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Review Article

IMAGING AS AN AID TO THE DIAGNOSIS OF ACUTE APPENDICITIS

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ABSTRACT

Acute appendicitis has been known as a disease entity for well over a century but a confident diagnosis before surgery in all patients suspected of the condition is still not possible. Timely diagnosis is essential to minimise morbidity due to possible perforation of the inflamed organ in the event treatment is delayed; so much so that surgeons often preferred to operate at the slightest suspicion of the diagnosis in the past. This resulted in the removal of many normal appendixes. When the diagnosis of appendicitis is clear from the history and clinical examination, then no further investigation is necessary and prompt surgical treatment is appropriate. Where there is doubt about the diagnosis however it is advisable to resort to imaging studies such as abdominal ultrasound or computed tomography to clear such suspicions before subjecting the patient to an appendicectomy. These studies would also help avoid delays in surgery in deserving patients.

Key words: *Appendicitis, diagnosis, computed tomography, ultrasound*

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INTRODUCTION

Acute appendicitis, as we know it today, was first diagnosed in 1886.[1] Although it is by far the most common acute abdominal emergency that requires surgical treatment,[2] a confident diagnosis of acute appendicitis before operation in all patients is still beyond reach. Since family physicians may have first contact with at least some of these patients it is imperative that they are familiar with the clinical features as well as the initial steps in making the diagnosis.

Diagnostic difficulty is particularly common in children[3] in whom the symptoms and signs may often be somewhat nonspecific. The fact that the position of the appendix is also more abdominal rather than pelvic in children makes certain physical signs, particularly the point of maximum tenderness, different. Diagnostic problems are also common in the elderly of both genders as well as in women of reproductive age. Since the most common extra-uterine emergency that requires surgery during pregnancy is also acute appendicitis[4] it is even more important to arrive at the correct diagnosis in this group of patients.

Accurate and timely diagnosis of the condition is essential in all groups of patients to minimise morbidity as only prompt surgical treatment would ensure reduction of the risk of perforation of the appendix. This is because there is a significant rise in mortality from less than 1% in non-perforated cases to 5% or more when perforation does occur.[5] Largely because of this, surgeons over the years preferred to perform appendicectomy at the slightest suspicion of acute appendicitis rather than to 'sit on' such patients and risk the grave consequences associated with perforation of the organ. Even half a century ago, the typical advice to surgeons in training used to be "If the diagnosis of appendicitis is in doubt, take the appendix out".[6] Take the appendix out they did, often in the middle of the night!

This policy however resulted in many normal appendixes being removed and the rather embarrassing non-therapeutic appendicectomy rates sometimes as high as 50 per cent.[7] Clearly, this position have to improve.

CLINICAL DIAGNOSIS

The diagnosis of acute appendicitis has always been clinical, based on the patient's history and the findings on physical examination but unfortunately there is such wide variation in the clinical presentation of the disease that diagnostic errors are committed worldwide; too frequently for comfort.[8] The few studies reported from Malaysia also reveal that there is room for improvement in our diagnostic accuracy.[9,10] In a retrospective Malaysian study of the pathology of 1000 consecutive appendicectomy specimens, where the pre-operative diagnosis was acute appendicitis, up to 22.5% of

appendixes removed did not have acute inflammation.[11] A diagnostic delay may of course result in a higher perforation rate too, as detected at the time of surgery.[9,12]

As would be expected, abdominal pain is the most common presenting symptom. The classic sequence of central abdominal pain shifting to the right lower quadrant of the abdomen usually within 12 to 24 hours of onset, sometimes even earlier, followed at times by vomiting, as first described by Murphy[13], however occurs in less than half of the patients.[14] It is also well-known that the variable anatomical position of the appendix contributes to the actual site of maximal pain and tenderness thus confusing the clinical picture even further,[15] e.g. pain and tenderness in the right loin when the inflamed organ is retrocaecal or retrocolic in position. Other often mentioned clinical features such as constipation or diarrhoea are somewhat less constant. The presence of a low-grade fever (up to 38°C) with tachycardia is relatively common but a significant elevation of temperature is present in less than a fifth of patients.[14]

