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Sensitivity & Specificity Of Ultrasonography In Evaluation Of Acute Appendicitis With Histopathological Correlation

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Abstract

Introduction: *Acute appendicitis (AA) is a common cause of abdominal pain encountering unnecessary surgeries in emergency departments. The present study aims to assess the accuracy of abdominal ultrasound in suspected acute appendicitis cases in terms of sensitivity, and specificity with histopathology.*

Methods: *This cross-sectional study was conducted at the Department of Radiology and Imaging, Combined Military Hospital Sylhet, Bangladesh. The study duration was 3 years; from July 2020 to June 2023. 106 patients admitted to the emergency room with clinical symptoms of suspected acute appendicitis were considered study subjects per inclusion criteria. Patients underwent USG of the abdomen and histopathological analysis of the specimen of the appendix after appendicectomy. A simple random sampling technique was used in this study. Each patient's age, sex, sonography report, and histopathological results were collected in a data collection sheet. The data were analyzed at a 95% confidence interval using Statistical Package for the Social Sciences (SPSS) Version 24.*

Result: *In this study, the majority of the patients (45.28%) were from the 26-35 years age group, followed by 29.25% who were over 36 years of age. Most of the patients (54.72%) were male and the rest (45.28%) were female. All 106 patients presented with a tenderness of the right iliac fossa. The majority of the patients (80.19%) experienced migration of pain to the right iliac fossa, followed by 71.70% who had nausea and vomiting. Evaluating the correlation between histopathology and ultrasonography, 88 cases were correctly identified as positive for appendicitis by both methods (true positives), while ultrasonography yielded 6 false positives and missed 2 cases that were confirmed by histopathology (false negatives); 10 cases were accurately identified as negative for appendicitis by both methods (true negatives). The diagnostic performance of ultrasonography revealed high sensitivity at 98.33%, specificity at 90.0%, and overall accuracy of 94.7% in diagnosing acute appendicitis.*

Conclusion: *This study concluded that, though histopathology is the gold standard method, ultrasound also plays an active role in early diagnosis, with a sensitivity of 97.8%, specificity of 62.5%, and accuracy of 92.3%*

Keywords: *Acute Appendicitis, Sensitivity, Specificity, USG, Histopathology*

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I. INTRODUCTION

Acute appendicitis (AA) is considered one of the most common causes of surgical emergencies worldwide. [1] The reported mortality rate is from <1% in younger patients up to 5% in the elderly. [2][3]

Abdominal pain is one of the most common causes of acute appendicitis, yet 34% of cases [4][5] are still misdiagnosed, which results in unnecessary surgery. This high rate of negative appendectomy can be decreased by careful and accurate diagnosis of appendicitis, thus preventing acute appendicitis from progressing to perforation and peritonitis. Despite ultrasonogram (USG) confirmed low diagnostic accuracy, the USG has been listed as a potential method for diagnosing AA because it does not require radiation. However, despite being a non-ionizing process, the question remains whether the USG can contribute to the management of patients with AA suspicion without causing further management delays. [6] In the past 2 decades, the negative appendectomy rate has been relatively constant with a slight decline after 2000, but the rate of perforated appendicitis seems to be increasing [7]. This high rate can be decreased by careful and accurate diagnosis of appendicitis thus preventing acute appendicitis to progress to perforation and peritonitis. [8] Ultrasound is highly sensitive and specific for the diagnosis of not only acute appendicitis but also other conditions that cause right lower quadrant pain. It was not possible to routinely evaluate acute appendicitis till the development of high-resolution real-time sonography. But at present with the availability of high-frequency transducers, it is easier to diagnose appendicular pathologies owing to its better resolution. [9] In young men, the limited number of alternative diagnoses usually permits a high degree of diagnostic accuracy. It is generally accepted that, in men, the negative appendicectomy rate should be below 20%, and rates of 10%-15% are commonly reported. [10] In contrast, young women far more commonly have an acute gynecologic illness, symptoms of which may closely mimic the clinical findings of appendicitis. As a result, the reported negative appendectomy rate in ovulating women remains disturbingly high and ranges from 34%- 46%. [11] The major factors contributing to this continued high negative appendicectomy rate have been the nonspecificity of clinical findings and the lack of a readily available technique allowing direct visualization of the appendix and identification of specific diagnostic features of appendicitis. In a recent ultrasonographic study, a high-resolution linear array transducer and graded compression technique were used in evaluating the appendix. [12] When the diagnosis of acute appendicitis is clinically obvious based on strongly positive clinical signs, it can be an indication for operative treatment. However, in the cases of equivocal diagnosis Ultrasonography should be used as an adjunct to clinical diagnosis and thereby decreasing the rates of negative laparotomies. [13] The degree of inflammation can lead to inconsistent clinical presentation. It has been reported that the perforation risk in acute appendicitis can increase by 5% every 12 h, meaning that an appendectomy should be performed no later than 36 h after a diagnosis of acute appendicitis is confirmed. [14] Therefore, any delay in diagnosis can lead to adverse effects such as perforation and wound abscesses. So, this aimed to assess the sensitivity and specificity of USG in patients having acute appendicitis.

