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Review Article

Imaging in acute appendicitis: What, when, and why?

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ARTICLE INFO

Article history:

Received 26 November 2015

Accepted 18 February 2016

Available online 29 March 2016

Keywords:

Acute appendicitis

Ultrasonography

CT scan

MRI

ABSTRACT

Acute appendicitis (AA) is the commonest cause of pain abdomen requiring surgical intervention. Diagnosis as well as management of acute appendicitis is mired in controversies and contradictions even today. Clinicians often face the dilemma of balancing negative appendectomy rate and perforation rate if the diagnosis is based on clinical scoring alone. Laboratory results are often non-specific. Imaging has an important role not only in diagnosing appendicitis and its complication but also suggesting alternate diagnosis in appropriate cases. However, there is no universally accepted diagnostic imaging algorithm for appendicitis. Imaging of acute appendicitis needs to be streamlined keeping pros and cons of the available investigative modalities. Radiography has practically no role today in the diagnosis and management of acute appendicitis. Ultrasonography (USG) should be the first line imaging modality for all ages, particularly for children and non-obese young adults including women of reproductive age group. If USG findings are unequivocal and correlate with clinical assessment, no further imaging is needed. In case of equivocal USG findings or clinico-radiological dissociation, follow-up/further imaging (computed tomography (CT) scan/magnetic resonance imaging (MRI)) is recommended. In pediatric and pregnant patients with inconclusive initial USG, MRI is the next option. Routine use of CT scan for diagnosis of AA needs to be discouraged. Our proposed version of a practical imaging algorithm, with USG first and always has been incorporated in the article.

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Introduction

Acute appendicitis (AA) is the commonest cause of pain abdomen in children and young adults requiring surgical

intervention and has an estimated lifetime risk of 7–9%. AA, as we know today, was formally described by Reginald Fitz in the year 1886, although there are historical descriptions about appendix dating back as early as fifteenth century.¹ As we clock 125 years since Fitz's initial description of 'Perforating

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<http://dx.doi.org/10.1016/j.mjafi.2016.02.005>

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Inflammation of the Vermiform Appendix', it is a painful reality that even today, the diagnosis as well as management of AA is mired in controversies and contradictions.² Despite progressive advancement of our clinical understanding by the concerted efforts of physicians and surgeons over these years, complimented by technological evolution in laboratory and imaging sciences, the enigma of appendicitis still presents a diagnostic challenge quite frequently. A multitude of widely divergent and at times conflicting publications discussing about the ideal diagnostic modality and treatment algorithm for AA are being added regularly in the scientific knowledge bank, which by itself is a testimony for the uncertainty that exists in this field today.³⁻⁸ Without a clearly defined, universally accepted diagnostic algorithm for AA, a condition which is so common in our day to day practice, diagnosticians are at crossroads in selecting the right path. In this review, we intend to make an attempt to organize the approach to AA, especially with reference to the imaging diagnosis.

Clinical perspectives

Historically, clinical assessment has always played a vital role in the diagnosis and management of AA, and remains the cornerstone of diagnosis even today.⁹ There are well-known confounders which often come in the way of accurate clinical diagnosis of AA, especially in the young women and extremes of age. Since the recognition of AA as a clinical entity, clinicians have been facing the dilemma of balancing two important but reciprocal measures, namely perforation rate and negative appendectomy rate (NAR). Alfredo Alvarado was one of the first to develop a practical score for early diagnosis of AA taking clinical and certain laboratory parameters with the sole aim to reduce NAR without proportionately increasing the perforation rate.¹⁰ Since then, a number of scoring systems have been and are still being developed to increase the diagnostic accuracy for AA.¹¹⁻¹⁴ Most of these scoring systems use clinical and various laboratory parameters for the diagnosis of AA. Alvarado scoring has been extensively used and tested in last three decades. Alvarado scoring is a useful clinico-pathological tool to diagnose AA, though many components of the scoring system are non-specific.

Prompt and accurate diagnosis with timely initiation of appropriate treatment remains the cornerstone for successful management of AA. The relative importance assigned to clinical diagnosis of AA based on history and physical examination findings, with or without laboratory markers, varies widely not only amongst different countries but even amongst institutions within the same country. It may not be incorrect to state that with the availability of various biomarkers and cross-sectional imaging like ultrasound, computed tomography (CT) scan and magnetic resonance imaging (MRI), clinical assessment is possibly being often relegated to a back seat. The situation becomes further complicated in the setting of pregnancy. However, it is heartening that though dwindling in numbers, there exist a sub-set of clinicians in many countries including India, who still trust their clinical acumen more than any investigative modalities when it comes to final diagnosis and management of AA.

Ironically, majority of research publications have focused on the ability of a particular diagnostic tool to detect presence or absence of AA as its prime objective rather than considering AA as a disease process having its own spectrum of evolution. Alternative diagnoses/differential diagnosis of clinical mimics of AA is discussed much less frequently. Similarly, the importance of close observation and monitoring in equivocal cases is often understated. Today, the fear of missing the diagnosis of AA is possibly unfounded. What adds to the woes are the reports of significant discordance between operative and histopathological diagnosis.^{15,16}

There has been a paradigm shift in the clinician's outlook as far as the optimal management of AA is concerned. Firstly, the clinicians are now striving to achieve the lowest possible NAR using whatever diagnostic means available today. This includes disproportionately increased usage of CT scan in many parts of the world over the last three decades. Gone are the days, when a NAR of 20-30% was acceptable to the clinicians. Secondly, it is amply clarified in the literature that there is no need to rush for early appendectomy in doubtful cases.^{17,18} Thirdly, the age old concept of 'early appendectomy' as the sole remedy for all cases of AA is being increasingly questioned with an alternative, although debatable, therapeutic option of conservative treatment with antibiotics for the select group of uncomplicated AA.^{2,7,9,19-21}

Inflammatory biomarkers

A raised total leukocyte count with a shift to left is well known to be associated with AA depending on the severity of the disease. Similarly, C-reactive protein (CRP) has also been found to be helpful in supporting clinical diagnosis of AA. A combination of leukocyte count and CRP assay helps to predict appendicitis inflammatory response score.^{5,12,22} Various other biomarkers that are being studied include serum bilirubin level, D-dimer, pro-calcitonin, neutrophil to lymphocyte ratio, mean platelet volume, red blood cell distribution width, etc. It is important to understand here that most of these inflammatory markers are likely to be elevated/positive in many other inflammatory/infective conditions and are not specific to AA alone.

Role of radiology

Radiologists have always played significant role in the evaluation of a suspected case of AA. Since the advent of cross-sectional imaging, radiologist's role has vastly expanded in the diagnosis of AA and its complications. Today's clinicians have become increasingly dependent on imaging correlation besides laboratory markers to confirm their clinical judgment, before planning management of acute abdomen including AA. It would be very uncommon today to treat a patient of suspected AA without the help of cross-sectional imaging. The role of imaging lies not only in the prompt and accurate diagnosis of AA and its complications, but also in the reliable exclusion of AA and providing alternative diagnosis in the appropriate situation. It is widely believed, barring a few exceptions, that cross-sectional imaging has been instrumental in reducing NAR to a reasonably

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