TPM Vol. 32, No. S2, 2025
ISSN: 1972-6325
https://www.tpmap.org/

Open Access

A RETROSPECTIVE COMPARATIVE STUDY OF APPENDICOLITH DETECTION BY ULTRASONOGRAPHY AND HISTOPATHOLOGICAL EXAMINATION IN PATIENTS UNDERGOING APPENDECTOMY

DR CHANDRALEKHA PAKALAPATI[1]
DR NANDITHA GUDI[1]
DR DIVYA VASIREDDY[2]
DR PRASNA S[2]

[1]DEPARTMENT OF GENERAL SURGERY, SAVEETHA MEDICAL COLLEGE HOSPITAL SAVEETHA INSTITUTE OF MEDICAL AND TECHNICAL SCIENCES (SIMATS) SAVEETHA UNIVERSITY
[2]SAVEETHA MEDICAL COLLEGE AND HOSPITAL SAVEETHA INSTITUTE OF MEDICAL AND TECHNICAL SCIENCE (SIMATS) SAVEETHA UNIVERSITY .

Abstract

Background: Acute appendicitis is one of the most common surgical emergencies worldwide. The presence of an appendicolith is an important predictive factor for disease severity, and its preoperative identification may aid clinical decision-making. Abdominal ultrasonography (USG) is widely used in evaluating suspected appendicitis, but its diagnostic accuracy for detecting appendicolith remains inconsistent across studies.

Aim: To evaluate the efficacy of ultrasonography in detecting appendicolith and to correlate sonographic findings with histopathological examination (HPE) of appendectomy specimens.

Methods: This retrospective observational study included 50 patients who underwent appendectomy at Saveetha Medical College and Hospital, Chennai, India. Patients whose HPE confirmed the presence of appendicolith were analyzed. Preoperative ultrasonography reports were reviewed and compared with postoperative HPE findings. Sensitivity and specificity were calculated using paired statistical comparison.

Results: Of 50 patients (45 males, 5 females; mean age 32.5 years), HPE confirmed appendicolith in all cases. Preoperative ultrasonography identified appendicolith in 17 patients (34%), whereas 33 cases (66%) were missed. The sensitivity of USG in detecting appendicolith was 34%, comparable to prior studies. No cases of perforation or abscess were noted intraoperatively.

Conclusion: Ultrasonography, though a valuable first-line diagnostic tool in suspected acute appendicitis, has limited sensitivity (34%) for appendicolith detection. Histopathological examination remains the gold standard, and reliance on sonography alone may underestimate appendicolith prevalence. Further prospective studies integrating CT imaging may improve diagnostic accuracy.

Keywords: Appendicitis, Appendicolith, Ultrasonography, Histopathology, Retrospective study

INTRODUCTION

Acute appendicitis is among the most frequent causes of acute abdominal pain requiring emergency surgical intervention, with a lifetime risk estimated at 7–8% globally [1]. The disease is primarily caused by luminal obstruction of the appendix, resulting in inflammation, ischemia, bacterial proliferation, and potential perforation if untreated [2]. One of the important etiological factors contributing to this obstruction is the appendicolith, a calcified concretion formed from inspissated fecal material mixed with mineral salts [3].

The clinical importance of appendicolith lies in its association with higher rates of perforation, peri-appendiceal abscess formation, complicated appendicitis, and poorer outcomes [4]. While many appendicoliths remain asymptomatic, their presence in acute appendicitis increases the risk of complications and often necessitates urgent appendectomy [5].

Imaging plays a critical role in preoperative diagnosis. Ultrasonography (USG) is widely adopted due to its safety, non-invasiveness, low cost, and lack of ionizing radiation [6]. Studies report sensitivity ranging from 80% to 91% and specificity between 92% and 97% for diagnosing acute appendicitis with ultrasonography [7]. However, its ability to detect appendicolith is less reliable, with sensitivities varying between 33% and 58% [8]. González et al. found a sensitivity of 58.1% and specificity of 78.3%, with a PPV of 33.1% [9]. In contrast, computed tomography (CT) demonstrates superior accuracy (>90%) for appendicolith detection, but concerns about radiation exposure limit its use, particularly in children and pregnant women [10].

Given these limitations, it is necessary to validate the role of USG in appendicolith detection against the gold standard—histopathological examination (HPE). This study was undertaken to evaluate the diagnostic efficacy of ultrasonography in detecting appendicolith in appendectomy patients and to correlate these findings with histopathology.

MATERIALS AND METHODS

Study Design: Retrospective observational study.

Study Population:50 patients who underwent appendectomy at Saveetha Medical College and Hospital (2022–2024).