OBJECTIVE

General Objective

- To assess the sensitivity and specificity of USG in patients having acute appendicitis.

Specific Objectives

- To see the age and sex distribution of patients having acute appendicitis.
- To know the presenting complaints of the respondents.
- To assess the correlation between histopathology ultrasonography and the report of the subjects.

II. METHODS

This cross-sectional study was conducted at the Department of Radiology and Imaging, Combined Military Hospital Sylhet, Bangladesh. The study duration was 3 years; from July 2020 to June 2023. 106 patients admitted to the emergency room with clinical symptoms of suspected acute appendicitis were considered study subjects per inclusion criteria. Patients underwent USG of the abdomen and histopathological analysis of the specimen of the appendix after appendicectomy. A simple random sampling technique was used in this study. Each patient's age, sex, sonography report, and histopathological results were collected in a data collection sheet. All USG examinations were performed using Philips Affinity 70. Either a curvilinear transducer (at 3.5 MHz) or a linear transducer (at 5–7 MHz) was used, depending on the patient's weight, and a graded compression technique was used to diagnose appendicitis. Diagnostic features, including the diameter of the appendix ≥7 mm, free fluid, lack of compressibility, no appendix seen, normal appearance, and thick wall, were recorded for each patient. The histopathology test involved both macroscopic and microscopic examinations of the surgically-removed appendix. The features assessed included signs of acute inflammation, chronic inflammation, and luminal obstruction. The descriptive statistics of frequency and percentage were used to summarize the data. We calculated the diagnostic accuracy measures as follows: sensitivity (ability to correctly report images with appendicitis), and specificity (ability to correctly classify images without appendicitis as being normal). The data were analyzed at a 95%

confidence interval using Statistical Package for the Social Sciences (SPSS) Version 24. Informed written consent was taken from each patient and all data were kept confidential.

Inclusion Criteria:

- Patients of 15-80 years of age.
- Patients who are admitted to the emergency room with clinical symptoms of suspected acute appendicitis.
- Patients who had given consent to participate in the study.

Exclusion Criteria:

- Patients who had contraindications of appendicectomy.
- Pregnant women.
- Patients who were kept on observation.
- Patients who did not give consent to participate in the study.

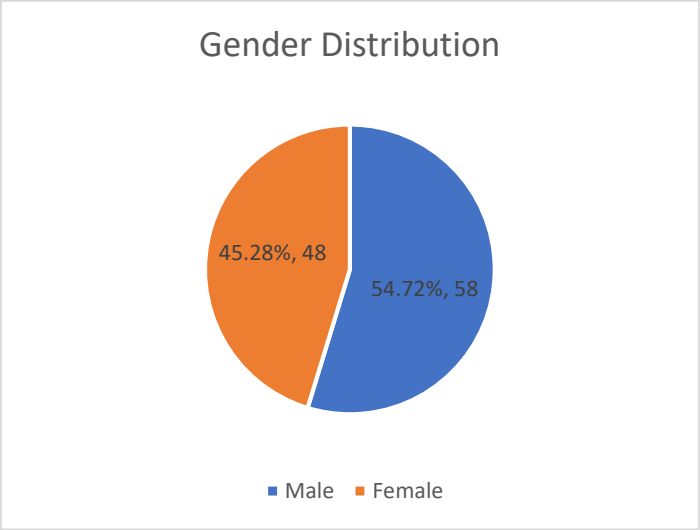
III. RESULTS

Table 1: Age distribution of the study subjects (N=106)

Age (years)	N	%
15-25	27	25.47%
26-35	48	45.28%
>36	31	29.25%

In this study, the majority of the patients (45.28%) were from the 26-35 years age group, followed by 29.25% from the oldest age group of >36 years, and 25.47% being from the youngest age group.

Figure 1: Gender distribution of the respondents (N=106)



This study showed that most of the patients (58, 54.72%) were male and the remaining 48 (45.28%) were female.

Table 2: Distribution of respondents according to presenting complaints (N=150)

Presenting Complaints	N	%
Fever	37	34.91%
Anorexia	30	28.30%
Nausea & Vomiting	76	71.70%
Tenderness in right iliac fossa	106	100.00%

Migration of pain to the right iliac fossa	85	80.19%
Rebound tenderness	45	42.45%

In this study, all of the patients (106,100.0%) presented with the tenderness of right iliac fossa. The majority of the patients (80.19%) experienced migration of pain to the right iliac fossa, followed by 76 (71.70%) who had nausea and vomiting.

