score plus ultrasound outperform CT scan or upfront surgery, especially in doubtful cases. World J Surg. 2024;48(6):1350-9.

11. Lastunen KS, Leppäniemi AK, Mentula PJ. DIAgnostic iMaging or Observation in early equivocal appeNDicitis (DIAMOND): open-label, randomized clinical trial. Br J Surg. 2022;109(7):588-94.

12. Zhao Y, Liu H, Guo D. Diagnostic efficacy of ultrasound and computed tomography for acute appendicitis: A single center retrospective study. Medicine (Baltimore). 2025;104(13):e41968.

13. Arruzza E, Milanese S, Li LSK, Dizon J. Diagnostic accuracy of computed tomography and ultrasound for the diagnosis of acute appendicitis: A systematic review and meta-analysis. Radiography (Lond). 2022;28(4):1127-41.

14. Lehmann B, Koeferli U, Sauter TC, Exadaktylos A, Hautz WE. Diagnostic accuracy of a pragmatic, ultrasound-based approach to adult patients with suspected acute appendicitis in the ED. Emerg Med J. 2022;39(12):931-6.

15. Gokli A, Dillman JR, Humphries PD, Ključevšek D, Mentzel HJ, Rubesova E, et al. Contrast-enhanced ultrasound of the pediatric bowel. Pediatr Radiol. 2021;51(12):2214-28.

16. Babington EA. Complicated appendicitis in an adult patient. Ultrasound. 2022;30(4):333-7.

17. Alnuaymah F, Etonyeaku AC, Alsaeed HS, AlSamani AN, Alshubrmi AA, Aldoubiab RK, et al. Clinical, Radiological and Pathological Appraisal of Acute Appendicitis in Al Qassim, Saudi Arabia: A Single-Center Retrospective Analysis. Cureus. 2022;14(8):e28627.

18. Lu K, Zhong F, Miao J, Sun C, Zhou K, Wang W, et al. Assessment of diagnostic value of ultrasound and multi-slice spiral computed tomography in acute appendicitis: a retrospective study. Abdom Radiol (NY). 2025;50(3):1117-22.

19. Queiroz MRG, Jabour VA, Souza Junior JL, Paixão MR, Silva P, Kang DWW, et al. APENDIC-RADS: an ultrasound reporting system for the diagnosis of acute appendicitis. Einstein (Sao Paulo). 2024;22:eAO1164.

20. Lloyd AJ, Abd Elwahab SM, Boland MR, Elfadul A, Hill ADK, Power C. Acute complicated appendicitis caused by an ingested toothpick - A case report. Int J Surg Case Rep. 2022;92:106872.

21. Hashmi MT, Taqi I, Taqi A, Sarwar HJ. Role of ultrasonography for evaluation of acute appendicitis. Pak Armed Forces Med J. 2021;71:S255–60.