The vermiform appendix

- Dr. Mohanned Alshalah
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- The vermiform appendix is considered by most to be a vestigial organ, its importance in surgery due only to its propensity for inflammation which results in the clinical syndrome known as acute appendicitis.

- Anatomy

  - It is a blind muscular tube with mucosal, submucosal, muscular and serosal layers.
  - The position of the base of the appendix is constant, being found at the confluence of the three taeniae coli of the caecum which fuse to form the outer longitudinal muscle coat of the appendix.
  - The mesentery of the appendix or mesoappendix arises from the lower surface of the mesentery of the terminal ileum.
  - The appendicular artery is a branch of the lower division of the ileocolic artery.

Four, six or more lymphatic channels traverse the mesoappendix to empty into the ileocaecal lymph nodes.

- Microscopic anatomy

  - The average length is between 7.5 and 10 cm. The lumen is irregular, being encroached upon by multiple longitudinal folds of mucous membrane lined by columnar cell intestinal mucosa of colonic type.
  - Crypts are present but are not numerous.
  - In the base of the crypts lie argentaffin cells (Kultschitzky cells) which may give rise to carcinoid tumours.
  - The submucosa contains numerous lymphatic aggregations or follicles.
  - The prominence of lymphatic tissue in the appendix of young adults seems important in the aetiology of appendicitis.
• **Acute appendicitis**

  • Acute appendicitis is relatively rare in infants, and becomes increasingly common in childhood and early adult life, reaching a peak incidence in the teens and early 20s.

  • After middle age the risk of developing appendicitis in the future is quite small.

  • The incidence of appendicitis is equal amongst males and females before puberty.

  • In teenagers and young adults the **male: female ratio** increases to 3:2 at the age of 25 years, thereafter the greater incidence in males declines.

• **Aetiology**

  • Appendicitis is clearly associated with bacterial proliferation within the appendix.

  • No single organism is responsible, indeed a mixed growth of aerobic and anaerobic organisms is usual.

  • Obstruction of the appendix lumen has been widely held to be important, faecolith or stricture is found in the majority of cases.

  • A faecolith is composed of inspissated faecal material, calcium phosphates, bacteria and epithelial debris.

  • Rarely a foreign body is incorporated into the mass.

  • A fibrotic stricture of the appendix usually indicates previous appendicitis which resolved without surgical intervention .

  • Obstruction of the appendiceal orifice by tumour, particularly carcinoma of the caecum, is an occasional cause of acute appendicitis in middle age and the elderly.

  • Intestinal parasites, particularly Oxyuris vermicularis (syn. pinworm), can proliferate in the appendix and occlude the lumen.

• **Pathology**

  • Obstruction of the appendiceal lumen seems to be essential for development of appendiceal gangrene and perforation.
• Yet, in many cases of early appendicitis the appendix lumen is patent despite the presence of mucosal inflammation and lymphoid hyperplasia.

• Once obstruction occurs, continued mucus secretion and inflammatory exudation increase intraluminal pressure, obstructing lymphatic drainage.

• Oedema and mucosal ulceration develop with bacterial translocation to the submucosa.

• Resolution may occur at this point either spontaneously or in response to antibiotic therapy.

• Where the condition progresses, further distension of the appendix may cause venous obstruction and ischaemia of the appendix wall and then bacterial invasion occurs through the muscularis propria and submucosa producing acute appendicitis.

• Finally, ischaemic necrosis of the appendix wall produces gangrenous appendicitis, with free bacterial contamination of the peritoneal cavity.

• Alternatively, the greater omentum and loops of small bowel become adherent to the inflamed appendix, walling off the spread of peritoneal contamination resulting in a phlegmonous mass or paracaeal abscess.

• Rarely, appendiceal inflammation resolves leaving a distended mucus-filled organ termed a mucocele of the appendix.

• Peritonitis occurs as a result of free migration of bacteria through an ischaemic appendicular wall, through frank perforation of a gangrenous appendix or delayed perforation of an appendix abscess.

• Factors which promote this process include extremes of age, immunosuppression, diabetes mellitus, faecolith obstruction of the appendix lumen, a free-lying pelvic appendix and previous abdominal surgery which limits the ability of the greater omentum to wall off the spread of peritoneal contamination.

• Clinical diagnosis — history

• The classical features of acute appendicitis begin with poorly localised colicky abdominal pain.

• This is due to midgut visceral discomfort in response to appendiceal inflammation and obstruction. The pain is frequently first noticed in the periumbilical region and is similar to, but less intense than, the colic of small bowel obstruction.
• Central abdominal pain is associated with anorexia, nausea and usually one or two episodes of vomiting which follow the onset of pain.

• With progressive inflammation of the appendix, the parietal peritoneum in the right iliac fossa becomes irritated producing more intense, constant and localised somatic pain which begins to predominate.

• The classical visceral—somatic sequence of pain is present in only about half those patients subsequently proven to have acute appendicitis.

