

Acute appendicitis

Introduction

Acute appendicitis is the commonest cause of the 'acute abdomen' in this country. It can occur at any age, but is unusual before the age of 5 years, becomes less frequent after the 30s and is rare in the elderly. The disease has a worldwide distribution, but its incidence does appear to be associated with the western diet, although the reason for this is subject for debate. When people move from central Africa or the Indian subcontinent to the western world, or change to its diet, appendicitis increases in its frequency.

Surgical anatomy

The appendix arises from the postero-medial aspect of the caecum (Figures 1 and 2). Both its size and position are extremely

variable – indeed it has been said that 'the appendix is the only organ with no anatomy'. Its length varies from 1 to 25 cm. Usually it lies in the retrocaecal position (75%). If very long, it may ascend extraperitoneally behind the ascending colon, its tip lying against the right kidney. In about 20% of cases, the appendix lies in the subcaecal position or dangles down into the pelvis. Occasionally it lies in front of the caecum or, if long, extends over to the left iliac fossa up against the sigmoid colon.

Dextrocardia may be associated with transposition of all the viscera, with the caecum and appendix being situated on the left side of the abdomen. Most experienced surgeons (including the author) will have dealt with a true left-sided appendicitis in such circumstances.

The arterial supply of the appendix is from the appendicular branch of the ileocolic artery (Figure 2). This represents the entire blood supply of the organ. It runs first along the free edge of the appendix mesentery and then along its wall. Thrombosis of the terminal branches of this artery in acute appendicitis inevitably results in gangrene and subsequent perforation. This is in contrast to acute cholecystitis, where the rich collateral blood supply to the gall bladder, from branches of the right hepatic artery in the liver bed, accounts for the comparative rarity of gangrene in acute cholecystitis. This enables the surgeon to treat most cases of acute cholecystitis conservatively.

Note that the colon and caecum, unlike the appendix, are characterized by the outer longitudinal muscle layer being condensed into three longitudinal bands, the taniae coli. Indeed, in searching for a 'difficult' appendix, tracing a couple of taeniae along the caecum until they meet is a well-known method of identifying the appendix base.

Pathology

Examination of a series of fresh specimens of acute appendicitis removed surgically will reveal two groups. The first demonstrate diffuse inflammation of the whole organ (Figure 3). The mucosa is inflamed and may demonstrate patchy necrosis, while the serosa is covered with a fibrinous exudate. The aetiology is probably bacterial invasion of the lymphoid tissue of the appendix wall. Because the lumen of the appendix is not obstructed, these cases do not usually progress to gangrene and, in many cases, the attack may resolve.

Repeated episodes may result in kinking, or swelling of the lymphoid tissue in its wall leads to obstruction and it is interesting that an episode of gangrenous appendicitis may have been preceded by one or more milder resolving attacks. Obstructive appendicitis is also frequently seen distal to an impacted faecolith in the lumen of the appendix. Once thrombosis occurs in the end-artery supply of the appendix, necrosis and gangrene of the organ is inevitable (Figure 4). This may result in free perforation into the perito-

Figure 1. The anatomy of the appendix. (Percentages refer to anatomical position.)

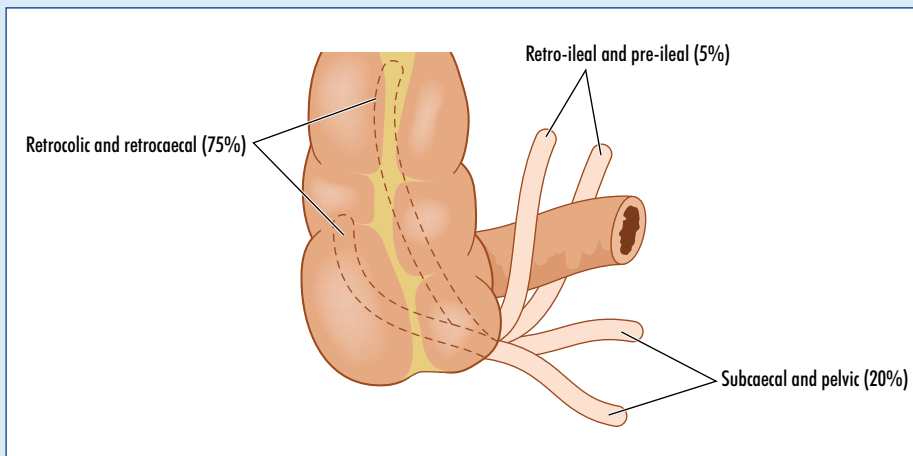
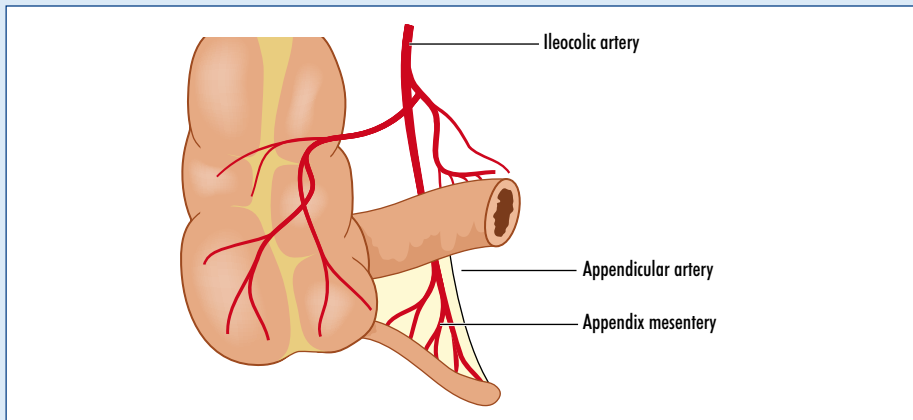


