



The Role of Ultrasound in Diagnosis of Acute Appendicitis: A Review Article

Rania Mohammed Ahmed ^{a*}

^a Radiological Sciences Department, Applied Medical Sciences College, Taif University, Saudi Arabia.

Author's contribution

The sole author designed, analyzed, interpreted and prepared the manuscript.

Article Information

DOI: 10.9734/JPRI/2021/v33i53B33674

Editor(s):

(1) Dr. Sirigireddy Sivajothi, Sri Venkateswara Veterinary University, India.

Reviewers:

(1) Kanwar Singh Goel, SGT University, India.

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Complete Peer review History, details of the editor(s), Reviewers and additional Reviewers are available here:
<https://www.sdiarticle5.com/review-history/77758>

Review Article

Received 30 September 2021

Accepted 02 December 2021

Published 06 December 2021

ABSTRACT

Acute appendicitis (AA) is a frequent abdominal infection that affects 7% of people at some time in their lives. As a result, any delay in diagnosis might lead to complications such as perforation and abscesses in the incision. Ultrasound (U/S) plays an essential role in the diagnosis and management of acute appendicitis, which improves patient outcomes. Recent technological advances have brought profound changes to diagnostic ultrasound imaging. Acute appendicitis is a frequent abdominal condition that affects many people at their lives, and clinical and laboratory data alone are insufficient to diagnose acute appendicitis.

Abnormal US findings during appendiceal scan indicate a greater chance of having recurrent appendicitis, the importance of US scan cannot be overstated in the pre-surgical evaluation and planning of patients with appendicitis.

In this review, different US techniques and their applications in diagnosis of appendicitis and early and accurate diagnosis are discussed.

Keywords: Ultrasound; acute appendicitis; abdominal pain; sign & symptom.

1. INTRODUCTION

Acute appendicitis (AA) is a frequent abdominal illness that has an impact in 7% of the population

at some point [1]. Appendicitis is one of the most widespread causes of abdominal discomfort in adult patients who visit the emergency (ER) room. Each year, in the United States, more than

*Corresponding author: E-mail: rania_awad1@hotmail.com;

250,000 cases of appendicitis are identified each year, and appendectomy is the most common urgent procedure performed all throughout the world [2,3]. Acute appendicitis is a challenging diagnosis to make just on clinical and laboratory evidence since it might seem like a variety of urologic, gastrointestinal, or gynecologic problems [4].

When compared to non-perforating AA, perforation of the appendix is linked to an increased risk of morbidity and mortality. Acute but not gangrenous AA has a mortality risk of less than 0.1 percent, but gangrenous AA has a risk of 0.6 percent, on the contrary, perforated AA has a 5-percentage-point greater mortality rate. Currently, mounting evidence suggests that perforation is not always the inevitable conclusion of appendiceal blockage, and that not only do not all patients with AA develop to perforation. However, that resolution could be something that happens on a regular basis [5].

In this way, any delay in making a decision can have negative consequences such as wound abscesses and perforation [6]. A non-peristaltic, incompressible tubular blind structure with a diameter of 6 mm or greater evident in the right iliac fossa is one of the ultrasonography diagnostic criteria for acute appendicitis. However, there are numerous auxiliary symptoms of acute appendicitis that might aid in the ultrasonography diagnosis of the condition [7].

Regarding US diagnostic criteria; a retrospective study of children, the appendix was not visible in 241 (38%) of the trials. Secondary US symptoms such as high volumes of free intrabdominal fluid, phlegmon, and pericaecal inflammatory fat alterations were studied. These secondary symptoms demonstrated a high specificity (98 percent – 100 percent) for the diagnosis of AA in this investigation [8].

When it comes to perforation rates, emergency department (ER) re-visits, and negative appendectomy rates, the use of ultrasound is accurate and safe. Using an appropriate clinical and/or staged approach with US/MRI may reduce the need for CT scans. In adults, the sensitivity and specificity of MRI are at least equal to those of CT, and despite greater costs as a second-line imaging modality, it should be favored above CT [9].

