

Cochrane for Clinicians

Putting Evidence into Practice

Acute Appendicitis: Computed Tomography for Diagnosis in Adults

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Clinical Question

What are the sensitivity and specificity of computed tomography (CT) for the diagnosis of acute appendicitis in nonpregnant adults?

Evidence-Based Answer

In a nonpregnant adult with clinical signs and symptoms of appendicitis, CT has a sensitivity of 95% and specificity of 94%. Therefore, the probability of having appendicitis following a positive CT result is 92%, and the probability of having appendicitis following a negative CT result is 4%. These conclusions are based on studies of low methodologic quality.¹ (Strength of Recommendation: B, based on inconsistent or limited-quality patient-oriented evidence.)

Practice Pointers

The lifetime risk of appendicitis is approximately 10%. The “classic” clinical presentation of periumbilical abdominal pain migrating to the right lower quadrant, loss of appetite, nausea and/or vomiting, fever, and leukocytosis occurs in approximately 50% of patients. Before widespread use of diagnostic imaging, the acceptable negative appendectomy rate (i.e., no appendicitis found intraoperatively) was 10% in young, otherwise healthy male patients and approximately 20% in female patients. With the use of imaging (mostly CT), the negative appendectomy rate has decreased to around 8% regardless of a patient’s sex or age.²

The findings of this Cochrane review were based on 64 studies that included 71 separate study populations in 22 countries (30 studies were performed in the United States) with a total of 10,280 participants (55% women; median age of 33 years). Included studies were prospective and had at least 10 nonpregnant patients older than 14 years who presented to the emergency department with suspected appendicitis based on history, physical examination, and/or laboratory testing. No studies compared antibiotic therapy with surgery. The reference standard for diagnosing appendicitis was histologic examination of the resected appendix or intraoperative findings consistent with appendicitis if histology was not available.

Among the patients in this analysis (i.e., those seen in the emergency department whose initial history and workup led to CT), 43% had appendicitis. This analysis demonstrates that CT is a good screening test (sensitivity = 95%; 95% CI, 72% to 100%) and a good confirmatory test (specificity = 94%; 95% CI, 50% to 100%). Using normalized frequencies, if 1,000 patients presented to the emergency department with possible appendicitis based on history, physical examination, and laboratory findings, the CT results of 443 of these patients would further suggest this diagnosis. However, if each of those 443 patients went to surgery, 35 would not have appendicitis. Of the 557 patients whose CT results did not suggest appendicitis, 22 would ultimately have the condition.

The secondary aim of this review was to determine how the use of contrast in both conventional and low-dose protocols affected accuracy (Table 1).¹ Unenhanced, standard-dose CT and CT with use of oral contrast alone appeared to be slightly less sensitive than standard-dose CT with rectal, intravenous, or oral plus intravenous contrast enhancement; however, they would each have similar specificity. Low-dose vs. standard-dose CT had equivalent sensitivity and specificity (Table 1).¹

The results were based on studies of low methodologic quality. Major methodologic problems were poor reference standards and inadequate follow-up for those who did not have surgery. The comparisons between types of contrast enhancement and radiation dose may have been unreliable

These are summaries of reviews from the Cochrane Library.

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A collection of Cochrane for Clinicians published in *AFP* is available at <https://www.aafp.org/afp/cochrane>.

CME This clinical content conforms to AAFP criteria for CME. See CME Quiz on page 401.

TABLE 1

Accuracy of Contrast-Enhanced and Low-Dose CT of the Abdomen and Pelvis to Diagnose Acute Appendicitis

Type of study	Number of studies	Summary sensitivity	Summary specificity
Any type of CT	64	0.95	0.94
Unenhanced CT	19	0.91	0.94
CT with IV enhanced contrast media	17	0.96	0.93
CT with rectal enhanced contrast media	9	0.97	0.95
CT with oral enhanced contrast media	7	0.89	0.94
CT with oral and IV enhanced contrast media	15	0.96	0.94
Low-dose CT	7	0.94	0.94

CT = computed tomography; IV = intravenous.

Information from reference 1.

because they were based on indirect comparisons that may have been confounded by multiple other factors. This testing is not without risk; the estimated increased lifetime risk of cancer from one abdominopelvic CT is as high as 0.14%.³

According to the American College of Radiology (ACR) Appropriateness Criteria for right lower quadrant pain–suspected appendicitis, abdominal and pelvic CT with intravenous contrast is “usually appropriate” (highest rating) whereas an abdominal and pelvic CT without intravenous contrast “may be appropriate” (middle rating).² The results of this Cochrane review are consistent with the ACR decision-support recommendations.

The practice recommendations in this activity are available at <http://www.cochrane.org/CD009977>.

