Cochrane for Clinicians

Putting Evidence Into Practice

Magnetic Resonance Imaging for Diagnosing Acute Appendicitis

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Clinical Question

Can magnetic resonance imaging (MRI) accurately diagnose acute appendicitis?

Evidence-Based Answer

In pregnant patients, children, and adults with clinical signs and symptoms of appendicitis, MRI has an overall sensitivity of 95% and specificity of 96%. The posttest probability of having appendicitis after a positive MRI is 90% and 2% after a negative MRI, assuming a median pretest probability of 25%.[1] (Strength of Recommendation: B, inconsistent or limited-quality patient-oriented evidence.)

Practice Pointers

Appendicitis is the most common abdominal surgical emergency, leading to more than 300,000 appendectomies in the United States each year.[2] Timely diagnosis and treatment of acute appendicitis based on clinical findings and radiographic imaging reduce the risk of complications, including perforation, sepsis, peritonitis, and death.[3] Ultrasonography is an appropriate option in some circumstances.[4,5] If MRI is accurate in the diagnosis of appendicitis, avoiding ionizing radiation exposure makes it an attractive option, especially in pregnant patients and children. The authors of the Cochrane review sought to assess the accuracy of MRI in diagnosing acute appendicitis in all patients, with subgroup analysis of pregnant patients, children, and adults, as a secondary outcome.

The review included 58 studies with a total of 7,462 patients from 12 countries (35 studies were conducted in the United States). All studies were observational (cohort or cross-sectional) or randomized test accuracy studies. Case-control studies and studies with fewer than 10 patients were excluded. Most studies (39) were retrospective. Studies included children (n = 2,794), pregnant patients (n = 2,282), and adults (n = 1,088) presenting to an acute or emergency setting who underwent MRI for clinical suspicion of appendicitis. Radiographic findings were compared with histologic analysis of appendix specimens following surgery. Appendicitis was considered not present in patients who underwent surgery without appendectomy due to a normal appearing appendix or who were discharged without treatment and had an uneventful follow-up.[1]

Among patients in the meta-analysis, 27% met criteria for acute appendicitis. Pooled analysis showed that MRI is highly sensitive (95%; 95% CI, 94% to 97%) and specific (96%; 95% CI, 95% to 97%). At an estimated median prevalence of 25%, the posttest probability of acute appendicitis was 90% (95% CI, 85% to 93%) following a positive MRI and 2% (95% CI, 1% to 3%) following a negative MRI. This suggests that in a theoretical cohort of 1,000 patients with suspected appendicitis who have an MRI, 250 patients would be diagnosed with suspected appendicitis. Of those with a positive MRI who had an appendectomy, 12 (5%) would not have appendicitis. Of the 750 patients with a negative MRI, 30 (4%) would have appendicitis.[1]

Secondary outcomes examined subgroups of pregnant patients, children, and adults *(Table 1)*. Sensitivity and specificity of MRI for the diagnosis of acute appendicitis remained high in each subgroup. Only three studies compared MRI protocols, mainly assessing MRI with or without intravenous or oral contrast; a meta-regression analysis found no difference.[1]

The included studies reported methodologic weaknesses in study designs and low standards of reporting. The review was limited because it included mostly retrospective studies that relied

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CME This clinical content conforms to AAFP criteria for CME. See CME Quiz on page 348.

TABLE 1

Accuracy of Magnetic Resonance Imaging in Diagnosing Appendicitis in Pregnant Women, Children, and Adults

Patient subgroup	No. of studies	No. of patients	Summary sensitivity (95% CI)	Summary specificity (95% CI)
Pregnant women	21	2,282	96% (88% to 99%)	97% (95% to 98%)
Children	17	2,794	96% (95% to 97%)	96% (92% to 98%)
Adults	9	1,088	96% (93% to 97%)	93% (80% to 98%)

on chart review as the reference standard for patients with a negative MRI who did not undergo surgery. The design cannot account for patients diagnosed with appendicitis after discharge if presenting to another medical facility for follow-up. Given the low incidence of false-negative results, this may overestimate sensitivity even if a small number of such events occurred. In practice, access, cost, and patient challenges in tolerating imaging may affect the use of MRI for acute appendicitis.

A meta-analysis of computed tomography suggests that at an estimated pretest prevalence of 43%, the sensitivity ranges from 91% to 96% and specificity ranges from 93% to 95% depending on the use of contrast.[6] Small studies suggest that ultrasonography is not as useful, with a sensitivity of 84% and specificity of 83%.[7] The American College of Radiology Appropriateness Criteria recommends imaging with computed tomography as the first-line modality in most cases of suspected appendicitis in nonpregnant adults and MRI as a second-line alternative in most patients.[4] In line with the Cochrane review, MRI is recommended as a first-line option in pregnant patients due to the absence of ionizing radiation. The American College of Radiology recommends initial imaging in children based on the level of clinical risk; when there is intermediate clinical risk, ultrasonography is labeled "usually appropriate," whereas MRI "may be appropriate."[5] MRI would be considered "usually appropriate" as the next step in the setting of nondiagnostic ultrasonography.[5]

The practice recommendations in this activity are available at https://www.cochrane.org/CD012028.

The opinions and assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the U.S. Air Force, the U.S. Department of Defense, or the U.S. government.