Figure 2. The blood supply of the appendix.



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neal cavity, with peritonitis or, less often, with the formation of a localized appendix mass (Figures 5 and 6). Rarely, occlusion of an appendix by a faecolith or adhesive kink when the organ happens to be empty results in its becoming distended with mucus, secreted by the mucous glands in its wall ('mucocele of the appendix').

Note that appendicitis may occur in pregnancy – indeed the incidence is the same as in any other 9 months of a woman's life. However, the appendix and caecum are pushed up by the enlarged uterus, so the condition is mistaken for an upper abdominal pathology, such as cholecystitis.

Diagnosis

In no other common clinical situation is early diagnosis and prompt management so important as in the management of the 'acute abdomen'. To leave a patient with

Figure 3. An acutely inflamed, non-gangrenous appendix, photographed at operation.



Figure 4. A gangrenous, perforated appendix after operative removal.



suspected acute appendicitis overnight, well sedated, while waiting for further sophisticated investigations or observations, or for the convenience of theatre staff, may miss the opportunity for smooth recovery of the patient, who may by now be seriously ill with general peritonitis.

The classical story is of central, periumbilical, abdominal pain, with nausea or vomiting. After some hours, the pain shifts to the right iliac fossa, is now continuous and more severe, and is aggravated by any movement. The central pain is the result of stretching of the inflamed appendix wall, and has the T10 autonomic referral of periumbilical pain. The pain then shifts to the site of parietal peritoneal irritation at the site of the inflamed appendix – usually the right iliac fossa, but anywhere from the right flank to down towards the pelvic brim or even the left iliac fossa. Rapid progression to gangrene may occur within 12 hours; in other cases an acutely inflamed but non-perforated appendix may be removed after 3 or 4 days.

On examination, a good aphorism to remember is that 'there are no constant physical signs in appendicitis'. The temperature and pulse are usually raised, and the tongue is often coated. In the early case, there is guarding and tenderness at the site of the appendix, usually in the right iliac fossa, and tenderness on rectal examination when the appendix lies in the pelvic position. In late cases, with peritonitis, the patient is obviously severely ill, the abdomen diffusely tender, rigid and silent.

If the perforated appendix has become walled off into an appendix mass, the examiner can palpate a tender mass in the right iliac fossa (Figure 6) and may detect a boggy mass on rectal or vaginal examination, but the rest of the abdomen is soft and bowel sounds are present. It must be stressed that there are no specific clinical features of acute appendicitis – they are those of right lower abdominal peritoneal inflammation.

The differential diagnosis is wide, and includes Meckel's diverticulitis, acute Crohn's ileitis, mesenteric adenitis, renal

Figure 5. Pathological pathways in acute appendicitis.

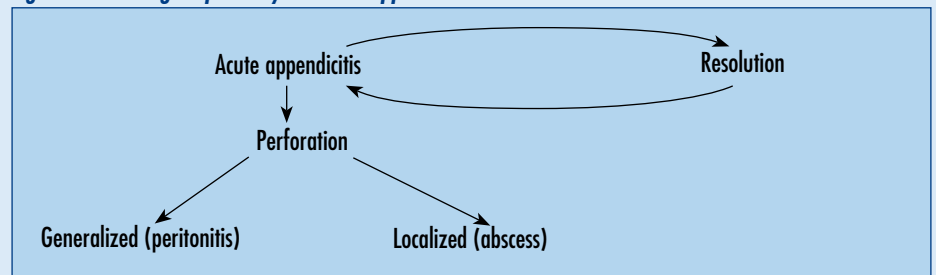


Figure 6. Patient with an appendix mass marked out on his abdominal wall. The mass resolved under conservative treatment and appendicectomy was performed 12 weeks later.



tract infection and, in the female, right-sided salpingitis, ruptured ovarian cyst and ectopic pregnancy. A missed period and positive pregnancy test (serum beta human chorionic gonadotropin) helps confirm the latter. Basal pneumonia and pleurisy may give referred abdominal pain and be surprisingly difficult to differentiate, especially in children. Auscultation may detect a rub and a chest X-ray may demonstrate pneumonia. Clinical surgery is difficult – the author has removed a gangrenous appendix from a child with undoubted pneumonia.

