Appendicitis

Acute appendicitis is sudden inflammation of the appendix, usually initiated by obstruction of the lumen. This results in invasion of the appendix wall by gut flora, and it becomes inflamed and infected. If the appendix then ruptures, infected and faecal matter escape into the peritoneal cavity, producing life-threatening peritonitis. Alternatively, particularly if perforation or gangrene occurs after 24 hours or more, the inflamed surfaces may become stuck together first so that the peritonitis is trapped and localised. Sometimes the inflamed appendix becomes surrounded by omentum which adheres and localises the infection more effectively, forming an appendix mass or appendix abscess. [1]

Epidemiology

- Appendicitis is the most common cause of an acute abdomen in the UK. [2]
- About 10% of the population will develop acute appendicitis. [2]
- Appendicitis is most common between the ages of 10 and 20 years but can occur at any age. [3]
- Appendicitis is more common in men. [3]
- A normal appendix is removed at 10-20% of appendicectomies. [2]

Presentation

Classic symptoms often do not appear in young children, in pregnant women and in the elderly and the diagnosis is particularly easy to miss in these age groups. The classical presentation consists of:

- Pain:
  - Early periumbilical pain moves, after hours or sometimes days, to the right iliac fossa (RIF) as the peritoneum becomes involved. Pain which wakes the patient or keeps a child awake is significant.
  - Movement and coughing aggravate the pain. The patient may lie still with shallow breathing. Deep breathing and coughing hurt.
  - Nausea, vomiting, anorexia. The patient is usually constipated or simply does not want to have the bowels open, but may have diarrhoea. Rapidly progressive cases may have recurrent vomiting without fever and diarrhoea. This may be marked in post-ileal appendix (which is rare).
  - Temperature and pulse are initially normal. Low-grade pyrexia then develops.
  - A rising pulse rate may be an indication of peritonitis.
  - Localised tenderness, guarding and rebound tenderness develop in the RIF.
  - Rovsing’s sign may be positive: palpation of the left lower quadrant increases the pain felt in the right lower quadrant. This pressure stretches the entire peritoneal lining, and so causes pain in any location where the peritoneum is irritating the muscle.
  - RIF peritonism can also be demonstrated by percussion tenderness or rebound tenderness.
  - Other methods to demonstrate an inflamed appendix include: the psoas test (extend the hip and abduct the thigh with the patient on the left side) and the obturator test (flex and internally rotate the right hip).
  - A retrocaecal or pelvic appendix may be missed. Rectal examination may reveal localised tenderness as the only sign of an inflamed retrocaecal or pelvic appendix.
  - Stage of illusion: just after perforation, a child may sit up in bed apparently better. A rising pulse rate may be the only indication of perforation, before the obvious signs of peritonitis develop.

Atypical presentations

- Pain may be atypical due to unusual appendix positioning. The position of the appendix can vary considerably in non pregnant individuals. A fully mobile caecum and ascending colon are rarely present, although some degree of caecal mobility is found in 10-20% of patients at post-mortem, which may have significance for the presentation of appendicitis. [4, 5] Pain, therefore, may be predominantly left-sided pain in the upper and/or lower quadrants, suprapubic pain, generalised abdominal pain, low back pain or rectal pain.
- This makes it important to consider the appendix as a differential diagnosis of all acute abdominal pain, and to identify the caecum by imaging in patients with suspicion of acute appendicitis and atypical pain.
- Pregnancy: the appendix is usually pushed upwards on the abdomen by the developing uterus in the second trimester of pregnancy. Pain and tenderness may be higher in pregnant women, although RIF symptoms are still the main presentation.
- Infants may present with watery diarrhoea and vomiting.
- Young children may show only vague abdominal pain and anorexia.
- Elderly patients may present with confusion without pain. They may also present with shock. Progression can be very rapid.

