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Research Article

**ROLE OF MODERN DIAGNOSTIC IMAGING MODULATES IN
DIAGNOSING ACUTE APPENDICITIS IN PREGNANT
PATIENTS**¹Sanawar Abbas, ¹Liu Wenya.¹Imaging Center, the First Affiliated Hospital of Xinjiang Medical University, Urumqi 830054, China.**Article Received:** February 2019**Accepted:** March 2019**Published:** April 2019**Abstract:**

Introduction Acute appendicitis is not a rare condition in pregnant patients. it accounts for 1 in 500-635 pregnancies per year. Diagnostic Imaging in pregnancy is of higher significance.

Aims and Objectives: The main aim and objectives of this study are to analyze all diagnostic imaging modalities.

Diagnosis of Acute Appendicitis: The most typical symptoms are acute right lower quadrant (RLQ) abdominal pain, relocation of pain from an upper part of the abdomen to the RLQ, loss of appetite, nausea, vomiting, and elevation of temperature.

Imaging Techniques: Today, imaging for suspected appendicitis is even considered mandatory in many institutions. Major imaging modalities utilized to diagnose acute appendicitis in pregnant patients is US and MRI. **Effects of Radiations:** The precise risks of radiation from diagnostic imaging are unknown, but estimations based on research exist.

Discussion: US persists as the first line of imaging, as a rule, yet of coarse accuracy and other imaging tools such as CT or MRI are usually avoided for the diagnosis of acute appendicitis in pregnant patients.

Conclusion: literature review suggested that the imaging of choice for acute appendicitis is US. Now MRI is also recommended as a first-line diagnostic test. CT will only be performed only as a last resort.

Corresponding author:**Liu Wenya.**Imaging Center, the First Affiliated Hospital of Xinjiang Medical University,
Urumqi 830054, China

QR code



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INTRODUCTION:

Acute appendicitis is one of the common acute conditions mostly occurs in the second trimester of pregnancy, associated with non-obstetric cause of surgery, it accounts for 1 in 500-635 pregnancies per year [1, 2]. No symptoms, sign or test is 100% accurate in diagnosing appendicitis, but a combination of various findings supports the diagnosis. However, current research studies based on proper data relating to acute appendicitis is scarce. The clinical presentation during reproductive age is similar in pregnant and non-pregnant patients.[3] Diagnostic Imaging in pregnancy is of higher significance because of risks involved to mother and fetus due to delayed diagnosis, mimicking other acute abdominal conditions lead complications. Historically US is basic imaging choice and CT have been used with caution due to ionizing radiation, MRI has becoming imaging of choice in last 20 years, especially in pregnancy and pediatric patients, whom CT was used reluctantly[4]. In order to apply iodinated and gadolinium-based contrast agents, we must strictly follow the guidelines and give patient proper counseling and take consent before use of any contrast agents before imitating the procedure. One of the important factors in delayed diagnosis is due to major hormonal fluctuations secondary to anatomical and physiological changes post -pregnancy, causing compaction and displacement of major vital organs and laxity of abdominal wall anteriorly. In suspected pregnant patients immediate and appropriate imaging can provide the best conclusive results [5, 6]. All these factors pose a greater diagnostic challenge to all the radiologists, sonographers and clinicians.

Key words: Acute appendicitis, Ultrasonography(US), pregnant, Computed Tomography(CT), Magnetic Resonance Imaging (MRI).

Aims and Objectives:

The main aim and objectives of this study are to analyze all diagnostic imaging modalities and provide a detailed review of all the modalities with greater diagnostic value of acute appendicitis in pregnant patients of reproductive age.

Diagnosis of Acute Appendicitis:

The most typical symptoms are acute right lower quadrant (RLQ) abdominal pain, relocation of pain from upper part of the abdomen to the RLQ, loss of appetite, nausea, vomiting, and elevation of temperature. The pain can be aggravated by movement or cough as a sign of peritoneal inflammation, and the patient may have vomited [7, 8].