2. APPROACHES OF CLINICAL PRACTICE

Among the imaging techniques now in use in clinical practice is US which is a valuable useful

diagnostic tool. It was first documented in 1986 by Puylaert, who characterized the "graded compression" approach as a way to see the inflamed appendix better [10]. A linear transducer (high-frequency) is positioned on the right lower quadrant using the graded compression approach, as well as applying pressure progressively during scanning, displacing overlaying gas-filled bowel loops. Furthermore, when compared to expenses of CT, this noninvasive approach is reproducible, avoids nonionizing radiation exposure, and may be less costly.

Pre-operative diagnosis of acute appendicitis is difficult, especially in women of childbearing age [11]. Negative appendectomies, perforations, and hospital stays can all be greatly reduced with diagnostic help. Laparoscopy, scoring systems, US, CT, MRI, and other tools are among them, which are all available in various settings and each have their own set of benefits and drawbacks [12]. As a result, any delay in diagnosis might result in complications such perforation and wound abscesses [6]. The fatality rate from acute appendicitis is estimated to be around 0.25 percent across all age groups [13].

3. CLINICAL JUDGMENTS

As a result, clinical judgment is still very important in the diagnosis of appendicitis. Women are more likely than males to have their appendicitis misdiagnosed. Diagnostic imaging has not been found to improve outcomes, hence limiting imaging to truly equivocal cases and employing it early in the diagnostic workup may improve outcomes. US is very user-dependent, and operator experience could have a role in appendicitis diagnosis accuracy. The Alvarado scale is a simple and inexpensive additional tool for confirming the diagnosis of acute appendicitis, particularly for aspiring surgeons [14].

The appendix was visible on US and MRI, and the sensitivity and specificity for MRI were both 100%, whereas the sensitivity and specificity for US were 50% and 100%, respectively. This is a good example of a study with a small sample size and a low prevalence of the disease being studied [15].

A common and critical problem in general surgery is misdiagnosis of acute appendicitis. One of the novel diagnostic techniques that has been demonstrated to increase diagnostic accuracy and clinical outcomes is graded

compression ultrasonography [16]. In a graded compression approach, a hand-held US transducer applies a consistent pressure in the right iliac fossa (RIF). Normal and gas-filled intestinal loops are either pushed out of view or squeezed between the front and posterior abdominal walls. As a result of the incompressibility of the inflamed appendix, it is best viewed. The inflamed appendix appears as a blind-ended tubular structure with a laminated wall that emerges from the caecum's base. It should be a peristaltic, noncompressible, and have a diameter of at least 6mm [16].

The risk of perforation increases by 5% every 12 hours in acute appendicitis, hence an appendectomy should be performed within 36 hours following a confirmed diagnosis of acute appendicitis [17]. As a result, any delay in diagnosis can result in complications like perforation and wound abscesses [18]. The fatality rate from acute appendicitis, on the other hand, is estimated to be around 0.25 percent across all age groups [19, 20].

Negative appendectomy rates range from 16 percent to 47 percent when a diagnosis is made only on the basis of the patient's history and a clinical examination. When medical imaging modalities are employed to aid in the diagnosis, however, that percentage reduces to between 6% and 10% [21]. As a result, an accurate diagnosis is required to avoid any complications that may arise as a result of delayed surgical intervention.

Different tools were created to improve diagnostic accuracy, such as computer aided programs, different scoring systems, GIT contrast investigations, CT, US, MRI, and laparoscopic [22]. Ultrasonography is the simplest, most accessible, noninvasive, easy, and cost-effective of these methods [23]. The most common sonographic error occurs when the inflamed appendix can't be seen due to its position (i.e. when it's posteriorly placed behind the cecum) or when enough bowel compression can't be achieved due to excess body fat. However, because the differential diagnosis of pain in this region is not straightforward. A correct diagnosis of acute right iliac fossa discomfort is still a challenge in clinical practice. [24,25].