Nothing can be so easy, nor anything so difficult, as the diagnosis of acute appendicitis. The surgical trainee may smile indulgently at the long list of differential diagnoses given in the textbooks. However, as year follows year, he or she will experience the chagrin of making most, if not all, these errors.

Special investigations

Leucocyte count

A mild polymorph leucocytosis is usually present; a normal count certainly does not exclude the diagnosis.

Plain abdominal X-ray

This is unhelpful except in excluding other causes – ureteric stone, bowel obstruction or perforation.

Abdominal ultrasonography

In expert hands this has a sensitivity reported as between 78 and 98.5% and a specificity of 85–98% (Jeffrey et al, 1994). The most sensitive sign is a non-compressible appendix with a diameter of 7 mm or more. The main drawback is that, in most hands and in most cases, a normal appendix cannot be seen, so a negative ultrasound when the appendix is not visualized is of little value. Ultrasound is well suited for thin patients and for children. It is useful also in

the diagnosis of pelvic pathologies, especially ovarian cyst (which may have ruptured), ectopic pregnancy and pyosalpinx.

Abdominal computed tomography is a highly accurate test for confirming or refuting the diagnosis of acute appendicitis (Rao and Boland, 1998). Local practice will depend on the availability of expert radiological staff and imaging facilities at short notice.

It must be stressed that speed is vital in dealing with this emergency. If obtaining sophisticated investigations and skilled help mean that surgery is to be delayed, say until the next day, then the surgeon must rely on experience and judgement in making the decision to operate at once on his/her clinical diagnosis.

Treatment

The importance of urgent surgery has already been emphasized in all cases except when a local mass has formed. Metronidazole is given by rectal suppository and one dose, given on admission, suffices in the early case. Where a gangrenous or perforated appendix is found at surgery, metronidazole is supplemented by gentamycin or a cephalosporin and this regimen is continued for 5 days. The choice of antibiotic may require modification depending on the result of bacteriological investigation of the appendix, peritoneal exudate and/or pus. Appendectomy is performed either by open surgery or laparoscopically. Open surgery is carried out through a 'grid iron' or skin crease right iliac fossa incision.

The grid iron incision is centred on McBurney's point, one third of the way along a line joining the anterior superior iliac crest with the top of the pubic symphysis. The lateral abdominal aponeuroses are split along the line of their fibres. It is a reasonably aesthetic incision, and has the great virtue that it can be greatly extended,

both medially and laterally, in a difficult case or when some other pathology is revealed.

These days, many surgeons favour the skin crease incision, which certainly heals with an almost invisible scar. Care must be taken that the incision is commenced just medial to the anterior superior iliac spine. If centred over McBurney's point, it will take the surgeon down onto the rectus sheath rather than the oblique muscles. It is also more difficult to enlarge in a difficult case. On opening the peritoneal cavity, a bacteriological swab is taken for culture. The appendix is delivered by drawing out the caecum. Lateral mobilization of the caecum may be needed if the appendix is lying in the retrocolic position. The appendix mesentery and its contained vessels are divided and ligated, the appendix base is crushed and ligated and the appendix removed. It is no longer the practice to bury the stump of the appendix into the caecum.

Laparoscopic appendectomy is becoming increasingly used, especially in female patients, where misdiagnosed pelvic pathologies can readily be dealt with. There is faster recovery and excellent cosmesis, but the operative time is longer and there is a greater risk of residual intra-abdominal infection.

The appendix mass

Not uncommonly, the patient presents with a history of several days of abdominal pain, a localized mass in the right iliac fossa and a soft abdomen (*Figure 6*). Here the inflamed appendix has become walled off by adhesions to the omentum and adjacent viscera.

Differential diagnosis must be made from other masses, for example carcinoma of the caecum or Crohn's disease.

On conservative management, comprising careful observation and a short course of metronidazole, the mass usually resolves and interval appendectomy is performed after an interval of 3 months. If the mass enlarges under observation, drainage of the abscess is carried out – often percutaneously under ultrasound control. **BJHM**

Conflict of interest: none.

Jeffrey RB, Jain KA, Ngheim HV (1994) Sonographic diagnosis of acute appendicitis; interpretive pitfalls. *Am J Roentgenol* **162**: 55–9
Rao PM, Boland GWL (1998) Imaging of acute right lower abdominal quadrant pain. *Clin Radiol* **53**: 639–9

KEY POINTS

- Acute appendicitis is the commonest cause of the 'acute abdomen' in this country.
- The appendix has an end artery supply. If this vessel thromboses in an acute attack, gangrene and then perforation are inevitable, with either general peritonitis or formation of a local abscess.
- Diagnosis is often straightforward but may be difficult. Differential diagnosis includes most of the causes of acute abdominal pain – other acute abdominal or pelvic pathologies, and acute urological, chest and even CNS diseases.
- Diagnosis is essentially clinical. Imaging in expert hands is useful but must not delay urgent surgery. The exception is the appendix abscess, which frequently resolves under conservative treatment.