

# Journal Club Of The Boston Medical Center: Unenhanced Limited CT of the Abdomen in the Diagnosis of Appendicitis in Children: Comparison with Sonography. Discussion and Review

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## Abstract

A review of the article is presented with discussion based on input from faculty and residents.

## WHAT IS THE QUESTION BEING ASKED?

What is the sensitivity, specificity, and accuracy of unenhanced limited CT of the abdomen in children with suspected appendicitis, and how does that compare to graded compression sonography?

## WHY IS THIS QUESTION IMPORTANT; TO YOU, TO RADIOLOGY?

As a resident, I am being asked to perform the best diagnostic procedure for the patient. Given the morbidity of both false positives and false negatives in suspected appendicitis, the availability of a possibly superior exam which is relatively independent of operator ability would provide a reasonable alternative.

For radiology, the time and cost involved in making a diagnosis with sonography is significant. CT scanners are abundant in major hospital centers and the time to perform an unenhanced scan is minimal. As well, the study is independent of operator ability or patient discomfort.

## WHAT IS THE BACKGROUND WORK?

## WHAT GROUNDWORK LEAD TO THIS QUESTION?

Appendicitis affects 6% of the population and is the most common surgical condition of childhood. However, atypical presentations occur in 30-45%. Preoperative clinical assessment alone yields an accuracy from 70-90%, with rates of unnecessary surgery in 15-25%. Delay in diagnosis and treatment causes increased morbidity, with perforation

in 15-30%.

## HAS ANYBODY ELSE TRIED TO ANSWER THIS QUESTION?

Radiologists' confidence in interpretation of sonography and CT in suspected pediatric appendicitis<sup>[1]</sup>: In equivocal clinical exams, sonography was performed first. If suspicion unchanged, then the CT exam was performed with rectal contrast. In the evaluation of childhood appendicitis, radiologists' confidence in interpretation is influenced by the choice of imaging technique as well as by the results of the study. Radiologists were more confident in their interpretation of CT than sonography ( $p < 0.001$ ). If sonography was a true-positive examination, radiologists were more confident in its interpretation than if it was a false-positive study ( $p = 0.003$ ). Radiologists were more confident in sonographic interpretation of a true-negative examination than of a false-negative study ( $p = 0.03$ ).

Ultrasonography and limited computed tomography in the diagnosis and management of appendicitis in children<sup>[2]</sup>: Patients were first evaluated with pelvic Ultrasonography. If negative or inconclusive, then limited computed tomography with rectal contrast was performed. The protocol had a sensitivity of 94%, specificity of 94%, positive predictive value of 90%, negative predictive value of 97%, and accuracy of 94%.

Imaging evaluation of suspected appendicitis in a pediatric population: effectiveness of sonography versus CT<sup>[3]</sup>:

Helical CT has a significantly higher sensitivity and accuracy than graded compression sonography for the diagnosis of appendicitis in a pediatric and young adult population, particularly in children more than 10 years old. Helical CT had a significantly higher sensitivity (95% versus 78%,  $p = 0.009$ ) and accuracy (94% versus 89%,  $p = 0.05$ ) than graded compression sonography. There was no mention in the abstract of the use of contrast agents.

Evaluation of suspected appendicitis in children and young adults: Helical CT[4]: Helical CT is useful in a pediatric population to diagnose or exclude appendicitis and to establish an alternative diagnosis (sensitivity 95%, specificity 94%, alternative diagnosis in 35% of patients without findings of appendicitis). 131 of 134 received either oral or rectal contrast.

### **WHAT ARE THE LIMITATIONS THAT PREVENTED THIS QUESTION FROM BEING ASKED BEFORE?**

None. Prior studies primarily focused on the adult population and were largely retrospective. Methodology has varied widely – IV, oral, rectal contrast. At the institution the study was performed, sonography was the primary imaging modality for 6 years.

### **WHAT IS THE NULL HYPOTHESIS?**

There is no significant statistical difference between the sensitivity, specificity, and accuracy of unenhanced limited CT of the abdomen as compared to graded compression sonography. However, the null hypothesis is not “disproven” in this study by the data provided.

### **WHO IS THE TEST POPULATION?**

Included were 76 consecutive children with suspected appendicitis over 11 months and a historical cohort of 86 consecutive children who had undergone graded compression sonography until 1 month before the study. 10 children imaged during the transition period were not included, and 12 with incomplete follow-up were also excluded. No analysis of age or sex bias was performed.

### **WHAT ARE THE METHODS USED?**

Prospective selection of the CT group. Retrospective analysis of prior sonography patients.

### **WHAT ARE THE RESULTS?**

Unenhanced limited CT: Sensitivity 97%; Specificity 100%; Accuracy 99%

Graded compression sonography: Sensitivity 100%; Specificity 88%; Accuracy 91%

Difference is not statistically significant ( $p > 0.05$ )

Difference in alternative diagnosis is not statistically significant ( $p > 0.05$ )

According to the data provided, the prevalence of positive findings of appendicitis on CT is 50%, on ultrasound 25%. This is a very high prevalence, suggesting high clinical suspicion. Therefore, the data may have referral biases towards positive findings, especially since ultrasound has been shown to have reduced sensitivity in other studies. Using the ultrasound prevalence data, the odds of a positive finding ( $p$ ) are 0.25. Therefore, the standard deviation of a normal distribution would equal  $(p \cdot q / N)^{0.5}$ , or 0.05. Two standard deviations would equal 0.1, for a range of 0.15 to 0.35, likely well above the average prevalence in random populations.

### **WHAT ARE THE KEY PRO/CONS OF EACH RESULT?**

Pros: Not using IV, oral, or rectal contrast reduced delay times, eliminated need for sedation or restraining devices, and lacked invasiveness. The sensitivity and specificity of CT was equal to that of sonography. Reduced imaging times. Relatively operator independent.

Cons: Radiation to the pelvis. However, a standard abdominal radiograph delivers 0.56 mSv, and a full CT of the abdomen 1.11 mSv. Increased cost at the study site (\$408 vs. \$295) – this “cost” may not accurately reflect the technologist and scanner fees for other institutions.

### **WHAT ARE THE LIMITATIONS OF THE STUDY?**

Cohort size, prevalence of appendicitis among suspected cases, retrospective nature of the sonography results.

### **WHAT IS THE NEXT QUESTION RAISED, OR NEEDS ANSWERING?**

What are the measured risks of radiation to the pelvis in the pediatric population? How do the impressive results hold up with a larger, purely cohort population of all-comers, versus the selected patients with high-clinical suspicion?

### **References**

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