Acute Appendicitis

53

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53.1 Epidemiology

Lifetime risk ~7–8% (in Western populations).

The incidence of appendicitis has been declining worldwide at least in the last two decades. Current estimates of prevalence are 68/100,000 in the United Kingdom and 100/100,000 in Sweden.

In our age group, the incidence rises with age so for 8–11 year olds it is 122/100.000 and 12–15 year olds it is 163/100,000.

53.2 Pathology

Appendicitis is a progressive, inflammatory disease, and may distinct stages:

1. Obstruction of lumen—e.g., fecolith, viral-induced lymphoid hyperplasia, or rarely, foreign body.
2. Catarrhal inflammation and luminal distension. Transmural bacterial migration by resident flora (aerobic and anaerobic; *E. coli and Bacteroides* spp., etc.).]
3. Ulceration of mucosa and fibrinopurulent exudates.
4. *Gangrene* eventually occurs as a result of progressive bacterial invasion and vascular impairment.

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5. *Perforation* (20–40%) causing peritonitis and/or abscess formation.
   (a) ↑ Incidence in younger children:
      (i) >80% for <5-year olds
      (ii) ~100% in 1-year olds.

53.2.1 Reasons for Increased Perforation in the Young

- Caused by impaired communication and a poorer history than in older children.
- Parents and caregivers assume "gastroenteritis" based on the common features of anorexia, vomiting, diarrhea, and fever.
- Increasing perforation rates may be due to socioeconomic factors such as ethnicity, access to healthcare, insurance status, and patient referral patterns.

53.3 Clinical Features

The key features are abdominal pain, non-bile-stained reflex vomiting, and anorexia.

- Pain is initially periumbilical or poorly localized and correlates with luminal distension and early inflammation. Progressive transmural inflammation and serosal exudates cause localized irritation of the overlying parietal peritoneum and a distinct *shift* of the pain to the RLQ (or wherever the appendix is).
- Nausea and vomiting—after the onset of pain and may be short lived.
- Anorexia—almost invariable. If a child is hungry, the diagnosis should be in doubt.

Examination shows a child who appears acutely ill, often with a slight flush of the cheeks.

- Typical maximum point of tenderness—McBurney's1[1]point (*2/3 along a line drawn from umbilicus to anterior iliac spine*). Peritonism limits walking and some children adopt a legs-flexed posture when lying down.
- Hierarchy of abdominal muscle reflex response—from rebound tenderness, through guarding to rigidity—depending on the degree of parietal peritoneal involvement.

53.3.1 Named Signs in Appendicitis

- Rovsing's sign
  – Palpation in the left iliac fossa provokes pain in the RIF.

[1] Charles McBurney (1845–1913)—Surgeon at Roosevelt Hospital, New York City, USA. During the 1880s and 1890s, he was a leading advocate for surgery in appendicitis, describing clinical features and incision.

- Obturator sign
  - Internal rotation of the flexed hip exacerbates RIF pain—due to adjacent retrocecal appendiceal inflammation.
- Psoas sign
  - Leg extension exacerbates pain—due to adjacent retrocecal appendiceal inflammation.
- Hop sign
  - Ask to jump or percussion under the right calcaneus with an extended leg.

Fever is usually moderate (38–39 °C), and indeed if higher it suggests the presence of perforation or another diagnosis (e.g., viral mesenteric adenitis).

Only about half of children show the typical pattern of symptoms described here. In those with an age < 5 years, the most common presenting symptoms are pain, vomiting, fever, anorexia, and diarrhea.

53.4 Investigations

Laboratory tests are of limited value in the diagnosis of appendicitis.

- A mild leukocytosis (11,000–15,000) with left-shift is typical but not universal. A high WBC (20,000) in a patient with minimal abdominal findings is suggestive of a different diagnosis.
- Elevated C-reactive protein is typical but does not increase discrimination.

Clinical scoring systems (e.g., Alvarado and Pediatric Appendicitis Score-PAS, see Table 53.1) incorporating elements of the history, examination, and lab studies have been used, but sensitivity and specificity are still modest (70–80%).

Table 53.1 Most common scores for pediatric appendicitis

Alvarado Score		Pediatric Appendicitis Score	
Rebound pain	1	Cough or percussion or hop tenderness	2
Anorexia	1	Anorexia	1
Pyrexia >37.3 °C	1	Pyrexia	1
Nausea/emesis	1	Nausea/emesis	1
Tenderness in RIF	2	Tenderness in RIF	2
Leukocytosis >10,000	2	Leukocytosis >10,000	1
Left shift (neutrophils >75%)	1	Polymorphonuclear neurophilia	1
Migration of pain	1	Migration of pain	1
Score of ≥7 is considered diagnostic of appendicitis		Score of 6 or above is considered diagnostic of appendicitis	

Ohle R, O'Reilly F, O'Brien KK, Fahey T, Dimitrov BD. The Alvarado score for predicting acute appendicitis: a systematic review. *BMC Med.* 2011;9:139. Published 2011 Dec 28. doi:10.1186/1741-7015-9-139 and Samuel M. Pediatric appendicitis score. J Pediatr Surg. 2002 Jun;37(6):877–81. doi: 10.1053/jpsu.2002.32893. PMID: 12037754

Diagnostic accuracy can be improved by adding the US scan result to these clinical scoring systems.