• Atypical presentations include pain which is predominantly somatic or visceral and poorly localised.

• The diagnosis of appendicitis rests more on thorough clinical examination of the abdomen than on any aspect of the history or laboratory investigation.

• The cardinal features are those of an unwell patient with low grade pyrexia, localised abdominal tenderness, muscle guarding and rebound tenderness.

• Inspection of the abdomen may show limitation of respiratory movement in the lower abdomen.

• The patient is then asked to point to where the pain began and to where it moved (the pointing sign).

• Gentle superficial palpation of the abdomen, beginning in the left iliac fossa moving anticlockwise to the right iliac fossa, will detect muscle guarding over the point of maximum tenderness, classically McBurney point.

• Asking the patient to cough or gentle percussion over the site of maximum tenderness will elicit rebound tenderness.

• Deep palpation of the left iliac fossa may cause pain in the right iliac fossa (Rovsing’s sign), which is helpful in supporting a clinical diagnosis of appendicitis.

• Occasionally an inflamed appendix lies on the psoas muscle and the patient, often a young adult, will lie with the right hip flexed for pain relief (the psoas sign).

• Spasm of the obturator internus is sometimes demonstrable when the hip is flexed and internally rotated. If an inflamed appendix is in contact with the obturator internus, this manoeuvre will cause pain in the hypogastrium (the obturator test).
• **Cutaneous hyperaesthesia** may be demonstrable in the right iliac fossa, but is rarely of diagnostic value.

• **The differential diagnosis in Children**
  • Acute gastroenteritis.
  • In mesenteric lymphadenitis.
  • Meckel’s diverticulitis.
  • Intussusception.
  • Henoch—Schönlein purpura
  • Lobar pneumonia and pleurisy

• **The differential diagnosis in Adults**
  • Terminal ileitis
  • Ureteric colic
  • Right-sided acute pyelonephritis
  • Perforated peptic ulcer
  • Testicular torsion
  • Acute pancreatitis
  • Rectus sheath haematoma

• **The differential diagnosis in Adult females**
  • The most common diagnostic mimics are salpingitis, mittelschmerz,
  • torsion or haemorrhage of an ovarian cyst
  • and ectopic pregnancy.

• **The differential diagnosis in Elderly**
• Sigmoid diverticulitis
• Intestinal obstruction
• Carcinoma of the caecum
• **Rare differential diagnoses**
  • Preherpetic pain of the right 10th and 11th dorsal nerves is localised over the same area as that of appendicitis.
  • Tabetic crises are now rare.
  • Spinal conditions are sometimes associated with acute abdominal pain, especially in children and the elderly. These may include tuberculosis of the spine, metastatic carcinoma, osteoporotic vertebral collapse and multiple myeloma.
  • The abdominal crises of porphyria and diabetes mellitus need to be remembered.
  • Typhlitisor leukaemic ileocaecal syndrome is a rare but potentially fatal enterocolitis occurring in immunosuppressed patients.
  • Gram-negative or clostridial (especially C. septicum) septicaemia can be rapidly progressive.

**Investigation**

• The diagnosis of acute appendicitis is essentially clinical.
• A full blood count and urinalysis should be performed in all cases.
• In women of reproductive years, it is wise to obtain a urinary pregnancy test before proceeding to exploration. Pelvic ultrasound is of value in excluding tubal or ovarian disease if suspected.
• Abdominal ultrasound examination is a useful diagnostic tool, particularly in children, with a diagnostic accuracy of appendicitis in excess of 90 per cent.
• In dehydrated or elderly patients or where comorbid conditions dictate, serum urea and electrolytes should be checked.
• If a diagnosis of intestinal obstruction, intussusception or ureteric colic is being entertained, a supine abdominal X-ray should be performed.
• **Treatment**

• The treatment of acute appendicitis is appendicectomy.

• Intravenous fluids sufficient to establish adequate urine output (catheterisation is needed only in the very ill) and appropriate antibiotics should be given.

• There is more than enough evidence that a single perioperative dose of antibiotics reduces the incidence of postoperative wound infection.

• When peritonitis is suspected, therapeutic intravenous antibiotics to cover Gram-negative bacilli, as well as anaerobic cocci, should be given.

• Appendicectomy may be performed by conventional open operation or by using laparoscopic techniques.

• **The incision that is widely used for appendicectomy** is the so-called grid-iron incision (a grid-iron was a frame of cross-beams to support a ship during repairs).

• In recent years, a transverse skin crease (Lanz) incision has become more popular, as the exposure is better and extension, when needed, is easier.

• When the diagnosis is in doubt, particularly in the presence of intestinal obstruction, a lower midline abdominal incision is to be preferred over a right lower paramedian incision.

• **Rutherford Morrison’s incision** is useful if the appendix is paracaecal or retrocaecal and fixed.

• **Laparoscopic appendicectomy:** The most valuable aspect of laparoscopy in the management of suspected appendicitis is as a diagnostic tool, particularly in women of child-bearing age.