

## General Surgery: Acute Appendicitis

**Introduction:** Appendicitis is “inflammation of the appendix caused by **obstruction** of the appendiceal lumen, producing a closed loop with resultant **inflammation** that can lead to **necrosis & perforation**.” It is the most **common** cause of emergent abdominal surgery in the US and has a 7% lifetime incidence.

Etiology:

- Common causes: **Lymphoid hyperplasia & Fecalith** (30% of the time)
- Uncommon causes: Foreign objects [vegetable/fruit seeds, Barium from previous x-ray study], Stricture [tumor], Parasites [i.e. *Ascaris* spp.]

Classification – **uncomplicated** vs. **complicated** (perforation or abscess)

- Disease severity score: Grade 1 = inflamed; 2 = Gangrenous; 3 = Perforated + localized free fluid; 4 = perforated + regional abscess; 5 = Perforated + diffuse peritonitis

Epidemiology

- A **common** acute surgical disease
- Incidence peaks in **early adulthood / 10-19 y/o** age group
- 1.3:1 **M:F**
- Second incidence peak in the elderly
- 84% appendectomies performed for *acute* appendicitis

Pathophysiology

- **Obstruction** →distension →inc. intraluminal P →lymphatic obstruction & **venous congestion** →edema →bacterial diapedesis →mucosal ulcers →bact. invasion →inflamed serosa contacts the parietal peritoneum --> venous thrombosis →compromise of arterial blood supply →**ischemia** →**gangrene** →**perforation** →bacteria escape →**peritonitis**
- Periumbilical pain is referred (T8-T10); RLQ pain is peritoneal.

Clinical presentation: **periumbilical pain (intermittent, crampy)** →nausea & vomiting →anorexia →**constant, intense RLQ pain**, us. in <24 hours

- Symptoms: classic = **RLQ pain, anorexia, nausea & vomiting**; (abdominal pain preceding vomiting (unlike gastroenteritis); pain is initially diffuse (epigastrium or periumbilical), --> RLQ localization; fever; leukocytosis). Atypical: indigestion, flatulence, malaise
- Signs: **Rovsing's** sign (palpate LLQ --> RLQ pain); **Iliopsoas** sign (passive R. hip extension --> pelvic pain; signifies retrocecal appendicitis); **guarding**, muscle spasm; direct **rebound** tenderness, maximal around **McBurney's** point (1/3 distance along line from ASIS to umbilicus); **Obturator sign** (int. rot. right thigh --> pelvic pain; signifies pelvic appendicitis); **Dunphy's** sign (cough --> pain)
- *Appendix tip* --> *pain depending on location of tip*: long tip: LLQ, retrocecal: flank or back pain, pelvic: suprapubic, retroileal: testicular, malrotation: perplexing pain pattern

Work up

- Labs:
  - **CBC:** WBC (10,000-18,000) with moderate PMN predominance, often w/ left shift; if >18,000 consider perforation +/- abscess
    - Acute – 14,500 +/- 7,300 vs. Gangrenous – 17,100 +/- 3,900 vs. Perforated 17,900 +/- 2,100
  - UA: to **r/o UTI, pyelonephritis or renal calculus**; several WBCs or WBCs 2/2 ureter or bladder irritation from inflamed appendix; no urine bacteria; r/o. (+) **UA does NOT r/o appendicitis**
  - Imaging:

- AXR: *not generally helpful*. appendicolith/fecalith ~5% of time; scoliosis away from right 2/2 pain, fecalith, sentinel loops, loss of psoas shadow, loss of preperitoneal fat stripe
- **Abdominal CT w/ contrast: best for diagnosis and ruling out** other pathologies; 95-98% sensitive, 83-90% specific; positive findings: >6mm appendiceal dilatation, appendiceal **thickening**, periappendiceal streaking (densities within perimesenteric fat), appendicolith, wall enhancement
- Graded compression US: to exclude gynecologic pathology; 85% sensitive, 92% specific; operator depended; positive finding: >6mm noncompressible appendix.
  - False (+) seen with: dilated fallopian tube, inspissated stool (resembles fecalith), obese patients (noncompressible 2/2 overlying fat)
  - False (-) seen with: retrocecal cecum, inflammation confined to appendix tip, large appendix (mistaken for small bowel), perforation (makes appendix compressible)

Diagnosis

- H&P (75-90% accurate) with labs/imaging supporting clinical findings; don't need imaging. Go to OR if clinical suspicion is high.
- Differential includes: gastroenteritis, ectopic pregnancy, mesenteric adenitis, meckel's diverticulum, intussusception, typhoid fever, regional enteritis, torsion & infarction of epiploic appendages, UTI, ureteral stone, pyelonephritis, primary peritonitis, Henoch-Schonlein purpura

Symptoms	M = Migratory right iliac fossa pain	1
	A = Anorexia	1
	N = Nausea/vomiting	1
Signs	T = Tenderness right lower quadrant	2
	R = Rebound tenderness right iliac fossa	1
	E = Elevated temperature [>37.3]	1
Investigation	L = Leucocytosis [>10,500]	2
Total score		9

Management

- ~1/3 appendixes rupture before appendectomy
- Alvarado score: 0-3 → low risk; 4-6 → admit for observation & re-examination, if score same after 12 hours then operate; 7-9 → appendectomy (male) or (female, nonpregnant) diagnostic laparoscopy → appendectomy if indicated
- **Definitive treatment = appendectomy**
  - **Preoperative:** Rehydrate w/ IV fluids (LR) + preoperative antibiotics: *uncomplicated* (cefoxitin, amp/sulbactam, or cefazolin + metronidazole) vs *complicated* (broad spectrum w/ gram (-) w/ anaerobic coverage: piperacillin-tazobactam or ticarcillin-clavulanate or ceftriaxone + metronidazole). Revise after cultures and susceptibilities return
  - **Prompt appendectomy (prevent perforation,** 24 hours antibiotics; uncomplicated: DC home usually within 24-48 hours; start on clear liquid diet)
  - **Laparoscopic Appendectomy:** women, need to return to physical activity, obese; decreased pain, hospital stay, wound infections but higher readmission, abscess formation, hospital costs.
  - **Complicated (perforation):** IV fluid resuscitation, prompt appendectomy; drain pus; wound left open in most cases after closing the fascia (secondary intention/delayed primary closure); peritoneal washout;
    - Antibiotics for 3-7 days (until WBC normal, afebrile, ambulating, eating regular diet)
    - Advance diet more slowly (5-7 days)
  - **Complications: wound infection (most common post-op. complication),** pelvic abscess, liver abscess, free perforation;

*Special populations*

- Pregnant: most common surgical emergency; 1st trimester most common; fetal mortality increases 3-8% (30% w/ perforation); surgery is treatment but carries 10-15% risk of premature labor; pain may be RUQ due to uterine enlargement
- Elderly: present late in the course; higher perforation rate (50%), atypical findings (less pain & peritonitis); delayed leukocytosis
- Immunocompromised: susceptible to neutropenic colitis & CMV-related bowel perforation