Scoring systems

- The diagnosis of acute appendicitis is mainly based on clinical assessment and experience.
- Diagnosis may be difficult and scoring systems have been shown to be useful in determining the need for further investigation and treatment for acute appendicitis.
One example is the Alvarado scoring system which scores the following indicators:
- Symptoms: migratory RIF pain (scores 1), nausea or vomiting (1), anorexia (1).
- Signs: tenderness in the RIF (2), rebound tenderness in the RIF (1), elevated temperature (1).
- Laboratory findings: leukocytosis (2), shift to the left of neutrophils (1).
- From a total possible score of 10, one study recommended further investigation with CT scan for a score of 4-6, and consideration of appendicectomy for scores of 7 or above.\(^6\)

Another example is the RIPASA score (= the Raja Isteri Pengiran Anak Saleha Appendicitis score). This uses 15 parameters, each scoring 0.5, 1, or 2. The scores are generated by:
- Age - less than 40 years (1 point); greater than 40 years (0.5 point).
- Gender - male (1 point); female (0.5 point).
- RIF pain (0.5 point).
- Migration of pain to RIF (0.5 point).
- Nausea and vomiting (1 point).
- Anorexia (1 point).
- Duration of symptoms (less than 48 hours (1 point); more than 48 hours (0.5 point).
- RIF tenderness (1 point).
- Guarding (2 points).
- Rebound tenderness (1 point).
- Rovsing's sign (2 points).
- Fever (1 point).
- Raised white cell count (1 point).
- Negative urinalysis (1 point).
- Foreign national registration identity card (the paper originated in Singapore) (1 point).
- A score of 7.5, had a sensitivity of 88%, a specificity of 67%, a positive predictive value (PPV) of 93% and a negative predictive value (NPV) of 53% for appendicitis.\(^7\)

Differential diagnosis

Other causes of abdominal pain

Gastrointestinal
- Gastrointestinal obstruction, constipation, intussusception, strangulated hernia, acute cholecystitis, perforated peptic ulcer, mesenteric adenitis, Meckel's diverticulitis, Crohn's disease, diverticulitis, pancreatitis, rectus sheath haematoma, gastroenteritis.

Urological
- Testicular torsion, renal calculi, urinary tract infection.

Gynaecological
- Ectopic pregnancy, torsion or rupture of an ovarian cyst, pelvic inflammatory disease.

Others
- Diabetic ketoacidosis, pneumonia, porphyria, adverse effects from immune modulation therapies (eg, panniculitis in the abdomen at the left iliac fossa, associated with beta-interferon injection).\(^8\)

Other causes of RIF mass
These include:
- Crohn's disease, carcinoma of colon, mucocele of the gallbladder, psoas abscess, pelvic kidney, ovarian cyst.\(^9\)

Investigations

Appendicitis is essentially a clinical diagnosis (see separate article Abdominal Examination). However, the following may be useful:
- Urinalysis to exclude urinary tract infection.
- Pregnancy test to exclude ectopic pregnancy.
- FBC: there is usually a mild leukocytosis but a normal white cell count does not exclude appendicitis.
- Raised inflammatory markers: CRP may be raised but a normal level does not exclude a diagnosis of appendicitis.
- Ultrasound may help in some patients where the diagnosis is doubtful and in the assessment of an appendix mass or abscess.
- CT scanning is more sensitive and specific than ultrasound when diagnosing acute appendicitis.\(^3\) It is becoming increasingly used and this has lowered the rate of negative appendectomies in women under the age of 45 years in some centres.\(^10\)
- Most useful predictors of acute appendicitis on CT are enlarged appendix, appendiceal wall thickening, peri-appendiceal fat stranding, and appendiceal wall enhancement.\(^11\)
- Diagnostic laparoscopy may be considered.
There is a particular imperative to detect appendicitis early in young women, as perforation may lead to impaired fertility later in life.

