

### **The role of ultrasound in diagnosis of acute appendicitis: A review article**

#### **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 acute appendicitis is a difficult diagnosis based on clinical and laboratory data.

Abnormal US findings during appendiceal scan indicate a greater chance of having recurrent appendicitis, US scan play an important role 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.

**Key words:** Ultrasound, Acute appendicitis, Abdominal Pain, Sign & symptom.

## **Introduction:**

Acute appendicitis (AA) is a common abdominal illness that affects 7% of the population at some point [1]. Appendicitis is one of the most common causes of abdominal discomfort in adult patients who visit the emergency room. Each year, more than 250,000 cases of appendicitis are diagnosed in the United States, and appendectomy is the most common urgent procedure performed worldwide [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, appendiceal perforation is associated with increased 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 other hand, perforated AA has a higher mortality rate of around 5%. 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, but that resolution may be a regular occurrence as well [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].

In terms of 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, MRI has at least the same sensitivity and specificity as CT and, despite greater costs, should be preferred over CT as a second-line imaging modality. [9].

## Results and discussion:

Among the imaging techniques now in use in clinical practice is Ultrasound (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 high-frequency transducer is positioned on the right lower quadrant using the graded compression approach, and pressure is applied progressively while imaging, displacing overlaying gas-filled bowel loops. Furthermore, as compared to the expenses of computed tomography (CT), this noninvasive approach is reproducible, avoids nonionizing radiation exposure, and may be less expensive.

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, ultrasonography, computed tomography, magnetic resonance imaging, 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, on the other hand, is estimated to be around 0.25 percent across all age groups [13].

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. Ultrasonography 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 junior surgeons [14].

When the appendix was visualized on US and on MRI, sensitivity and specificity for MRI were both 100 % and for US, they were 50 % and 100 %, respectively. This is a nice example for a study that is limited by a small study population and a low prevalence of the disease to be 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 used in the diagnostic process, 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. Scan, Ultrasonography, 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, proper diagnosis of acute right iliac fossa pain remains a difficult clinical challenge [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 computed tomography (CT) scan are all relevant diagnostic modalities for acute appendicitis. 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 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 a delay in seeking medical help, 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].

As a result, imaging examination for suspected acute appendicitis 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, and increased blood flow in the appendiceal wall are all US findings of appendicitis [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].

Adult patients with clinically suspected acute appendicitis 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 skill is required not just to complete a good exam, but

also to prioritize those equivocal situations that will need to be assessed by computed tomography [35].

### **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.

### **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, sex, 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.**

**Informed consent statement:** Not applicable.

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