Examination of the abdomen in most patients usually reveals localised tenderness and guarding in the right iliac fossa. Rebound tenderness is often present but looking for percussion tenderness would be a more humane way of gathering the same information. The patient often lies rather still too since any movement exacerbates the pain.[16] The site of maximum tenderness is usually at McBurney's point as first observed by McBurney himself.[17] Findings on per rectal or per vaginal examination may be normal, although tenderness towards the right may be felt particularly if the inflamed appendix happens to lie in the pelvic position. A positive Rovsing's sign (where deep palpation of the left iliac fossa causes pain in the right lower quadrant), a positive psoas sign (where the patient is seen to lie in bed with the right hip flexed for some relief of pain since the inflamed appendix lies on the right psoas muscle) and a positive obturator sign (pain felt in the hypogastrium on flexion and internal rotation of the right hip) may help in the diagnosis of less obvious cases.

If the diagnosis of appendicitis is clear from the history and clinical examination at the time the patient is first seen, then no further investigation is necessary and prompt surgical treatment is indicated[18] but since that is so in only about half of the patients,[8] acute appendicitis can be one the most difficult diagnoses to make with certainty resulting in delays in treatment, unnecessary hospital admissions for observation and at times unnecessary surgery.

BLOOD TESTS

Laboratory tests, particularly the white blood cell count (WBC) are often done in the initial evaluation of patients with right lower quadrant pain in order to confirm or exclude the suspected diagnosis. Eighty per cent of patients with acute appendicitis are found to have a leucocytosis and 80% of these harbour a neutrophilia greater than 75%. This, being a sensitive indicator of underlying inflammation, was almost universally used to aid the diagnosis of acute appendicitis early on but on its own has a low specificity and thus low predictive value for appendicitis, being evident in such a large number of other acute inflammatory conditions causing similar pain in the right lower quadrant.[19] Added to this is the interesting but unfortunate fact that the proportion of gangrenous and perforated appendixes in patients with a normal white cell count may be the same as in those with a raised count.[20] C-reactive protein (CRP) can also be used. A normal pre-operative CRP in a patient clinically suspected to have acute appendicitis is most often associated with a normal appendix but if raised along with at least one other inflammatory marker the diagnosis of acute appendicitis becomes more likely.[16]

The overall diagnostic accuracy achieved by the history, physical examination and laboratory tests even at the present time is only about 80 per cent, at best.[21]

IMAGING

Diagnostic imaging is not among the recommended routine where the clinical assessment points to a clear diagnosis of acute appendicitis but where the latter is equivocal, making use of imaging to clarify the diagnosis may be considered. A few newer radiologic modalities have been shown to improve patient outcomes.[22]

Plain abdominal radiography

Plain abdominal radiography, being the most readily available among them was naturally the first investigation thus used. Localised ileus in the right lower quadrant of the abdomen detected as a dilated sentinel loop of bowel, air-fluid levels in loops of bowel in the right lower quadrant on an erect abdominal film, an increase in the soft tissue density in the same area, obliteration of the psoas shadow or lumbar scoliosis may be detectable in up to half of the patients with early acute appendicitis.[23] An opaque faecolith may be apparent in the right lower quadrant in fewer than 5% of patients subject to abdominal radiography. Plain radiography, however, has a low sensitivity and specificity for the diagnosis of acute appendicitis and can even be misleading.[24] So, generally speaking, plain abdominal radiographs are not really recommended unless other conditions (e.g. perforation of a viscus, intestinal obstruction, ureteric calculus) are considered in the differential diagnosis.[7]

Likewise, as other more convenient imaging techniques are available, barium enema is now used infrequently[25] although

there was a tendency to use barium studies to exclude the condition in the past.

Ultrasonography

Ultrasound (US) has been in regular use for nearly four decades as a diagnostic tool for the investigation of right lower quadrant pain in gynaecology but had no place of prominence in the investigation of similar pain in general surgical practice. Its use to visualise the inflamed appendix during early attempts to do so was limited by the interference of overlying gas-filled loops of intestines. More recently, however, the technique of graded compression has been used to overcome this handicap by displacing such loops of bowel away from the appendix without undue discomfort to the patient; so the virtues of ultrasound scanning to establish the diagnosis of acute appendicitis are clearer today.[27,28] Ultrasound appearances of the inflamed appendix are rather characteristic in that the inflamed organ is usually non-compressible and there is dilatation of the lumen. Less often, thickening of the neighbouring caecum as well as the presence of peri-appendiceal fluid might be noticed.

