

Ultrasonic evaluation of patients with clinical suspicion of acute appendicitis

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Abstract

Background: Acute appendicitis is a highly prevalent disease that needs timely and accurate diagnosis. USG has been suggested as the first imaging modality for its diagnosis. The present hospital-based study describes the experience with ultrasound evaluation of patients with clinical suspicion of acute appendicitis at a rural tertiary care centre in Kerala state in India. **Methods:** This study included 215 patients attending the tertiary care centre during the one and half year study duration with suspected acute appendicitis on clinical evaluation. The sonographic examination was based on the graded compression technique proposed by Puylaer. A detailed histological analysis was performed on all surgically removed appendices, which formed the basis of definitive judgement. Final discharge records were reviewed for the patients who did not have appendicitis. In the group that did not undergo surgery, the final diagnosis was substantiated by combining clinical findings and radiological follow-up. Sensitivity, specificity, positive and negative predictive value, and overall accuracy parameters for USG in acute appendicitis diagnosis were described. **Results and Conclusions:** The maximum number of cases, i.e. 72 (33.5%), belonged to the age group in the third decade of life. The mean age was 25.4 years. Out of 215 total suspected cases, 150 (69.8%) were males, and 65 (30.2%) were females with a male: female ratio of 2.3:1. In 68% of cases, ultrasound suggested a diagnosis, whereas, in 32% of cases, no diagnosis was suggested by USG. The sensitivity of USG was found to be 90.3%, sensitivity was 92.3%, positive predictive value was 92.1%, and the negative predictive value was 91.2%. Overall accuracy was found to be 91.6%. The study results reflect a reasonable degree of sensitivity, specificity, and accuracy of the ultrasound evaluation for suspected acute appendicitis patients.

Keywords: Appendicitis, ultrasonography.

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INTRODUCTION

Acute appendicitis is a highly prevalent disease that needs timely and accurate diagnosis. The lifetime probability of suffering from this commonest abdominal emergency is about 7%. The disease's presentation, often atypical, makes it difficult to diagnose as the symptoms are not very

specific and similar to various other conditions.¹⁻⁴ In this scenario, the imaging modalities play an essential role in the diagnosis of acute appendicitis. The imaging options include ultrasonography (USG), computed tomography (CT) and magnetic resonance imaging (MRI). Although the sensitivity and specificity of CT and MRI are more, there is a need to balance the exposure to ionising radiation and the financial aspect. So, USG has been suggested as the first imaging modality.²⁻⁴ The present hospital-based study describes the experience with ultrasound evaluation of patients with clinical suspicion of acute appendicitis at a rural tertiary care centre in Kerala state in India.

METHODS

This study included 215 patients attending the tertiary care centre during the two years of study duration with suspected acute appendicitis on clinical evaluation. The

sonographic examination was done using state of the art real-time greyscale ultrasound equipment GE Logic 400 Pro with a 7.5 MHz mechanical transducer. The method of assessment was based on the graded compression technique proposed by Puylaert⁵. If an abnormal appendix was not identified on the initial examination, the transducer was removed, and the patient was asked to indicate the point of maximum tenderness. Scanning was then resumed at the new location. In addition to the right lower quadrant, the entire abdomen and pelvis were examined to look for alternative diagnoses, especially in those patients without evidence of acute appendicitis. This examination of the abdomen and pelvis was carried out with a 3.5 MHz sector probe. The USG findings were recorded at the time of examination. Appendicitis was diagnosed if the appendix was visualised and not compressible, sausage-shaped, and blind-ended; if maximal cross-sectional diameter with compression exceeded 6mm or if an appendicolith or complex mass was noted.^{6,7} Non-visualization of the appendix was recorded as a negative result. The decision for operative versus nonoperative management was based solely on the clinical judgement of the surgeon responsible for the patient. However, the findings at ultrasonography were known to the surgeon. A detailed histological examination was performed on all surgically removed appendices, which formed the basis of definitive judgement. Final discharge records were reviewed for the patients who did not have appendicitis. In the group that did not undergo surgery, the final diagnosis was substantiated by a combination of clinical findings and radiological follow-up. In those cases, where no definitive diagnosis could be confirmed, the diagnosis was abdominal pain of unknown origin. To determine diagnostic accuracy of sonography in acute appendicitis, the following criteria were considered.

Sensitivity = True positive/(True positive + false negative)*100%

Specificity = True negative/(True negative+false positive)*100%

Predictive value of positive result = True positive/(True positive + false positive)*100%

Predictive value of negative result = True negative/(True negative + false negative)*100%.