Inclusion criteria: HPE-confirmed presence of appendicolith.

Exclusion criteria: Patients with incomplete records, prior abdominal surgery, or equivocal HPE reports.

Study Plan: Preoperative abdominal ultrasonography reports were retrospectively retrieved.Presence or absence of appendicolith on USG was noted.Findings were correlated with histopathology of appendectomy specimens.

Data Parameters: Age, gender, WBC count, intraoperative findings, USG-detected appendicolith, HPE-confirmed appendicolith.

Statistical Analysis: Data were analyzed using paired t-test.Sensitivity of USG was calculated using HPE as gold standard.p-value <0.05 was considered statistically significant.

RESULTS

A total of 50 patients who underwent appendectomy and were confirmed to have appendicolith on histopathological examination (HPE) were included in this retrospective study. The study population consisted predominantly of males (90%), with 45 men and 5 women, yielding a male-to-female ratio of 9:1. The majority of the patients (84%) were between 18 and 40 years of age, while only 16% belonged to the 41–60 years category, with a mean age of 32.5 years.

With respect to laboratory findings, 37 patients (74%) presented with a total leukocyte count below 10,000/µL, whereas 13 patients (26%) had leukocytosis above 10,000/µL. This indicated that an elevated leukocyte count was not a universal finding, and appendicolith was present even in patients with normal leukocyte values.

Preoperative ultrasonography identified the presence of appendicolith in only 17 patients (34%). In contrast, histopathological examination confirmed appendicolith in all 50 cases (100%). Thus, a significant discrepancy was observed between ultrasonographic and histopathological findings, with USG missing nearly two-thirds of cases. The calculated sensitivity of ultrasonography for detecting appendicolith was 34%, and the difference between USG and HPE findings was statistically significant ($p < 0.0001$).

Intraoperative examination corroborated the presence of appendicolith in all patients, although none of the patients demonstrated complications such as perforation or abscess formation at the time of surgery. The absence of complications likely reflects timely surgical intervention in this cohort.

Overall, the findings highlight the limitations of ultrasonography as a diagnostic tool for appendicolith detection. While HPE confirmed the universal presence of appendicolith in this series, ultrasonography underperformed in comparison, demonstrating poor sensitivity despite its value as a first-line modality in suspected appendicitis.

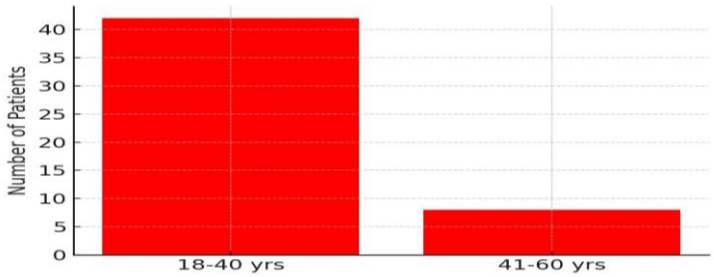

Figure 1. Age distribution of study population

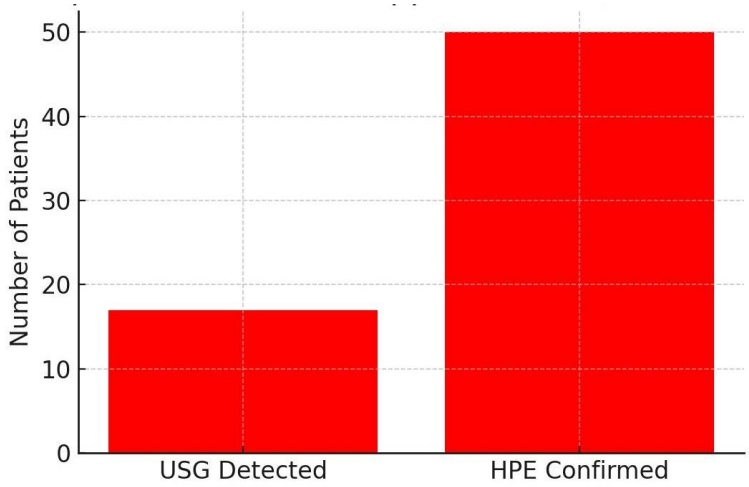

Figure 2. Detection of appendicolith in both modalities

DISCUSSION

Our study demonstrated that ultrasonography detected appendicolith in only **34%** of cases compared to 100% confirmation on HPE, emphasizing its limited sensitivity. These results are consistent with González et al., who reported a sensitivity of 58.1% and specificity of 78.3% for appendicolith on ultrasonography [9]. This highlights the ongoing challenge of relying solely on USG for appendicolith detection.