Before the era of CT, the decision to operate in suspected appendicitis was based on clinical signs and findings supported by laboratory examinations, and the reported negative appendectomy rate was commonly 15-30%[9]. The most frequent finding is tenderness in the RLQ. However, even this sign is not positive in 100% of cases. Peritoneal inflammation caused by inflammation of the appendix can be tested in several different ways, of which the combination of guarding and rebound (also referred as Blomberg's sign) is the most accurate sign. Indirect tenderness in Rovsing's test supports the diagnosis and so does the psoas sign. Patients often have an elevated temperature. The Rectal digital examination is not diagnostic of acute appendicitis. However, it might be valuable in diagnosing appendiceal abscess or diagnosing gastrointestinal malignancies behind the abdominal pain [8, 10].

Imaging Techniques:

Diagnostic imaging plays a vital role to reduce ambiguity in the diagnosis and unnecessary delays to initiate surgical removal of acute appendicitis because there is no specific presentation of the acute condition and basic clinical manifestation in pregnant patients are similar to that of other patients[1]. The technological development of imaging modalities has enabled imaging to play an increasing and even essential role in diagnostics of acute appendicitis. Today, imaging for suspected appendicitis is even considered mandatory in many institutions [11]. Major imaging modalities utilized to diagnose acute appendicitis in pregnant patients is Diagnostic Ultrasonography(USG) and Magnetic Resonance Imaging (MRI). Computed Tomography(CT) scan should not be delayed when an ultrasound and MRI study produce an inconclusive result and when there is an urgent need of early diagnosis [5, 12].

Diagnostic Ultrasonography(US):

Ultrasonography is recommended imaging modality in all pregnant patients with suspicion of acute appendicitis[13]. Graded compression sonography and Baldisserotto's technique of changing patients position can be used in diagnostics of acute appendicitis. Graded compression is used to displace gas-containing bowel loops to visualize the uncompressible inflamed appendix. Characteristic diagnostic features of appendicitis in graded compression US include local transducer tenderness, uncompressible thickened appendix and peri-appendiceal fat infiltration[14]. The presence of additional typical features of appendicitis makes diagnosis more reliable [15]. Comparisons between

US and CT for diagnostic performance are equivocal. US has shown inferior diagnostic performance compared to CT in comparative studies, though equal diagnostic performance was reported in earlier studies [16-19]. However, US involves no ionizing radiation or contrast medium, and the cost of US examination is lower compared to CTs. The sensitivity and specificity of US have been 76-88% and 93-95%, respectively [16, 20].

The appendix is not always visible under US examination, and therefore negative US examination does not reliably rule out appendicitis. Nevertheless, the positive predictive value of US is good. This together with the aim of avoiding excess ionizing radiation has led to the use of US as a primary imaging modality in many institutions. However, in the case of inconclusive or negative US, imaging by MRI or CT is required for diagnostic accuracy [19-23].

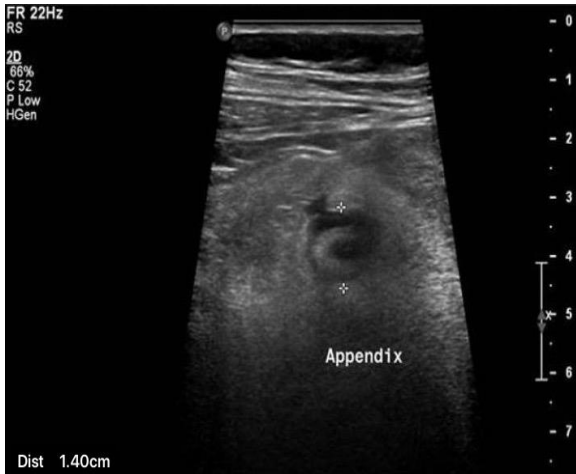


Figure 1- Acute Appendicitis. Thickened walls Dilatation of appendix, measuring 1.4 cm in diameter.