A marked reduction in the negative appendicectomy rate was shown after the introduction, in recent years, of ultrasound imaging for the diagnosis of acute appendicitis.[27] Ultrasound is relatively inexpensive, can be arranged with speed, does not need injection of contrast, and is safe even when investigating a pregnant patient. During the examination, the appendix is identified as a blind-ending, nonperistaltic loop of bowel attached to the caecum. The investigation is considered positive for acute appendicitis if the appendix measures 6 mm or more in diameter and even more likely with thickening of the appendiceal wall itself and the demonstration of periappendiceal fluid. The demonstration of an appendicolith is also highly suggestive of the diagnosis.[21]

Diagnosis of acute appendicitis during pregnancy is notoriously difficult. Some of the early symptoms such as nausea and vomiting might unfortunately be mistaken for features of pregnancy itself as would an elevated neutrophil count. The displacement upwards and sideways of the appendix by the enlarging uterus adds to the diagnostic difficulty in that the area of maximum tenderness on the abdominal wall may be well away from McBurney's point. Furthermore, the laxity of the abdominal wall associated with pregnancy often prevents the development of the expected rebound tenderness and guarding. Ultrasound of course would be a useful investigation to resolve such diagnostic doubt under these circumstances, enabling early surgery since foetal mortality rises sharply if the appendix perforates during pregnancy.[4]

In the early days, the likelihood of acute appendicitis was excluded if the appendix was not visualised on ultrasound but today such a study would be considered inconclusive and other imaging modalities recommended. If acute appendicitis is excluded sonograpically, a survey of the remainder of the abdomen and pelvis would usually be done for evidence of other pathology to account for the patient's clinical features. The sonographic diagnosis of acute appendicitis has a reported sensitivity of 86 to 96 per cent and a specificity of 85 to 98%.[29,30,33]

Computed tomography

Computed tomography, mostly in the form of helical scanning is now more widely used to diagnose acute appendicitis, particularly in North America. In a CT scan, as indeed it does on US, the inflamed appendix appears swollen with a thickened wall and with peri-appendiceal fat stranding. Other evidence of acute inflammation such as thickened mesoappendix and periappendiceal fluid is also looked for. Faecoliths, where present, are rather easily visualised. As with US, CT scanning may also help identify other intra-abdominal inflammatory processes that mimic acute appendicitis.

There is documented improvement in diagnostic accuracy with the use of CT scanning in patients suspected to have appendicitis. It has yielded even higher figures for accuracy compared to US.[31] The use of CT resulted in a lowering of the negative appendicectomy rate as observed in several studies[32] whereas in women an even more remarkable reduction from 24% to 5% was achieved.[33] There are however some obvious disadvantages in that CT scanning is still relatively expensive, exposes the patient to significant radiation, and of course is contraindicated in pregnancy.

CONCLUSION

Acute appendicitis still remains largely a clinical diagnosis supported at times by basic laboratory investigation. Where there is doubt, it is justifiable, indeed advisable, to resort to the use of imaging techniques to clear such doubt rather than subject the patient to an unnecessary appendicectomy. In the same vein, undue delays in performing early surgery on deserving patients would of course be avoided.

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Honey reduces nocturnal cough in children with URTI

Paul IM, Beiler J, McMonagle A, *et al.* Effect of honey, dextromethorphan, and no treatment on nocturnal cough and sleep quality for coughing children and their parents. *Arch Pediatr Adolesc Med.* 2007;161(12):1140-6

This is a randomised controlled trial comparing single dose of buckwheat honey, honey-flavoured syrup dextromethorphan and no treatment in 105 children with viral upper respiratory tract infection. Cough frequency and severity in children given honey was reported by parents to be significantly less when compared to no treatment group. Dextromethorphan did not fare better than no treatment.