Table 3: Distribution of patients based on the correlation between histopathology and ultrasonography report (N=106)

Ultrasonography	Histopathology Diagnosis		
	Appendicitis (N)	Non appendicitis (N)	Total
Positive	True positive (88)	False positive (6)	94
Negative	False negative (02)	True negative (10)	12
Total	90	16	106

Among the cases, 88 were correctly identified as positive for appendicitis by both methods (true positives), while 6 were incorrectly identified as positive by ultrasonography but not confirmed by histopathology (false positives). Additionally, 2 cases were missed by ultrasonography but correctly diagnosed as appendicitis by histopathology (false negatives), and 10 cases were accurately identified as negative for appendicitis by both methods (true negatives).

Table 4: Sensitivity, specificity, and accuracy of ultrasonography (N=106)

	Ultrasonography
Sensitivity	97.8%
Specificity	62.5%
Accuracy	92.3%

This table showed that the sensitivity, specificity, and overall accuracy of diagnosing acute appendicitis through ultrasonography were 97.8%, 62.5%, and 92.3%, respectively.

IV. DISCUSSION

The study investigated the utility of ultrasonography in diagnosing acute appendicitis while correlating the results with histopathological findings. In this study, the majority of patients (45.28%) fell within the age group of 26-35 years, followed by 29.25% who were over 36 years of age. In a study by Alelyani M et al. [15], the majority of patients (59.8%) were found to be between 21 to 40 years old. This current study revealed that a predominant proportion of patients (54.72%) were male, while the remaining (45.28%) were female. Similar male predominance was evident in another study conducted by Nshuti R et al. [16], where out of a total of 146 admitted patients with an average age of 26 years (SD = 12 years), the male-to-female ratio was 1.6:1. Regarding clinical presentation, all 106 patients (100.0%) exhibited tenderness in the right iliac fossa. Alongside this, the majority (85, 80.19%) experienced pain migrating to the right iliac fossa, followed by nausea and vomiting (76, 71.70%). Another study by Nshuti R et al. [16] indicated that 63% of patients presented two days after symptom onset. In a separate study involving 323 patients, 185 were male and 138 were female, yielding a sex ratio of 1.37. The most common presenting symptoms were abdominal pain (97.5%), vomiting (44%), and anorexia (39.9%). Hyperthermia was observed in 99.7% of patients, with tenderness on palpation in the right iliac fossa noted in 307 patients [17]. In this current study, the correlation between histopathology and ultrasonography showed that 88 cases were correctly identified as positive for appendicitis by both methods (true positives), while ultrasonography incorrectly identified 6 cases as positive that were not confirmed by histopathology (false positives). Additionally, 2 cases were missed by ultrasonography but correctly diagnosed as appendicitis by histopathology (false negatives), and 10 cases were accurately identified as negative for appendicitis by both methods (true negatives). These findings determined the sensitivity, specificity, and accuracy of the ultrasonography at 97.8%, 62.5%, and 92.3% respectively. Fu J et al. [18] reported an overall sensitivity of 77.2% (95% CI – 75.4–78.9%) and specificity of 60% (95% CI – 58–62%) for ultrasonography. In another study, the overall accuracy of sonography in diagnosing acute appendicitis was 94%, with sensitivity and specificity rates of 95.12% and 88.88%, respectively [19]. The overall specificity and sensitivity rates were consistent with the findings of Skanne et al [20], Hahn et al [21], Tarzan Z et al [22], and Puylaert et al [23], where specificity values ranged from 90% to 100% and

sensitivity ranged from 70% to 95%. These results are also in line with Tauro LF et al's [24] study, which reported a sensitivity of 91.37%, specificity of 88.09%, positive predictive value of 91.37%, negative predictive value of 88.09%, and diagnostic accuracy of 90%. Acute appendicitis stands as the most common acute abdominal condition necessitating emergency surgery. Combining clinical signs and symptoms with ultrasonography findings significantly enhances diagnostic accuracy. Ultrasonography aids in identifying alternative causes of right iliac fossa pain, thereby excluding appendicular pathology [19].

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

V. CONCLUSION

This study concluded that, though histopathology is the gold standard method, ultrasonography can also be used for non-invasive diagnosis of appendicitis, as it shows significant accuracy of diagnosis in patients with suspected acute appendicitis with high sensitivity (97.8%) and accuracy (92.3%) but somewhat low specificity (62.5%). Thus, it helps in reducing the number of negative appendicectomies. Quality assurance for patients with suspected appendicitis should aim to minimize the negative appendectomy rate without a delay in the treatment of perforated appendicitis.

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VI. RECOMMENDATION

When patients with AA are misdiagnosed as not having the condition, a mandatory appendectomy may be postponed, and severe complications may occur, with a mortality rate of about 1.5%. So, it is essential to correctly identify AA in patients who exhibit symptoms and signs suggestive of the condition. Moreover, further studies should be conducted involving a large sample size and multiple centers.

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