In addition, clinical pathways have been developed to standardize care, improve outcomes and reduce resource utilization in carrying out a diagnostic or treatment care plan.

In equivocal cases, clinical observation with regular abdominal examinations and lab studies over a period of 12–24 h is the best way to differentiate appendicitis from other nonsurgical conditions. Medical conditions tend to improve with appropriate IV resuscitation.

53.4.1 Investigations

Unnecessary if the diagnosis is obvious, and should be reserved for equivocal cases.

- *US scan*—looking for fluid collection, abscess cavity, soft-tissue mass, etc. Excellent specificity (~90%), but variable sensitivity (50–90%) for the disease. Highly operator (and patient) dependent.
- *CT scans*—probably offer no further improvement in accuracy in children but can be useful for those with prolonged or atypical features.

53.5 Management

This must include correction of fluid, electrolyte, and acid/base imbalance (due to vomiting, etc.), together with antibiotics (effective against BOTH anaerobes and Gram-negative coliforms) to combat features of systemic bacterial sepsis.

Antibiotic regimen—selected for effect against likely pathogens:

(a) Non-perforated appendicitis (SIMPLE)—single agent, e.g., second-generation cefalosporins, amoxycillin/clavulanate (Augmentin™) ampicillin/sulbactam, ticarcillin/clavulanate, or piperacillin/tazobactam.
(b) Perforated appendicitis (COMPLICATED)—"triple" antibiotic regimen (e.g., ampicillin, gentamicin, and clindamicin or metronidazole) or a combination (e.g., ceftriaxone/metronidazole or ticarcillin/clavulanate and gentamicin).

Conservative management of acute and complicated appendicitis is under evaluation with a few clinical trials. At the moment, we would only recommend conservative treatment with antibiotics in case of a localized peri-appendix abscess ("appendix mass").

53.5.1 Timing

- *Short history, nonperforated appendicitis*—prompt appendicectomy. But no real increase in perforation rates or morbidity if delayed to the following morning, etc.

- *Short history, perforated appendicitis*—full IV fluid resuscitation and antibiotic loading with appendicectomy after clinical improvement.
- *Longer history, palpable mass*—a continuation of nonoperative management with possible interval appendicectomy (>3 months) if clinical resolution. If no clinical improvement (24–72 h), then surgery is indicated.

53.5.2 Open Appendicectomy

Muscle-splitting RLQ incision centered on McBurney's point (or point of maximum tenderness). Ensure that skin incision follows normal skin crease (Langer's lines) for improved cosmesis.

- Ligation/coagulation of mesoappendix.
- Excision of appendix, suture, and ligature at the base of the appendix with cauterization of the mucosa of the stump.

53.5.3 Laparoscopic Appendectomy

- Ensure bladder is empty or place a urinary catheter
- Port Placement (Fig. 53.1)
  - 10 mm open Hasson[2] access supraumbilical
  - 5 mm LLQ and 5 mm pubic region
- Aspirate pus in the peritoneal cavity and send cultures to microbiology.
- Coagulation of mesoappendix as distal as possible using unipolar hook diathermy.
- Ligation/transection of base of appendix using double Endoloops™.
- Excision of appendix (withdrawal through the umbilical port with or without an endo bag).

The choice of approach is variable throughout the world; however, most pediatric studies generally conclude that LA has increased cosmesis with a similar length of stay and postoperative complications.

53.6 Outcome

The complication rate in most current series should be <10%, but may consist of:

- *Abscess formation*
  - Interloop, pelvic, rarely subdiaphragmatic, or subhepatic.
- *Intestinal obstruction*
  - Early or late but >90% occur within the first 3 months. It is caused by inflammation and adhesions and may be severe after perforated appendicitis.

[2] Harrith Hasson—American gynaecologist—described open access technique in 1971.

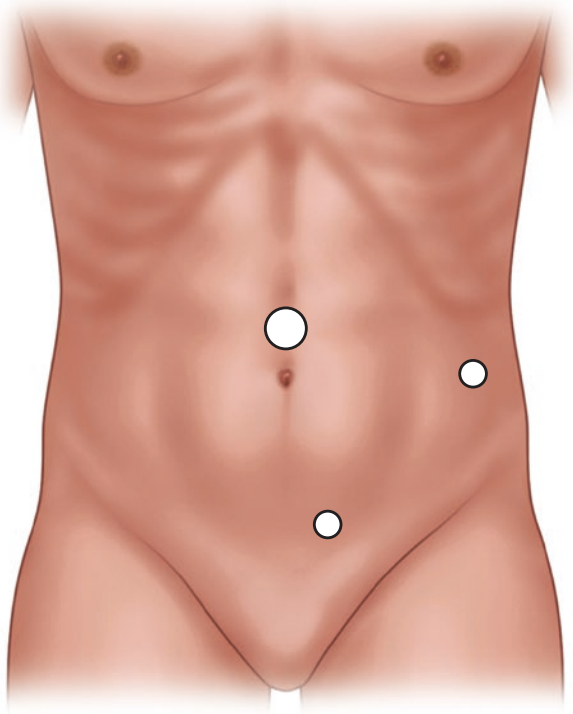

Fig. 53.1 Trocar position in laparoscopic appendectomy

- *Sterility*
  - Due to inflammatory obliteration of the Fallopian tubes in girls with perforated appendicitis. Literature is conflicting and the incidence is controversial.

Further Reading

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