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ORIGINALARTICLE

Evaluation of accuracy of Ultrasonography in diagnosing Acute Appendicitis: An observational study

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ABSTRACT:

Background: To evaluate the accuracy of ultrasonography in diagnosing acute appendicitis. **Materials & methods:** A total of 100 patients were enrolled. All patients with Alvarado score 4-7 and divided them in two groups: those with Ultrasound study prior to surgery and those without any imaging modalities for diagnosis of AA. The results were analysed using SPSS software. **Results:** Overall, Sensitivity and specificity of ultrasound in diagnosis of acute appendicitis was 74% and 68.2%, respectively. In 5to16 years old patients, sensitivity and specificity of ultrasound in diagnosis of acute appendicitis was 75% and 65.8% respectively and in ages between17 to 60, sensitivity was 71.2% and specificity was 70.5%. **Conclusion:** Ultrasound is more useful when the patient is female and the result of sonography is positive.

Keywords: Sonography, Ultrasound, Acute appendicitis.

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INTRODUCTION

Appendicitis represents one of the most common causes of abdominal pain of adult patients referred to the emergency department. More than 250,000 cases of appendicitis are diagnosed in the United States each year, and appendectomy is the most frequent emergent surgery performed worldwide.[1,2] Despite its prevalence, the diagnosis of appendicitis can be elusive and fraught with pitfalls because of the absence of a pathognomonic sign or symptom, the poor predictive value of associated laboratory testing, and its varied presentation diagnosis. [3,4]Acute appendicitis is one of the most common causes of acute abdominal pain and it is an urgent condition that requires prompt surgical intervention to minimize morbidity and mortality. Previous studies have shown the better performance of computed tomography (CT) than ultrasound (US) in diagnosing appendicitis and attested to the high sensitivity and specificity of CT, which are reported to be 87–100 % and 83–100 %, respectively. [5,6] However, the diagnosis of acute appendicitis can still be missed, especially when the patients have equivocal CT findings. [7]

Among imaging methods currently used in the clinical practice, Ultrasound (US) is a valuable tool. It was first introduced by Puylaert in 1986, who described the "graded compression" technique apt to better visualize the inflamed appendix [8] by using the graded compression technique, a linear high-frequency transducer is placed on the right lower quadrant and pressure is applied gradually while imaging, displacing overlying gas-filled loops of bowel. Moreover, this noninvasive option is repeatable, avoids the exposure to nonionizing radiation and can be less expensive as compared to Computed Tomography (CT) costs. At US, findings suggestive of appendicitis include, a thickened wall, a noncompressible lumen, outer appendiceal diameter greater than 6 mm, absence of gas in the lumen, appendicoliths, echogenic inflammatory periappendiceal fat change, and increased blood flow in the appendiceal wall . If compared to other diagnostic tests, US is inferior to CT as to sensitivity; due to its low negative predictive value for appendicitis, it may not be as useful for excluding appendicitis. More recently, color and power Doppler examination of the appendix have proven to be a useful adjunct to improve the sensitivity by demonstrating increased flow in an inflamed appendix. [9,10] Hence, this study was conducted to evaluate the accuracy of ultrasonography in diagnosing acute appendicitis.

MATERIALS & METHODS

A total of 100 patients were enrolled. All patients with Alvarado score 4-7 and divided them in two groups: those with Ultrasound study prior to surgery and those without any imaging modalities for diagnosis of AA. The complete history was taken. Laboratory investigations, sonography report and histopathological reports of patients were gathered. The results were analysed using SPSS software.

RESULTS

Overall, Sensitivity and specificity of ultrasound in diagnosis of acute appendicitis was 74% and 68.2%, respectively. In 5to16 years old patients, sensitivity and specificity of ultrasound in diagnosis of acute appendicitis was 75% and 65.8% respectively and in

ages between17 to 60, sensitivity was 71.2% and specificity was 70.5%. The overall accuracy of ultrasound was 72.5%.The positive predictive value and the negative predictive values of ultrasound were 85% and 44.1% respectively. In age group of 17-60, accuracy was 71%, positive predictive value was 85% and negative predictive value was 45%.

Table 1: Analytic results for patients with ultrasonography as an accessory modality of diagnosis

	Overall	5-16 years	17-60 years	Males	Females
Sensitivity %	74%	75%	71.2%	77%	71.2%
Specificity %	68.2%	65.8%	70.5%	45.2%	75.8%
PPV %	85%	87%	85%	92%	84.3%
NPV %	44.1%	45.8%	45%	25.5%	58%
Accuracy %	72.5%	72.6%	71%	72.1%	73%

DISCUSSION

Acute appendicitis is one of the most common etiologies of acute abdomen that leads to operation .[11] Almost 7% of people undergo appendectomy due to diagnosis of acute appendicitis during their lifetime. [12]Although it is a very common pathology its diagnosis still remains a challenge because it mimics many other conditions clinically. [13] Differential diagnosis of acute appendicitis are, but not limited to, mesenteric lymphadenitis, gastroenteritis, constipation, right lower lobe pneumonia and numbers of urologic or gynecologic diseases. [14] Hence, this study was conducted to evaluate the accuracy of ultrasonography in diagnosing acute appendicitis.

