

Pediatric Appendicitis



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KEYWORDS

- Appendicitis • Surgery • Appendectomy • Children • Nonoperative management
- Abdominal pain • Right lower quadrant

KEY POINTS

- Appendicitis is less likely to present in a classic manner than commonly thought.
- Appendicitis can be managed nonoperatively in selected children.
- For children with perforated appendicitis, a laparoscopic appendectomy should be performed.
- The long-term risk of recurrence of appendicitis is unknown.

INTRODUCTION

Appendicitis is the most common surgical emergency in children.¹ The lifetime risk of developing appendicitis is 7% to 8%, with a peak incidence in the teenage years.² It is estimated that 86 cases of appendicitis per 100,000 people occur annually, with an estimated 70,000 pediatric appendectomies performed in the United States each year with a mean cost of \$9000.^{3,4} In the recent decade appendicitis has become more protocolized with greater efforts to minimize antibiotic durations and radiation exposure as well as to begin to study the nonoperative management of appendicitis. Much variation still exists, however, in the diagnosis and management of appendicitis. This article serves to highlight and update some of the controversies and recent literature regarding pediatric appendicitis.

Diagnosis

The peak incidence of appendicitis occurs in the second decade of life with the median age between 10 and 11 years. The male/female ratio is 1.4:1. There is a seasonal variation with increased presentation of appendicitis in the summer months with perforated appendicitis occurring more frequently in the fall and winter.⁵

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SYMPTOMS

The symptoms of appendicitis have been classically described as the gradual onset of dull periumbilical pain migrating to the right lower quadrant over the course of a day. Additional and variable symptoms include nausea, vomiting, anorexia, fever, and, less frequently, diarrhea. Classically, it is thought that perforation occurs within 24 to 36 hours from the onset of symptoms of pain. The pain, which was localized, improves and then becomes generalized. This description of symptoms, however, occurs in less than 50% of children.⁶ Many other classic symptoms also variably present in children without appendicitis, including nausea, right lower quadrant guarding, or migrating pain.⁷ Certain findings have been shown to increase or decrease the likelihood of appendicitis, including the midabdominal pain migrating to the right lower quadrant (likelihood ratio [LR] 1.9–3.1) and the presence of fever (LR 3.4), which, if not present, lowers the likelihood of appendicitis by two-thirds.⁶ The overlap in symptoms makes the diagnosis a clinical challenge, which is amplified in young children who do not understand or articulate the early symptoms.⁸ Children less than 3 years of age present with perforated appendicitis more than 80% of the time compared with 20% of those aged 10 to 17 years.⁶

SIGNS

Physical examination findings include tenderness palpation and guarding in the right lower quadrant and rebound tenderness. Rovsing sign (left lower quadrant palpation resulting in referred pain to the right lower quadrant), obturator sign (internal rotation of the right lower extremity), and psoas sign (pain while lying on the left side and extending the right hip) are nonspecific physical examination findings of appendicitis. Only rebound tenderness has correlated with an increased likelihood of appendicitis (LR 2.3–3.9), whereas lack of tenderness in the right lower quadrant reduces the likelihood of appendicitis by half.^{7,9}

LABORATORY STUDIES

Although no single laboratory value has a high sensitivity and specificity for appendicitis, white blood cell (WBC) count, absolute neutrophil count (ANC), and C-reactive protein (CRP) are most often used to aid diagnose appendicitis. The use of these laboratory tests alone is not helpful or predictive. WBC, ANC, and CRP all have wide ranges in specificity and sensitivity for predicting appendicitis.^{9–14} An elevated WBC count does not predict appendicitis, as appendicitis may be present in children with a normal WBC count.¹² However, an increased WBC (>10–12,000 cells per cubic millimeter) increases the odds of appendicitis. In children less than 4 years of age, a normal WBC count has a negative predictive value of 95.6%, whereas the negative predictive value in those 4 to 12 years old is 89.5%. The negative predictive value of a low or normal WBC count among adolescents is 92%.⁹ A left shift or increase in the number of immature forms of neutrophils also has a strong association with appendicitis, because only 3.7% of pediatric patients without a left shift have appendicitis. Although CRP is nonspecific as an isolated laboratory value, a higher mean level may predict complicated or perforated appendicitis or those children more likely to form an abscess.^{12,15,16}

SCORING

The Alvarado score and the Pediatric Appendicitis Score (PAS) are the 2 systems that have been extensively evaluated for their ability to predict appendicitis based on symptoms, physical examination findings, and laboratory values (**Tables 1** and **2**).^{17,18} The

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