A negative appendectomy is somewhat acceptable in the past to overcome the morbidity and mortality of perforation before surgery. However, in recent years, many people have

found this unacceptable because the surgical method may be a source of morbidity and mortality. Despite the fact that appendectomy has lowered morbidity, it has also increased the rate of diagnostic errors [26].

Negative appendectomy is still common, with rates ranging from 15% to 30% worldwide [27]. According to the University of Malaya Medical Centre in Malaysia, the risk of negative appendectomy is as high as 19.3% [26].

With a precise and timely diagnosis, the rate of negative appendectomy can be minimized. Evaluation of clinical symptoms, scoring systems such as the Alvarado and RIPASA score, and imaging procedures such as ultrasonography and CT scan are all relevant diagnostic modalities for AA. The use of scoring systems can help predict acute appendicitis, but they lack sensitivity and specificity, and they don't tell you how far along the inflammatory process is [27].

Despite its inherent limitations, US should be utilized as the first line of imaging in pediatric patients with suspected appendicitis, especially as its accuracy rivals CT when the appendix is seen. Secondary sonographic indicators have a good chance of assisting the radiologist in making an appropriate diagnosis [28]. However, because it uses ionizing radiation and intravenous or gastrointestinal contrast material, CT scan is a more intrusive diagnostic, making it unsuitable for use in children. On the other hand, U/S is straightforward, accessible, noninvasive, easy, and cost-effective. Furthermore, in the pediatric population, U/S can not only detect inflamed appendices but also assess disease severity [29]. Because of atypical presentations and as well as a delay in obtaining medical assistance, the clinical diagnosis of appendicitis in the elderly is much more challenging than in young and middle-aged persons, with a higher rate of perforation, surgical complications, and mortality [30].

4. DISCUSSION

As a result, imaging examination for suspected AA in adults is becoming more common; regardless of the radiologist's experience or the patient's body mass index (BMI), the diagnostic performances of sonography and CT for acute appendicitis or an alternative diagnosis were not significantly different in a prospective research, albeit sonography yielded more inconclusive exams [31].

The common findings during US scan were a thicker wall, a noncompressible lumen, an outer appendiceal diameter more than 6 mm, the lack of gas in the lumen, appendicoliths, echogenic inflammatory periappendiceal fat change, all of these symptoms of appendicitis are found in the US, including increased blood flow in the appendiceal wall. [23].

When compared to other diagnostic tests, US is less sensitive than CT; because of its low negative predictive value for appendicitis, it may not be as CT effectiveness in excluding appendicitis. More recently, color and power Doppler US examination has proven to be a beneficial adjuvant in improving sensitivity by indicating increased flow in an inflamed appendix [33].

Adults with a clinical suspicion of AA require imaging; in fact, there is widespread agreement that early diagnosis improves the outcome of acute appendicitis. In the examination of patients referred with clinically suspected acute appendicitis, we still use graded-compression ultrasound [34].

US can be done at any time, regardless of how prepared a patient is. Nonetheless, due to varying diagnostic accuracy, individual aptitude is required not just to complete a good exam, but also to prioritize those equivocal situations that will need to be assessed by CT [35].

5. CONCLUSIONS

This review revealed that in distant settings, a diagnostic strategy based on clinical evaluations, routine US conducted by emergency physicians, and clinical re-evaluation of patients with acute abdominal pain is appropriate for obtaining favorable results for appendicitis diagnosis and treatment. Although imaging with U/S has significantly lowered the negative appendectomy rates; the specificity and the positive predictive values were high supporting the use of US as a first-line test in the diagnosis of acute appendicitis.

6. RECOMMENDATIONS

In patients with suspected acute appendicitis, we advocate using a customized personalized diagnostic method for stratifying risk and illness likelihood and establishing a suitable diagnostic modality, based on the patient's age, gender, and clinical signs and symptoms, in addition to

use of Elastography as a new technique to improve outcome. Besides that, we recommend studying the diagnostic accuracy of appendicitis among pregnant females.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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