Appendicitis

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Key Points

- About one-third of children with appendicitis present with perforation. Perforation of the appendix can lead to serious complications, such as intra-abdominal infection, sepsis, and intraperitoneal abscess, or death.
- Because diagnosis of appendicitis based on patient history and physical examination is often difficult in pediatric patients, imaging is a key diagnostic tool. In the past CT was frequently used.
- Ultrasound is now the preferred imaging choice due to concerns that radiation exposure from computed tomography (CT) may increase the risk of malignancy.
- Surgical treatment options for perforated appendicitis are early appendectomy or interval appendectomy (Figure 1).

Pathophysiology

Appendicitis develops in the following stages over a 24- to 36-hour period.

- **Obstruction**. The initiating problem is obstruction of the appendiceal lumen. This obstruction may occur as a result of fecaliths, lymphoid hyperplasia, foreign bodies, or parasites.
- **Increased pressure.** Because the obstruction prohibits the lumen from draining, progressive distention occurs. Mucus is secreted and bacteria growth begins.
- **Decreased blood flow.** As intraluminal pressure increases, venous outflow then arterial inflow are impeded. Reduced perfusion to the appendiceal wall results in tissue ischemia and mucosal compromise.
- **Bacterial growth.** Bacteria begin to grow throughout the luminal wall (transmural

inflammation).
- **Inflammation.** Transmural inflammation spreads beyond the appendix to the parietal peritoneum and adjacent structures.
- **Disease progression.** Tissue necrosis and perforation are the natural progression of the disease.

Assessment and Diagnosis

Prompt assessment and diagnosis of appendicitis is critical. Perforation of the appendix is likely in patients who have had symptoms for >48 hours.

Clinical Presentation

Patient History

- Vague pain may be present, typically in the periumbilical region due to the midgut embryological origin of the appendix. Pain commonly migrates to the right lower quadrant.
- Nausea/vomiting typically develop after the onset of pain.
- Anorexia is common in adults but less consistent in children.

Almost all children 3 years old or younger with appendicitis will present with perforation. Typical signs are abdominal distention, generalized peritonitis, and vomiting.

Physical Examination

Physical examination techniques to determine signs and symptoms of appendicitis are described in Table 1.

Table 1. Physical Examination Techniques to Determine Signs and Symptoms of Appendicitis

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Table 1. Physical Examination Techniques to Determine Signs and Symptoms of Appendicitis

	Sign/Symptom	Details
Deep palpation over McBurney's point	Right lower quadrant tenderness	Tenderness will be present early in disease process
Light palpation of right lower quadrant	Right lower quadrant tenderness	• Tenderness will be present when the parietal peritoneum is inflamed • Generalized peritonitis is most consistent with perforated appendicitis
Rovsing's technique	Right lower quadrant pain	Palpation of left lower quadrant produces pain in right lower quadrant
Psoas test	Abdominal pain caused by irritation to the iliopsoas group of hip flexors in the abdomen from an inflamed appendix	With patient lying on the side, passively extend the thigh or ask patient to flex thigh at hip
Obturator test	Abdominal pain caused when an inflamed, enlarged appendix comes in contact with the obturator internus muscle	With patient lying on the back with hip and knee flexed, rotate the right hip by moving the patient's ankle away from the body. Allow the knee to move only inward.
Fever	Inconsistent	• Commonly seen with perforated appendicitis • Less consistently seen with acute appendicitis

Diagnostic Imaging Tests

Diagnosis of appendicitis based on patient history and physical examination is often difficult in pediatric patients. Imaging tests are a valuable diagnostic tool.

- Plain radiography (x-ray)
  - Is of limited utility in diagnosing appendicitis.
  - Will infrequently note fecalith.

- Ultrasound
  - Is the imaging test of choice in children.
  - Published clinical studies of pathways to improve cost effectiveness and diagnostic accuracy detail increased use of ultrasound versus CT.
  - Disadvantages include learning curve and operator dependence.
  - Accuracy of surgeon-performed ultrasound at Arkansas Children's Hospital (ACH) is comparable to radiology department ultrasound.
- Computed tomography (CT)
  - Was once the imaging test of choice for evaluation of abdominal pain.
  - Use is declining due to concerns that increased exposure to radiation may contribute to increased risk of malignancy.
  - **A**s **L**ow **A**s **R**easonably **A**chievable (ALARA) is a principle that radiation exposure should be minimized when possible.
  - Pathways designed to minimize CT use are being implemented in many institutions.
- Magnetic resonance imaging (MRI)
  - In children with suspected acute appendicitis, diagnostic imaging with ultrasound followed by MRI yielded comparable results to CT.
  - MRI will possibly replace CT as second-line imaging in the future.

Treatment

Treatment is determined by whether the child has acute or perforated appendicitis. About one-third of children with appendicitis present with perforation.