The views expressed in this article are those of the author and do not necessarily reflect the official policy or position of the Uniformed Services University of the Health Sciences, the Department of Defense, or the U.S. government

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Effects of Inhaled Corticosteroids on Growth in Children with Persistent Asthma

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Clinical Question

Do different inhaled corticosteroids have different impacts on growth in children with asthma?

Evidence-Based Answer

Inhaled fluticasone (Flovent; 200 mcg per day) is associated with a greater linear growth velocity (mean difference [MD] = 0.81 cm per year; 95% CI, 0.46 to 1.16; one study, 23 participants) when compared with beclomethasone (400 mcg per day; an equivalent dose). (Strength of Recommendation: C, based on consensus, disease-oriented evidence, usual practice, expert opinion, or case series.)

Fluticasone via Diskus inhaler (200 mcg per day) is associated with a greater increase in height (MD = 0.97 cm; 95% CI, 0.62 to 1.32; two trials, 359 participants) over 20 weeks to 12 months compared with budesonide (Rhinocort) via turbuhaler (400 mcg per day). (Strength of Recommendation: B, based on inconsistent or limited-quality patient-oriented evidence.)

Budesonide via Easyhaler is associated with a greater increase in height over six months (MD = 0.37 cm; 95% CI, 0.12 to 0.62; one trial, 229 participants) when compared with budesonide via turbuhaler.¹ (Strength of Recommendation: C, based on consensus, disease-oriented evidence, usual practice, expert opinion, or case series.)

Practice Pointers

Asthma affects 19 million adults and 6.2 million children in the United States.² Between 2008 and 2013, asthma contributed to \$50 billion in direct medical costs and \$3 billion in indirect costs from missed school and work.³ The Global Initiative for Asthma (GINA) recommends the use of inhaled corticosteroids for all children with asthma, except for those with the mildest form (when inhaled corticosteroid use is optional).⁴ Inhaled corticosteroids are associated with

growth delays. A randomized controlled trial found that four years of budesonide use was associated with a 1.2-cm loss in final adult height, and a meta-analysis of two observational studies showed that inhaled corticosteroid use was associated with a 0.85-cm loss in height.⁵ Poorly controlled asthma also slows growth velocity; a 2019 review shows that more severe asthma tends to correlate with slower growth.⁶

The authors of this Cochrane review studied whether different inhaled corticosteroids and delivery systems had different effects on growth in children with asthma.¹ The review included six randomized trials of children four to 12 years of age with persistent asthma who were using an inhaled corticosteroid; 1,008 of the children completed their respective studies without major protocol deviations. The per-protocol population was used instead of the intention-to-treat population because the authors were trying to assess the impact of inhaled corticosteroid therapy on growth. With the small number of trials, subgroup analyses, meta-regression analysis, and sensitivity analyses were not performed. Ties to the pharmaceutical industry in two-thirds of the included studies, lack of blinding in two studies, concerns about allocation concealment in five studies, and incomplete outcomes data in two studies limited author confidence in the study results.

Compared with 400 mcg of beclomethasone per day, 200 mcg of fluticasone per day (an equivalent dose) was associated with a greater linear growth velocity (MD = 0.81 cm per year; 95% CI, 0.46 to 1.16; one study, 23 participants). When compared with a similarly equivalent dose of budesonide, fluticasone did not significantly impact linear growth velocity (two trials, 236 participants), but fluticasone via Diskus (200 mcg per day) was associated with a greater increase in height (MD = 0.97 cm; 95% CI, 0.62 to 1.32; two trials, 359 participants) over 20 weeks to 12 months when compared with budesonide via turbuhaler (400 mcg per day). With respect to delivery vehicles, budesonide via Easyhaler was associated with a greater increase in height over six months (MD = 0.37 cm; 95% CI, 0.12 to 0.62; one trial, 229 participants) than budesonide via turbuhaler.

The 2007 National Heart, Lung, and Blood Institute's Expert Panel Report 3 recommends the use of inhaled corticosteroids in all patients with persistent asthma.⁷ The more recent GINA

guidelines echo this recommendation but also provide that a low-dose inhaled corticosteroid may be taken as a daily controller medication in those with intermittent symptoms or as an on-demand addition whenever a short-acting beta agonist is used.⁴ There is a slowing of growth with inhaled corticosteroid use, but the magnitude of slowing is small and the harms of uncontrolled asthma are worse (and include a slowing of growth). Family physicians should review the risks and benefits of inhaled corticosteroids with patients and their families, noting that although there may be, on average, a 1.2-cm loss in final adult height, uncontrolled severe asthma can be associated with profound morbidity, hospitalization, and even death. Among the medications studied, fluticasone seems to be associated with the best growth outcomes.

The practice recommendations in this activity are available at <http://www.cochrane.org/CD010126>.

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