Diagnosis of Appendicitis: Part I. History and Physical Examination

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This guide is one in a series that offers evidence-based tools to assist family physicians in improving their decision making at the point of care.

This is part I of a two-part piece on the diagnosis of appendicitis. Part II, "Laboratory and Imaging Tests," will appear in the April 15, 2008, issue of *AFP*.

A collection of Point-of-Care Guides published in *AFP* is available at http://www.aafp.org/afp/poc.

Clinical Question

What are the most useful elements of the patient history and physical examination in the diagnosis of appendicitis?

Evidence Summary

Appendicitis is a relatively uncommon, but potentially serious, cause of abdominal pain in the primary care setting. An accurate diagnosis is important to prevent unnecessary surgery and avoid complications.

The probability of appendicitis depends on patient age, setting, and symptoms. A retrospective study, including three family practice centers, identified 556 adults with abdominal pain, of whom six (1.1 percent) were diagnosed with appendicitis.[1] Studies of children with abdominal pain, largely in the emergency department setting, found that 10 to 25 percent of patients had appendicitis.[2] In studies of patients with abdominal pain who underwent computed tomography and ultrasonography, 31 percent of children and 40 percent of adults had appendicitis.[3] The percentage of patients with appendicitis ranges from 60 to 90 percent in patients who undergo surgery. Perforation rates range from 4 to 28 percent.[4]

Individual signs and symptoms are of some value in the evaluation of patients with suspected appendicitis. In many patients, signs and symptoms are useful at ruling in appendicitis when findings are positive or abnormal, but the absence of signs and symptoms does not necessarily reduce the risk of appendicitis *(Table 1*[2,5]). In adults, right lower quadrant pain and migration of pain from the umbilicus area to the right lower quadrant are the symptoms that best predict appendicitis, whereas the absence of pain before vomiting greatly reduces the likelihood of appendicitis.[5] The accuracy of history and physical examination findings is somewhat different in children. Vomiting, rectal tenderness, rebound tenderness, and fever are more helpful (greater positive likelihood ratio) in children than in adults, whereas right lower quadrant tenderness is somewhat less helpful.[2] The usefulness of the finding of pain before vomiting has not been evaluated in children.

The Alvarado score (also known as the MANTRELS [Migration of pain, Anorexia, Nausea/vomiting, Tenderness in the right lower quadrant, Rebound pain, Elevation of temperature, Leukocytosis, Shift to the left] score; *Table 2*[2,6]) has been prospectively validated in several populations of children[6-10] and adults.[11] Variations include the modified Alvarado score, which excludes the left shift of the white blood cell (WBC) count,[12] and the Pediatric Appendicitis Score, which substitutes right lower quadrant pain with cough, hopping, or percussion for rebound tenderness.[7] However, these modifications have not been shown to perform better than the original Alvarado score.

Another score, which includes nine clinical variables and does not require a WBC count, accurately predicted the likelihood of appendicitis in the initial validation study of 109 children.[13] However, this and several other proposed diagnostic scores have not been prospectively validated in large, clinically relevant populations.

The Ohmann score *(Table 3)* includes seven clinical variables and a WBC count.[14] The score was developed in a group of 870 patients at German and Austrian hospitals and was validated four months later in a second group of patients at the same hospitals. In the prospective validation,

Table 1. Accuracy of Individual Findings from the History and Physical Examination in the Diagnosis of Appendicitis

	Likelihood ratio*	
Clinical finding	*Adults*	*Children*
Helpful for ruling in appendicitis		
Right lower quadrant pain	8.4	—
Migration (periumbilical to right lower quadrant)	3.6	1.9 to 3.1
Initial clinical impression of the surgeon	3.5	3.0 to 9.0†
Psoas sign	3.2	2.5
Fever	3.2	3.4
Pain before vomiting	2.7	—
Rebound tenderness	2.0	3.0
Rectal tenderness	—	2.3
Vomiting	—	2.2
Helpful for ruling out appendicitis		
Absence of pain before vomiting	0.02	—
Absence of right lower quadrant pain	0.18	—
Absence of vomiting	—	0.33
Absence of fever	0.42	0.32
Absence of rebound tenderness	—	0.28

**—Only shown if 2 or more for positive likelihood ratio or less than 0.5 for negative likelihood ratio.*
†—Estimated from data using a pretest probability of 10 to 25 percent and rate of appendicitis in children undergoing ultrasonography and computed tomography for undifferentiated abdominal pain.

Information from reference 2 and 5.

Table 2. Alvarado (MANTRELS) Score for the Diagnosis of Appendicitis in Children

Clinical Finding	*Points*
Migration of pain to the right lower quadrant	1
Anorexia	1
Nausea/vomiting	1
Tenderness in the right lower quadrant	2
Rebound pain	1
Elevated temperature (≥ 99.1°F [37.3°C])	1
Leukocytosis (≥ 10,000 WBCs per mm^3 [10 X 10^9 per L])	2
Shift of WBC count to the left (> 75 percent neutrophils)	1
Total:	_____

NOTE: *A score of 7 points or more has a positive likelihood ratio of 4.0, whereas a score of less than 7 points has a negative likelihood ratio of 0.2. Given a baseline 20 percent probability of appendicitis in a child with acute abdominal pain, that corresponds to a probability of 50 percent if the score is 7 points or higher and 5 percent if the score is less than 7 points. Patients with a score of less than 4 points have a very low risk of appendicitis.*

Adapted with permission from Alvarado A. A practical score for the early diagnosis of acute appendicitis. Ann Emer Med. *1986;15(5):561, with additional information from reference 2.*

the Ohmann score successfully identified patients at low, moderate, and high risk of appendicitis.[14]

The Alvarado and Ohmann scores alone are not accurate enough to diagnose or exclude appendicitis. However, they provide a useful starting point by identifying children and adults at low, moderate, and high risk of appendicitis. Most patients at low risk can be observed without further diagnostic study; patients at moderate risk may benefit from further diagnostic testing, including imaging studies; and patients at high risk should receive urgent surgical evaluation. Part II of this series addresses diagnostic testing in the context of the Alvarado and Ohmann scores.

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Table 3. Ohmann Score for the Diagnosis of Appendicitis in Adults and Children Older Than Six Years

Clinical Finding	*Points*
Tenderness in the right lower quadrant	4.5
Rebound tenderness	2.5
No difficulty with micturition	2.0
Steady pain	2.0
Leukocytosis (≥ 10,000 white blood cells per mm^3 [10 × 10^9 per L])	1.5
Age less than 50 years	1.5
Migration of pain to the right lower quadrant	1.0
Abdominal rigidity	1.0
Total:	_____

Risk group	*Score*	*Appendicitis (%)*
Low	< 4	0
	4.0 to 5.5	3
Moderate	6.0 to 7.5	10
	8.0 to 9.5	15
	10.0 to 11.5	24
High	12.0 to 13.5	38
	> 13.5	74

Adapted with permission from Ohmann C, Franke C, Yang Q, for the German Study Group of Acute Abdominal Pain. Clinical benefit of a diagnostic score for appendicitis: results of a prospective interventional study. Arch Surg. *1999;134(9):994.*

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