Several factors contribute to this low sensitivity. First, ultrasonography is highly operator-dependent, and adequate visualization of calcified deposits requires significant expertise [11]. Second, patient-related factors such as obesity, retrocecal appendix location, and bowel gas often hinder optimal imaging [12]. Third, small appendicoliths may fail to generate sufficient acoustic shadowing, making them difficult to detect [13].

In contrast, CT scans consistently show superior diagnostic performance, with reported sensitivities exceeding 90% and higher accuracy in complicated appendicitis [14,15]. However, CT is limited by radiation risks, especially in pediatric and obstetric populations, restricting its widespread use [16]. Despite these limitations, ultrasonography remains the first-line imaging modality due to its accessibility and diagnostic utility in appendicitis, even if its accuracy for appendicolith is suboptimal [17].

Previous reports also highlight the clinical relevance of appendicolith. Kaya et al. described different presentations of appendicolithiasis, ranging from asymptomatic cases to severe peritonitis [3]. Studies have consistently shown that appendicolith increases the risk of perforation, abscess formation, and treatment failure in conservative management [18,19]. In our series, no perforation or abscess was observed, likely due to early surgical intervention, underscoring the importance of prompt appendectomy [20].

The clinical implication of our findings is clear: USG should not be relied upon exclusively for appendicolith detection. Instead, a multimodal diagnostic strategy incorporating clinical examination, laboratory parameters, and adjunctive imaging (CT/MRI where appropriate) is recommended [21,22]. Histopathology remains the gold standard, providing definitive diagnosis and guiding postoperative management [23].

Limitations of our study include its retrospective design, relatively small sample size, and single-center setting. Nevertheless, our findings align with the global evidence base and emphasize the need for prospective multicenter trials [24,25].

CONCLUSION

This retrospective study highlights the limited role of ultrasonography in detecting appendicolith among patients undergoing appendectomy. While ultrasonography identified appendicolith in only 34% of cases, histopathology confirmed its presence in all specimens. The findings underscore the low sensitivity of USG for appendicolith compared to its high accuracy in diagnosing appendicitis.

Although USG remains the preferred initial imaging modality due to its safety, accessibility, and diagnostic utility in appendicitis, clinicians should exercise caution in relying on it for appendicolith detection. Histopathological examination remains the gold standard, and CT should be considered when appendicolith detection is clinically significant. Early surgical intervention continues to play a pivotal role in reducing complications associated with appendicolith.

Future research with larger sample sizes and comparative imaging modalities is necessary to refine diagnostic strategies and improve preoperative appendicolith detection rates.

REFERENCES

1) Bhangu A, Søreide K, Di Saverio S, Assarsson JH, Drake FT. Acute appendicitis: modern understanding of pathogenesis, diagnosis, and management. Lancet. 2015;386(10000):1278–87. doi:10.1016/S0140-6736(15)00275-5
2) Ferris M, Quan S, Kaplan BS, Molodecky N, Ball CG, Chernoff GW, et al. The global incidence of appendicitis: a systematic review of population-based studies. Ann Surg. 2017;266(2):237–41. doi:10.1097/SLA.0000000000002188
3) Kaya B, Eris C. Different Clinical Presentation of Appendicolithiasis: The Report of Three Cases and Review of the Literature. Clin Med Insights Pathol. 2011;4:1–4. doi:10.4137/CPath.S6412
4) Rabinowitz CB, Egglin TK. Prevalence of appendicoliths detected at CT in adults with suspected appendicitis. Radiology. 2018;289(1):104–9. doi:10.1148/radiol.2018171927
5) Singh JP, Mariadason JG. Role of the faecolith in modern-day appendicitis. Ann R Coll Surg Engl. 2013;95(1):48–51. doi:10.1308/003588413X13511609954851
6) Doria AS, Moineddin R, Kellenberger CJ, Epelman M, Beyene J, Schuh S, et al. US or CT for diagnosis of appendicitis in children and adults? A meta-analysis. Radiology. 2006;241(1):83–94. doi:10.1148/radiol.2411050913
7) Terasawa T, Blackmore CC, Bent S, Kohlwes RJ. Systematic review: computed tomography and ultrasonography to detect acute appendicitis in adults and adolescents. Ann Intern Med. 2004;141(7):537–46. doi:10.7326/0003-4819-141-7-200410050-00011
8) Baldisserotto M, Marchiori E. Accuracy of noncompressive sonography of acute appendicitis: review of 175 cases. AJR Am J Roentgenol. 2000;175(6):1539–42. doi:10.2214/ajr.175.6.1751539
9) González DO, Lawrence AE, Cooper JN, Sola R, Garvey EM, Weber BC, et al. Can ultrasound reliably identify complicated appendicitis in children? J Surg Res. 2018;229:76–81. doi:10.1016/j.jss.2018.04.065
10) Kim HY, Park JH, Lee SS, Kim AY, Yang SK, Yu CS, et al. Ultrasonography for suspected appendicitis: diagnostic performance and predictive values of secondary signs. J Ultrasound Med. 2014;33(3):585–93. doi:10.7863/ultra.33.3.585
11) Rettenbacher T, Hollerweger A, Gritzmann N, Gotwald T, Schwamberger K, Ulmer H. Appendicitis: should diagnostic imaging be performed if the clinical presentation is highly suggestive? Gastroenterology. 2002;123(4):992–8. doi:10.1053/gast.2002.35977
12) Keyzer C, Zalcman M, De Maertelaer V, Coppens E, Bali MA, Gevenois PA, et al. Comparison of US and unenhanced multi-detector row CT in patients suspected of having acute appendicitis. Radiology. 2005;236(2):527–34. doi:10.1148/radiol.2362040826
13) Kim K, Lee CC, Song KJ, Kim W, Suh G, Lee JH, et al. The impact of helical computed tomography on the negative appendectomy rate: a multi-center comparison. J Emerg Med. 2008;34(1):3–6. doi:10.1016/j.jemermed.2007.05.043
14) Pinto F, Pinto A, Russo A, Coppolino F, Bracale R, Fonio P, et al. Accuracy of ultrasonography in the diagnosis of acute appendicitis in adult patients: review of the literature. Crit Ultrasound J. 2013;5 Suppl 1:S2. doi:10.1186/2036-7902-5-S1-S2