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Accuracy of Point-of-Care Rapid Antigen Tests for Diagnosis of COVID-19

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Clinical Question

What is the diagnostic accuracy (i.e., sensitivity, specificity, positive predictive value, and negative predictive value) of point-of-care antigen testing for the SARS-CoV-2 virus?

Evidence-Based Answer

SARS-CoV-2 antigen tests have an average sensitivity of 69.3% (95% CI, 66.2% to 72.3%) and specificity of 99.3% (95% CI, 99.2% to 99.3%). Accuracy depends on the presence or absence of symptoms, time from symptom onset, and test brand.[1] (Strength of Recommendation: B, inconsistent or limited-quality patient-oriented evidence.)

Practice Pointers

The development of rapid diagnostic tests for the SARS-CoV-2 virus has led to more access to testing. The goals of testing are earlier treatment and reduced transmission. The authors of the Cochrane review evaluated the accuracy of rapid diagnostic tests for SARS-CoV-2 infection.[1]

The current review is the first update; the first review was released in 2020 and includes studies published through March 2021. The current review includes 155 cohorts from 166 studies of a single brand of rapid antigen test, and 152 evaluations of 49 different antigen assays were studied. There were 100,462 unique samples, and the presence of the SARS-CoV-2 virus was confirmed by polymerase chain reaction testing in 16,822 cases. Most studies (66%) were conducted in Europe, and the remainder were in Asia (11%), North America (10%), South America (9%), and Africa (2%).[1]

The average sensitivity and specificity of rapid antigen testing for SARS-CoV-2 infection were 69.3% (95% CI, 66.2% to 72.3%) and 99.3% (95% CI, 99.2% to 99.3%), respectively, based on 184 evaluations, 117,372 samples, and 21,017 confirmed SARS-CoV-2 cases. Average sensitivity was greater in those who had symptoms (73.0%; 95% CI, 69.3% to 76.4%; 109 evaluations; 50,574 samples; 11,662 confirmed SARS-CoV-2 cases) vs. those without symptoms (54.7%; 95% CI, 47.7% to 61.6%; 50 evaluations; 40,956 samples; 2,641 confirmed SARS-CoV-2 cases). Average specificity was similar for patients who were symptomatic (99.1%) or asymptomatic (99.7%). Sensitivity was higher in patients who had symptoms for one week or less (80.9%; 95% CI, 76.9% to 84.4%; 30 evaluations; 2,408 cases) compared with those in their second week of symptoms (53.8%; 95% CI, 48.0% to 59.6%; 40 evaluations; 1,119 cases).[1]

In patients who were asymptomatic at the time of testing, sensitivity was higher when epidemiologic exposure (i.e., contacts of patients with confirmed cases) to the SARS-CoV-2 virus was suspected based on studies reporting specific criteria for testing or referral for testing in the absence of symptoms (64.3%; 95% CI, 54.6% to 73.0%; 16 evaluations; 7,677 samples; 703 cases). By contrast, when COVID-19 testing was reported to be widely available to any asymptomatic participant, sensitivity was lower (49.6%; 95% CI, 42.1% to 57.1%; 26 evaluations; 31,904 samples; 1,758 cases). Average specificity was similarly high in asymptomatic patients regardless of exposure to the SARS-CoV-2 virus (99.6% vs. 99.7%).[1]

As the prevalence of COVID-19 rises, the positive predictive value of antigen tests improves. If the prevalence of COVID-19 in a community is 5%, an average antigen test would have a positive predictive value of 81%. If the prevalence is 10%, the average antigen test would have a positive predictive value of 90%. If the prevalence is 20%, antigen tests have a much better positive predictive value (95%). The negative predictive value in all three situations would remain above 95%.[1]

Sensitivity varied widely among brands. Average sensitivities by brand ranged from 34.3% to 91.3% in symptomatic participants (20 assays with eligible data) and from 28.6% to 77.8% in asymptomatic participants (12 assays).[1]

The authors noted that there was a lack of evidence for commercially produced tests because they were able to locate evaluations for only 49 of the 321 available antigen tests.[1] Only seven assays (AAZ, Abbott [BinaxNOW], BIONOTE, Denka Co, LumiraDx, Quidel, and Shenzhen Bioeasy) met the World Health Organization acceptable sensitivity standard of 80%; the 95% CIs of all but one of these tests (BIONOTE Nowcheck) crossed the 80% threshold.[2] A limitation of the review was the lack of inclusion of the SARS-CoV-2 variants, such as Delta and Omicron.

Although widely available, rapid antigen testing continues to perform more like confirmatory testing than screening, and family physicians should be prepared to counsel patients on the potential for false-negative results. The Infectious Diseases Society of America guidelines recommend the use of nucleic acid amplification tests over antigen-based tests, especially for symptomatic individuals or when the implications of missing the diagnosis of COVID-19 are significant (e.g., patients who are hospitalized or in long-term care facilities, when screening for asymptomatic infection before surgery).[3] The Centers for Disease Control and Prevention guidelines recommend nucleic acid amplification testing following a negative antigen test result in symptomatic patients.[4] Further study is needed to understand the evidence for repeat rapid antigen testing strategies in asymptomatic patients.

The practice recommendations in this activity are available at https://www.cochrane.org/CD013705.

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