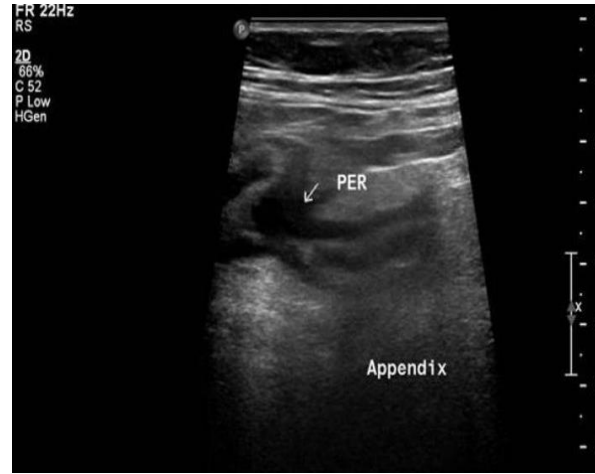


Figure 2- Acute Appendicitis. Discontinuity at the base of the appendix with surrounding fluid suggesting perforation.

Magnetic Resonance Imaging (MRI)

MRI is a superior imaging modality and may be optimized as a first-line of diagnostic imaging for acute appendicitis in the gamut of patients[24]. A normal appendix is depicted by T1 bright appendix sign in pregnancy[25, 26]. The diagnostic accuracy and efficiency of MRI during pregnancy is of greater diagnostic value, Burns, M., et al., suggested it should be considered as first-line imaging modality after vague US findings[27]. Non-visualized appendix or lack of inflammatory findings on MRI[28] effectively eliminates the need for emergency operation/laparotomy rate by ruling out acute appendicitis or other pathologies. Furthermore, it may miss at detecting appendiceal perforation [12, 25, 29-31].

Magnetic resonance imaging (MRI) features associated with acute appendicitis include appendiceal

diameter >7 mm, peri-appendiceal fat infiltration and restricted diffusion of the appendiceal wall [32]. The diagnostic performance of MRI in suspected appendicitis is superior to US but inferior to CT. The MRI involves no ionizing radiation and can be used even during pregnancy. MRI is often used to replace CT for pregnant patients after inconclusive or negative US. The reported sensitivity and specificity of MRI are 82-98% and 71-100%, respectively, depending on the expertise of the MRI reader [29, 33-36]. However, Burke, L.M., et al., concluded in their multi-institutional research study conducted and concluded over period of five years that the “Sensitivity, specificity, accuracy, positive predictive value, and negative predictive values” of pregnant patients who undertook MRI for suspected cases of acute appendicitis were “96.8%, 99.2%, 99.0%, 92.4%, and 99.7%, respectively”. [37]

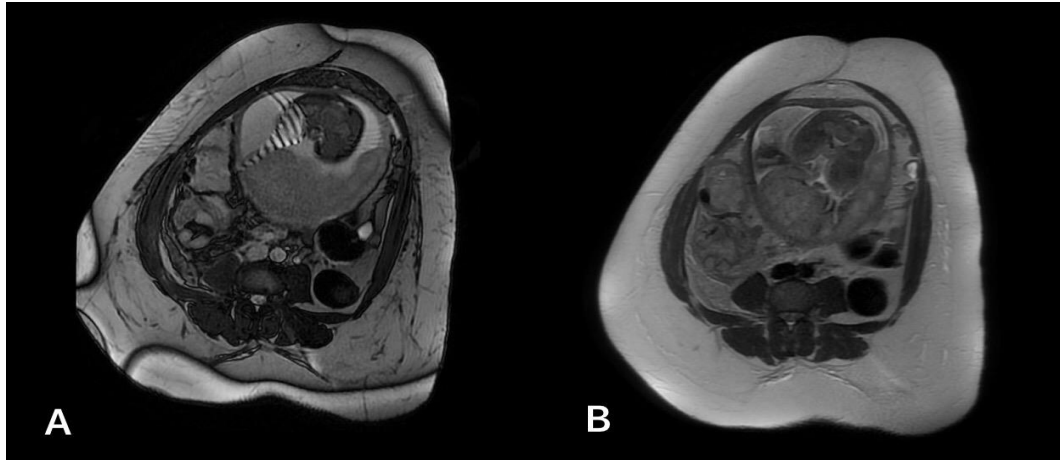


Figure 3-MRI-A,B-Axial Gradient Echo,Axial-T2. Gravid Uterus. Acute Appendicitis, inflammatory mass, fluid-filled tubular structure is seen in the center of this inflammatory mass.