- Acute appendicitis (Figure 1)
  - Single dose of antibiotics is given prior to incision (second generation cephalosporin or first generation + metronidazole).
  - Operation is performed laparoscopically.
  - Instead of a 23-hour overnight hospital stay for observation, same-day discharge is a safe alternative. This is presently the approach used at Arkansas Children's Hospital (ACH).
  - Nonoperative management of uncomplicated acute appendicitis has been investigated in recent pilot/feasibility studies.
    - 89% and 76% success rates at 1 month and 1 year, respectively.
    - Higher failure rate if appendicolith present.
- Perforated appendicitis (Figure 1)
  - Initial treatment is with broad spectrum antibiotics. Duration of antibiotics is debated.
  - Operation is typically performed laparoscopically.
  - Surgical treatment options for perforated appendicitis are early appendectomy or interval appendectomy.
    - **Early appendectomy** is performed during the initial hospital stay. The rate of infectious complications (eg, wound infection and intra-abdominal abscess) are higher.
    - **Interval appendectomy** delays surgery. Initial treatment is with antibiotics, and the laparoscopic appendectomy is performed 6 to 8 weeks later.
  - Best evidence supports early appendectomy.
    - Faster return to normal activities
    - Lower adverse event rate
    - Lower cost

Figure 1. Treatment of Appendicitis

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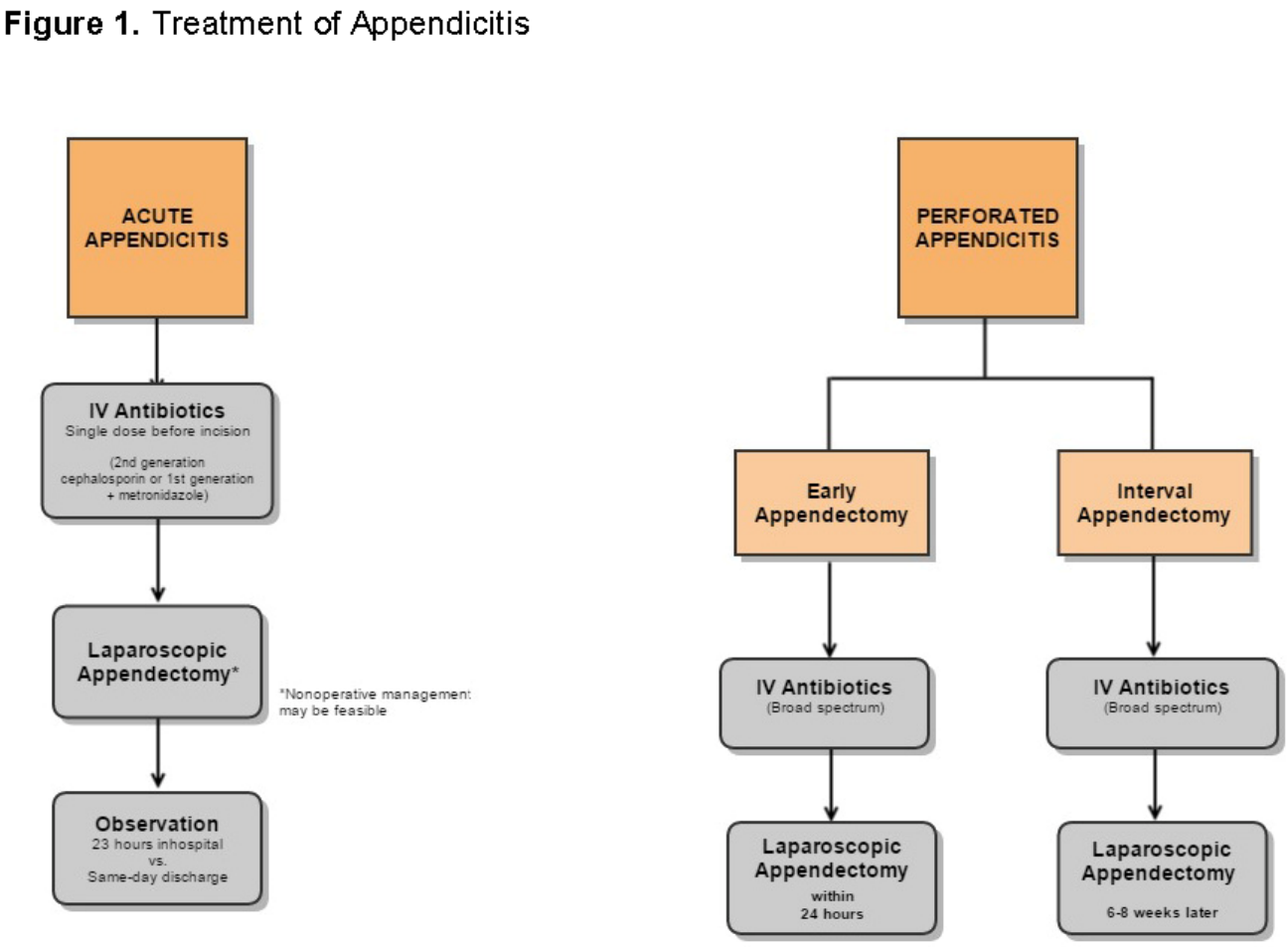

This guideline was developed to improve health care access in Arkansas and to aid health care providers in making decisions about appropriate patient care. The needs of the individual patient, resources available, and limitations unique to the institution or type of practice may warrant variations.

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