15) Krishnamoorthi R, Ramarajan N, Wang NE, Newman B, Rubesova E, Barth RA, et al. Effectiveness of a staged US and CT protocol for the diagnosis of appendicitis in children. Radiology. 2011;259(1):231–9. doi:10.1148/radiol.10100984
16) Lane MJ, Mindelzun RE, Jeffrey RB Jr, Katz DS. Appendicolith revealed on CT in adults with suspected appendicitis: clinical significance. AJR Am J Roentgenol. 1998;171(5):1171–4. doi:10.2214/ajr.171.5.9798856
17) Pickhardt PJ, Levy AD, Rohrmann CA Jr, Kende AI. Primary neoplasms of the appendix: radiologic spectrum of disease with pathologic correlation. Radiographics. 2003;23(3):645–62. doi:10.1148/rg.233025073
18) Smink DS, Finkelstein JA, Kleinman K, Fishman SJ. The effect of hospital volume of appendectomies on length of stay and complications in children. Pediatrics. 2004;113(1 Pt 1):21–7. doi:10.1542/peds.113.1.21
19) Atema JJ, Gans SL, Van Randen A, Laméris W, van Es HW, van Heesewijk HP, et al. Accuracy and interobserver variation of CT, MRI, and US in diagnosing appendicitis: systematic review and meta-analysis. Radiology. 2015;275(1):97–109. doi:10.1148/radiol.14140890
20) Paulson EK, Kalady MF, Pappas TN. Clinical practice. Suspected appendicitis. N Engl J Med. 2003;348(3):236–42. doi:10.1056/NEJMcp013351
21) Gorter RR, Eker HH, Gorter-Stam MA, Abis GS, Acharya A, Ankersmit M, et al. Diagnosis and management of acute appendicitis. EAES consensus development conference 2015. Surg Endosc. 2016;30(11):4668–90. doi:10.1007/s00464-016-5245-7
22) Mostbeck G, Adam EJ, Nielsen MB, Claudon M, Clevert D, Nicolau C, et al. How to diagnose acute appendicitis: ultrasound first. Insights Imaging. 2016;7(2):255–63. doi:10.1007/s13244-016-0469-6
23) Jones MW, Lopez RA, Deppen JG. Appendicitis. StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 [cited 2025 Aug 20]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK493193/
24) Snyder MJ, Guthrie M, Cagle S. Acute appendicitis: efficient diagnosis and management. Am Fam Physician. 2018;98(1):25–33. PMID: 30215934
25) Buckius MT, McGrath B, Monk J, Grim R, Bell T, Ahuja V. Changing epidemiology of acute appendicitis in the United States: study period 1993–2008. J Surg Res. 2012;175(2):185–90. doi:10.1016/j.jss.2011.07.017