Computed Tomography (CT)

In some institutions, CT is performed on all patients suspected of acute appendicitis, but concerns about radiation-induced risks and increased costs have led to diagnostic strategies with more selective use of CT and also low-dose CT protocols.

Studies that compare negative appendectomy rates in the general population before and after the implementation of CT reports an irrefutable association between increased use of CT and decreased rate of negative appendectomies [38-41]. However, the large-scale benefits of CT have been questioned in some studies [40, 42-44]. Commonly, intravenous contrast-enhancement is used with no oral contrast medium. The diagnostic performance of CT has been analyzed in numerous studies. The reported specificity and sensitivity of CT have been 93-98.0% and 94-98.5%, respectively [16, 45, 46].

Contrary to the excellent diagnostic performance of CT in suspected cases, the distinction between complicated and uncomplicated appendicitis by CT has not been reliable. The CT findings of the focal defects in the appendiceal wall, abscess, extraluminal gas, ileus, peri-appendiceal fluid, and appendicolith have had the highest specificity, but the sensitivity of these findings has been low, 28-70% [38, 47, 48]. However, fecolith's causal association to advanced pathology is controversial [49, 50]. To increase accuracy in the diagnosis of complicated appendicitis Atema et al., have suggested a scoring system based on clinical and imaging features in combination [48].

NOTE: No cases of CT scans were found in our center PACS database.

Effects of Radiations in CT

The precise risks of radiation from diagnostic imaging are unknown, but estimations based on research exist. The cancer risk associated with a CT examination is small but not non-existent. Abdominal organs are sensitive to ionizing radiation, and suspected appendicitis is most frequent in young patients with whom the considerations of radiation-induced risks are most important [18, 51]. An analysis of radiation-induced cancer associated with suspected appendicitis by Rogers et al. pessimistically concluded that if all patients with suspected appendicitis undergo CT, one cancer death will occur as a cost for every 12 avoided negative appendectomies [52]. Another estimation given by researchers was that approximately 2000 CT scans on young adults suspected of acute appendicitis would result in at least one cancer death[53]. Low-dose protocols for abdominal CT have been developed to reduce radiation dose of CT for suspected appendicitis. The common reported reference values for the effective radiation doses for standard abdominal CT range from 7 to 10 mSv, whereas the radiation doses of low-dose protocols can be as low as 2 mSv [46]. Studies show equal diagnostic performance for low-dose CT compared to standard-dose CT in diagnostics of acute appendicitis, and diagnostic protocols including low-dose CT as a part of diagnostic workup have been successfully adopted[21]. Many institutions have partly replaced CT by US in order to reduce risks of ionizing radiation. Consequently, US is used as the primary imaging

method for all patients in these settings, and CT is performed when US is negative or inconclusive [11, 21, 54]. Equal or superior diagnostic performance has been reported in conditional versus immediate CT protocols using US as the primary imaging modality [19, 22]. In addition to increased safety, conditional CT provides financial benefits [20, 22]. A randomized study reported that selective CT imaging based on clinical assessment was cost-effective compared to routine CT [55].

Other imaging modalities

Before the era of US, MRI, and CT, plain abdominal X-ray was frequently used in diagnostics of acute abdomen. The diagnostic accuracy of plain abdominal X-ray is weak, and this imaging modality cannot be recommended in the diagnosis of acute appendicitis [56].