In the present study, overall, Sensitivity and specificity of ultrasound in diagnosis of acute appendicitis was 74% and 68.2%, respectively. In 5to16 years old patients, sensitivity and specificity of ultrasound in diagnosis of acute appendicitis was 75% and 65.8% respectively and in ages between17 to 60, sensitivity was 71.2% and specificity was 70.5%. A study by Pinto F et al, the gold standard for the diagnosis of appendicitis still remains pathologic confirmation after appendectomy. In the published literature, graded-compression Ultrasound has shown an extremely variable diagnostic accuracy in the diagnosis of acute appendicitis (sensitivity range from 44% to 100%; specificity range from 47% to 99%). This is due to many reasons, including lack of operator skill, increased bowel gas content, obesity, anatomic variants, and limitations to explore patients with previuos laparotomies. Graded-compression Ultrasound still remains our first-line method in patients referred with clinically suspected acute appendicitis: nevertheless, due to variable diagnostic accuracy, individual skill is requested not only to perform a successful exam, but also in order to triage those equivocal cases that, subsequently, will have to undergo assessment by means of Computed Tomography.[15]

In the present study, the overall accuracy of ultrasound was 72.5%.The positive predictive value and the negative predictive values of ultrasound were 85% and 44.1% respectively. In age group of 17-60, accuracy was 71%, positive predictive value was 85% and negative predictive value was 45%. Another study by Pacharn P et al, forty-nine patients (25.4%) had appendicitis on sonography, and 144 (74.6%) had negative sonographic findings. Computed tomographic scans were obtained in 51 patients (26.4%) within 4 days after sonography. These included 39 patients with negative and 12 with positive sonographic findings. Computed tomography changed the sonographic diagnosis in 10 patients: from negative to positive in 3 cases and positive to negative in 7. Forty-three patients (22.2%) underwent surgery. The surgical findings were positive for appendicitis in 37 (86%) of the 43 patients who had surgery. Patients with negative sonographic findings who, to our knowledge, did not have subsequent CT scans or surgery were considered to have negative findings for appendicitis. Seven patients with negative sonographic findings underwent surgery and had appendicitis; therefore, 137 of 144 patients with negative sonographic findings did not have appendicitis. On the basis of these numbers, the NPV was 95.1%. Sonography has a high NPV and should be considered as a reasonable screening tool in the evaluation of acute appendicitis. Further imaging could be performed if clinical signs and symptoms worsen.[16] Tarjan Z et al, the diagnostic accuracy and practical value of graded compression ultrasound was evaluated in 298 patients admitted for ultrasound examination because of having suspected appendicitis by surgeons. The result of the ultrasound was considered to be positive, if the inflamed appendix, larger, than 6.5 mm in outer diameter or an abscess was depicted. Of the 99 pathologically proven cases of acute appendicitis ultrasound was positive in 94, that is the sensitivity was 94.9%. The diagnostic accuracy and specificity were 96.3% and 97.9%. The predictive value of a positive test was 95.9%, and was 97.5% of a negative one. In the group of patients under 18 years (140 patients) sensitivity, specificity and diagnostic accuracy were 93.3%, 96.3% and 95% respectively. The use of ultrasound helped many patients to earlier operation and reduced considerably the negative laparotomy rate. The routine use of ultrasound in the diagnosis of appendicitis especially if the clinical presentation is equivocal, complements usefully the clinical signs and increases diagnostic accuracy.[17] Sim JY et al, among 869 patients, 71 (8.2 %) had equivocal appendicitis findings and 63 (7.2 %) were diagnosed as probably not appendicitis. The sensitivity and specificity of CT combined with US re-evaluation

group (100 % and 98.1 %, respectively) exceeded those of the CT alone group (93 % and 99 %; equivocal group considered as negative appendicitis, 100 % and 89.9 %; as positive, respectively, P < 0.0001). After adding US re-evaluation, the overall negative appendectomy rate in our institution decreased from 3.4 to 2.3 %. For patients with equivocal CT findings of acute appendicitis, US re-evaluation can improve diagnostic accuracy and decrease the rate of negative appendectomies.[18]

In other published series, overall sensitivity of US in adult and adolescent patients was 86%, specificity 81% , the positive predictive value of graded compression US was 84% (range from 46% to 95%), and the negative predictive value of graded compression US was 85% (range from 60% to 97). While the range of reported accuracy (82% to 96%) for US in children has been acceptable, the sensitivity (44% to 100%) and the specificity (47% to 99%) have varied considerably; also, the visualization rates vary widely in the published literature, from a low of 22% to a high of 98%. [19] Several factors might be taken into account as the causes of these variations. First, because US is an operator-dependent technique, with a steep learning curve, individual skill may be an important factor to determine an extremely variable diagnostic accuracy of appendicitis. [20] Moreover, difficulties to scan populations of fertile age females may be related to the broad and frequent overlap of the symptoms for acute abdominal conditions. [21,22]

CONCLUSION

Ultrasound is more useful when the patient is female and the result of sonography is positive.

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