Overall accuracy = (True positive+True negative)/(True positive + True negative + false positive + false negative)*100%

Observations

Table 1 shows the age and sex-wise distribution of suspected cases of acute appendicitis. The maximum number of cases, i.e. 72 (33.5%), belonged to the age group in the third decade of life. The youngest patient was four years old, and the most geriatric patient examined was 70 years old. The mean age was 25.4 years. Out of 215 total suspected cases, 150 (69.8%) were males, and 65 (30.2%) were females with a male: female ratio of 2.3:1. Table 2 shows the final and ultrasonic diagnoses in the 215 patients of suspected cases of acute appendicitis. Out of 215 suspected patients, 103 (47.9%) had been finally diagnosed with acute appendicitis. The mean outer diameter of the inflamed appendix was 9 +/- 2.2 mm. Table 3 shows the parameters for sensitivity, specificity and accuracy analysis of USG in acute appendicitis. In 68% of cases, ultrasound suggested a diagnosis, whereas, in 32% of cases, no diagnosis was suggested by USG. The sensitivity of USG was found to be 90.3%, specificity was 92.3%, positive predictive value was 92.1%, and the negative predictive value was 91.2%. Overall accuracy was found to be 91.6%.

Table 1: Age and sex wise distribution of suspected cases of acute appendicitis

Age (years)	Sex		Total	Percentage
	Male	Female		
0 to 10	18	05	23	10.7%
11 to 20	46	19	65	30.2%
21 to 30	49	23	72	33.5%
31 to 40	26	12	38	17.7%
41 to 50	03	03	06	2.8%
51 to 60	03	02	05	2.3%
61 to 70	05	01	06	2.8%
Total	150	65	215	100%

Table 2: Final and ultrasonic diagnoses in suspected cases of acute appendicitis

Final Diagnosis	Number of cases	Sonography report*	
		Positive	Negative
Acute appendicitis	103	93	10
Mesenteric adenitis	13	05	08
GI disorders	09	07	02
Gynecological and Pelvic Disorders	09	08	01

Urinary Tract disorders	28	28	0
Biliary disorders	04	04	0
Parietal wall lesion	01	01	0
Non-specific abdominal pain	48	-	48
Total	215	146 (68%)	69 (32%)

*Ultrasonography

Positive: Final diagnosis was suggested on ultrasound; **Negative:** Final diagnosis not suggested on ultrasound.**Table 3:** Results of ultrasound in suspected cases of acute appendicitis

Ultrasound Diagnosis	Number of patients	Comments
True Positive	93	Operative treatment in 72 cases. Antibiotic therapy and clinical follow up in 21 patients.
True Negative	104	Operative confirmation in 14 cases.
False Negative	10	Confirmed operatively.
False Positive	08	Confirmed operatively.
Total	215	--

DISCUSSION

The sensitivity of USG was found to be 90.3%, sensitivity was 92.3%, positive predictive value was 92.1%, and the negative predictive value was 91.2%. Overall accuracy was found to be 91.6%. A recent similar study from Maharashtra evaluated USG in 100 cases of suspected acute appendicitis and reported that sensitivity was 96.5%, specificity was 85.7%, positive predictive value was 98.8%, and the negative predictive value was 66.7%. The overall accuracy of USG was reported to be 95.7%⁸. Terasawa and coworkers reviewed 14 studies regarding the role of graded compression USG for the diagnosis of acute appendicitis. They found an overall sensitivity of 86%, a specificity of 81%, a positive predictive value of 84%, and a negative predictive value of 85%⁹. Also, Yu SH *et al.* from Korea reviewed 22 articles on the role of graded compression ultrasound in the diagnosis of acute appendicitis. They found that overall sensitivity was 86.7% and specificity was 90%. They suggested that ultrasound was particularly useful in young, male and highly clinically suggestive cases of acute appendicitis¹⁰. Abu Yousef *et al.* study reported the ultrasound diagnosis of appendicitis sensitivity as 80 % and specificity as 95%¹¹. Ramachandran *et al.* study reported the sensitivity of ultrasound diagnosis of appendicitis as 80 % and specificity as 95% with an overall accuracy of 95%¹². However, in a large study by Marusch *et al.*, the sensitivity of ultrasound diagnosis of appendicitis was found to be lower at 21.5%¹³. The study limitations are a small sample size, and the number of cases with nonspecific abdominal pain is high. The data needs to be reported and analysed at various centres routinely so as to recommend evidence-based guidelines for the proper, judicious and efficient use of investigations for the diagnosis and management of patients with abdominal pain. To conclude, the study results reflect a good degree of sensitivity, specificity and accuracy of the ultrasound evaluation of patients in cases with suspected acute appendicitis.

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