Differential diagnosis

Many acute conditions mimic acute appendicitis. The diagnosis is most challenging in fertile-aged women with possible acute symptoms of gynecological origin. Acute Appendicitis and complicated biliary diseases are one of the most common differentials of non-obstetric acute abdomen in pregnancy[57]. Other diagnoses that are often mistaken for appendicitis include mesenteric adenitis, acute diverticulitis and gastroenteritis [58].

Epidemiological Data

The incidence of appendicitis is highest between the ages of 10 and 19 years, and 8.6% men are more likely to develop appendicitis than 6.7% women, Appendicitis has become more common in older patients, whereas its incidence for the most susceptible ages has continued to decrease [59, 60].

DISCUSSION:

US persists as the first line of imaging, as a rule, yet of coarse accuracy and other imaging tools such as CT or MRI are usually avoided for the diagnosis of acute appendicitis in pregnancy patients[4]. The technological development of imaging modalities improved diagnostic accuracy and thus the use of diagnostic imaging became popular in suspected acute appendicitis. In some institutions, diagnostic imaging is now considered mandatory [11]. Early and accurate diagnosis of acute appendicitis in pregnant patients is challenging due to anatomical, physiological, hormonal changes and other symptoms related to pregnancy, causing disinclination to opt for surgical options resulting in delayed diagnosis [1]. Normal physiological changes observed during pregnancy are

analogous to symptoms and laboratory findings as those during acute appendicitis, making the diagnosis awfully challenging[61]. Peritoneal aspiration cytology for the diagnosis of acute appendicitis studied before the era of CT was suggested as being diagnostic for acute appendicitis in all patients with RLQ abdominal pain. Today, the typical rate of false positive diagnosis is around 10% but the great variation in this rate still exists [11, 62, 63]. There is evidence that implementing a diagnostic algorithm or electronic clinical decision support into the diagnostics of appendicitis decreases the need for diagnostic imaging without impairing diagnostic accuracy [64-66]. Several diagnostic scoring systems have been developed that aimed to facilitate and standardize diagnostic decision-making. 36 hours post onset of symptoms of acute appendicitis in pregnancy, the treating physicians and surgeons should be very circumspect about not further delaying the treatment and surgical intervention despite the difficulty of diagnosing appendicitis during pregnancy[2, 67]. Patients with complicated appendicitis have a longer duration of symptoms, more guarding, fever and higher CRP values [38, 68-71]. Radiological diagnosis of perforation is uncertain, and the most specific radiological findings to perforation include extraluminal gas, focal defect in appendiceal wall, abscess and small bowel ileus [38, 47, 72]. Neoplasms are incidentally found in approximately 1% of appendectomy specimens in uncomplicated appendicitis. These neoplasms are usually unidentifiable by preoperative CT [73]. One study analyzed clinical and radiological features of complicated appendicitis and resulted in a scoring system that identified uncomplicated and complicated appendicitis that was more reliable than solely using imaging [48]. The use of ultrasound may have limited scope due to change in body habitus and CT is not recommended due to risks of fetal irradiation. MRI due to lack of ionization, better contrast ability, and multiplaner reconstruction, has thus become first-line diagnostic evaluation in pregnancy[74]. The sensitivity, specificity, and accuracy of MRI with DWI were 100%, 95%, and 96%, respectively[75]. Use of CT and MRI are cost-effective imaging modalities with associated radiation risks of CT. The risk of childhood cancer from CT has little effect on the population-level outcome but is a major concern of patients[76].

CONCLUSION:

Franca Neto., et al., concluded in their literature review that the imaging of choice for acute

appendicitis is US. MRI will only be employed if the results of ultrasound are inconclusive. MRI is recommended as a first-line diagnostic test, the impact of MRI as diagnostic imaging in pregnant patients with acute appendicitis is applicable and practical with high accuracy[37]. CT will only be performed only as a last resort, in very acute emergencies especially in the third trimester of gestation[1].

Conflict of interest

There is no conflict of interest to disclose.

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