Management

- All suspected cases should be admitted to hospital.
- Appendicectomy is the treatment of choice and this is increasingly done as a laparoscopic procedure.\cite{12, 3}
- Spontaneous resolution of early appendicitis can occur.\cite{11}
- However, because of relatively low morbidity and mortality associated with appendicectomy, and concern about possible readmission rates, early operative intervention remains the treatment of choice.\cite{3, 13}
- Medical treatment including antibiotics may be an alternative to surgery. There is as yet no absolute consensus and studies continue. For now surgical treatment is the accepted standard but there is an increasing body of evidence for conservative treatment, both in simple and in complicated cases (including perforation).\cite{13, 14, 15, 16, 17, 18}
- In cases of diagnostic doubt a period of 'active observation' can be useful.
- Intravenous fluids and opiate analgesia are also required.
- Pre-operative antibiotics are associated with a reduction in surgical site infections. The benefit of additional postoperative antibiotics remains unclear.\cite{19}
- There is considerable evidence for laparoscopic appendicectomy rather than open appendicectomy approach. Many studies suggest the laparoscopic approach leads to a reduced hospital stay and more rapid return to normal activity, both in uncomplicated and in complicated appendicitis (including cases with perforation). The jury is still slightly out, however, as some studies are inconclusive as to whether there is a true difference in outcome between the two surgical approaches.\cite{20, 21, 22, 23, 24}
- Young female, obese, and employed patients seem particularly to benefit from laparoscopic appendicectomy.\cite{20}
Complications

- Perforation: the average rate of perforation at presentation is between 16% and 30% (significantly higher in elderly people and young children).[3]
- Wound infection: rates of wound infection vary from <5% in simple appendicitis to 20% in cases with perforation and gangrene. Perioperative antibiotics have been shown to decrease the rates of postoperative wound infections.[1]
- Appendix mass:
  - Omamentum and small bowel adhere to the appendix.
  - Usually presents with a fever and a palpable mass.
  - Initial treatment is usually conservative with fluids, analgesia and antibiotics but urgent surgical intervention may be required if the mass enlarges or the patient's condition deteriorates.
- This conservative management approach is controversial. Traditional management has been conservative, with interval appendicectomy performed weeks after the mass has resolved. This remains the most common approach at many centres in the world. Recently, an increasing number of studies have challenged this approach.[25, 26]
- Appendix abscess: can be shown by ultrasound or CT scan; initial treatment is usually by percutaneous or open drainage (open drainage also enables appendicectomy) – but, again, there is controversy and a lack of a clear ‘best option’, with some surgeons preferring initial conservative management (fluids and antibiotics) with appendicectomy after delay.[27, 28]
- Other acute complications include pelvic abscess, subphrenic abscess, paralytic ileus and septicaemia.
- Long-term complications: adhesions may cause intestinal obstruction but this is uncommon.
- Maternal mortality is very low in acute appendicitis in pregnancy but increases to 4% with perforation in late pregnancy. Fetal mortality is less than 1.5% but increases to 20-35% in cases of perforation.[9]

Prognosis

- Appendicectomy is relatively safe with a mortality rate for non-perforated appendicitis of 0.8 per 1,000 and mortality after perforation of 5.1 per 1,000.[3]
- The mortality rate is more than 20% in patients older than 70 years. More subtle symptoms and a more virulent pathologic course mean the disease can progress rapidly. This leads to delayed diagnosis and hospitalisation, and delayed treatment. The high incidence of co-morbidities and the wide range of differential diagnostic possibilities in this age group are also factors.[20]

Further reading & references

2. Benjamin IS, Patel AG; Managing acute appendicitis. BMJ. 2002 Sep 7;325(7363):505-6.
9. Acute appendicitis; Surgical Tutor
21. St Peter SD, Apuyao P, Fraser JD, et al; Interval appendicectomy performed weeks after the mass has resolved. This remains the most common approach at many centres in the world. Recently, an increasing number of studies have challenged this approach.[25, 26]


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