

Utility of Staged US and CT Protocol for Suspected Appendicitis

Source: Krishnamoorthi R, Ramarajan N, Wang N, et al. *Effectiveness of a staged US and CT protocol for the diagnosis of pediatric appendicitis: reducing radiation exposure in the age of ALARA. Radiology. Epub 2011 Jan 28; doi:10.1148/radiol.10100984*

Investigators at Stanford University evaluated the efficacy of a staged imaging algorithm consisting of ultrasound (US), followed by computerized tomography (CT) only when US findings were equivocal, in children with suspected appendicitis. The goal of the algorithm was to accurately diagnose appendicitis while minimizing radiation exposure. The researchers reviewed reported findings of imaging studies obtained in children evaluated for appendicitis at an emergency department of a suburban hospital between 2003, when the imaging protocol was implemented, and 2008; the findings were classified as positive, negative, or equivocal. Outcome was based on surgical pathology results for those who underwent surgery and clinical outcome for those who did not. The diagnostic properties of the imaging protocol were calculated.

Of 1,228 eligible patients, 631 (344 girls) underwent the imaging protocol. The median age of study children was 10 years (range 2 months to 18 years). Among 176 patients with a positive US who did not undergo CT, 160 (91%) underwent surgery (152 of these children had pathology-proven appendicitis), and 16 (9%) were treated nonsurgically and did not subsequently have appendicitis. There were 157 patients with a negative US, of whom 155 did not undergo a follow-up CT and were discharged; one returned with a perforated appendix. Two patients with negative US went to surgery based on clinical considerations and one had appendicitis. Two hundred ninety-eight patients had an equivocal US and underwent CT, which was positive for appendicitis in 77 patients (26%), of whom 67 underwent surgery and 62 (92.5%) had appendicitis; 10 patients treated nonsurgically had no later evidence of appendicitis. Of 221 patients with an equivocal US and a negative CT, 6 (2.7%) went to surgery and one had appendicitis. Two hundred fifteen patients were treated nonsurgically and none were determined to have appendicitis.

The staged algorithm demonstrated 98.6% sensitivity, 90.6% specificity, 99.2% negative predictive value, 84.6% positive predictive value, and 93.3% accuracy in diagnosing appendicitis. There were 39 false positive and 3 false negative cases. The negative appendectomy rate (normal appendix found at surgery) was 8.1%. The missed appendicitis rate was 0.16% (1 case). The authors note that if all patients with positive findings had undergone appendectomy and all those with negative imaging studies had avoided surgery, the negative appendectomy rate would have been higher at 13%. Of 631 patients, 333 had definitively positive or negative US and did not undergo CT, reducing such examinations by 52.7%. There was no significant difference in sensitivity or specificity when patients were stratified by age or gender.

PICO

Question: Among children presenting with suspected appendicitis, does an algorithm employing staged ultrasound followed by computerized tomography in equivocal cases allow for accurate diagnosis?

Question type: Diagnosis

Study design: Retrospective

The authors note a greater reduction in CT percentages compared to the 22% found in a prior study,¹ in which CT was performed in equivocal as well as negative US cases. They conclude that a staged protocol in which US is performed first in children suspected of acute appendicitis is highly accurate and may substantially reduce radiation from CT.

Commentary by

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Dr Cohen has disclosed no financial relationship relevant to this commentary. This commentary does not contain a discussion of an unapproved/investigative use of a commercial product/device.

In 1986, Puylaert² introduced compression US as a method for diagnosing appendicitis. Prior to that time, US was limited to the analysis of collections resulting from appendiceal perforations. Puylaert's method, coupled with the availability of high frequency linear array transducers (which are constantly improving), has greatly advanced the imaging of appendicitis, particularly the nonperforated but inflamed appendix. Noting a blind ending tubular structure of greater than 6 mm that does not compress with transducer pressure allows a definitive diagnosis of appendicitis. The diagnosis is hindered by bowel gas and limited by the occasional unusual position of an appendix. It is aided by the presence of focal pain which allows the discovery in most instances of the cause of pain, including an abnormal appendix.

The authors of this study have shown the reliability of a negative US examination with considerable potential reduction in CT radiation. In addition, eliminating the need for CT in over 50% of children is associated with substantial cost savings. The major drawback of the staged protocol is the need for experienced sonographers and sonologists, both of whom are not available in all hospitals. Rather than arouse fear of an "operator-dependent examination," this may be viewed as a call for the development of greater expertise.

Editor's Note

The lack of follow-up of patients with negative US examinations in this retrospective study leaves open the possibility that some of these 154 patients may have presented at another institution with a ruptured appendix. We await prospective evaluation of this protocol before accepting these findings.

References

1. Garcia Peña BM, et al. *JAMA*. 1999;282:1041-1046
2. Puylaert JB. *Radiology*. 1986;158:355-360

Key words: ultrasound, CT, appendicitis

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