Efficacy of CT Enterography in the Detection of Active Inflammatory Crohn's Disease of the Terminal Ileum

Primary Authors: Mark E. Baker, MD
C. Daniel Johnson, MD
James H. Ellis, MD

Purpose and Rationale

This project aims to improve the accuracy of CTE interpretation for the diagnosis of active inflammatory Crohn's Disease of the terminal ileum.

CTE is now considered a method of choice in the evaluation of patients with suspected Crohn's disease. Thus, improving diagnostic efficacy of CTE in this disease is important. There are multiple sources of interpretive error:

- collapsed loops enhance to a greater degree than distended loops
- proximal small bowel enhances to a greater degree than distal small bowel, given a greater surface area
- ignorance of the important findings of active inflammatory disease, including wall thickening, wall hyperenhancement (often with stratification), vasa recta engorgement (Comb sign), fatty proliferation.

Further, while it has been shown that capsule endosocopy and CTE are complementary examinations, many sites do not use capsule endoscopy as a primary means for diagnosing Crohn's disease. Strictures may obstruct the capsule leading to unnecessary or undesirable surgery.

Resources

Bodily KD, Fletcher, JG, Solem CA, et al. Crohn disease: mutal attenuation and thickness at contrast-enhanced CT enterography—correlation with endoscopic and histologic findings of inflammation. *Radiology*. 2006; 238:505-516.

Booya F, Fletcher JG, Huprich JE, et al. Active Crohn disease: CT findings and interobserver agreement for enteric phase CT enterography. *Radiology*. 2006;241:787-795.

Solem CA, Loftus EV, Fletcher JG, et al. Small-bowel imaging in Crohn's disease: a prospective, blinded 4-way comparison trial. *Gastrointestinal Endoscopy*. 2008;68:255-66.

Baker ME, Walter J, Obuchowski NA, et al. Mural attenuation in normal small bowel and active inflammatory Crohn's Disease on CT enterography: location, absolute attenuation, relative attenuation, and the effect of wall thickness. *American Journal of Roentgenology*. 2009;192:417-423.

Lee SS, Kim AY, Yang S-K, et al. Crohn's disease of the small bowel: comparison of CT enterography, MR enterography, and small-bowel follow-through as diagnostic techniques. *Radiology*. 2009;251:751-761.

These and other investigations have established that CTE should detect active inflammatory Crohn's disease of the terminal ileum with sensitivity of 80-90%, using ileocolonoscopy/biopsy, and between 89-98% using a comprehensive, clinical reference standard.

Measures

Rates of CTE studies that are:

- true positive (interpreted as positive, confirmed by ileocolonoscopy and/or biopsy)
- true negative (interpreted as negative, confirmed by ileocolonoscopy and/or biopsy)
- false positive (interpreted as positive by CTE but negative by ileocolonoscopy and/or biopsy)
- false negative (interpreted as negative by CTE but positive by ileocolonoscopy and/or biopsy)
- equivocal

You may have to substitute a clinical reference standard if endoscopy and/or biopsy are unavailable.

Collecting Baseline Data

Depending upon the size and composition of your patient population, collect 25- 50 CTE reports with confirmatory ileocolonoscopy. From among those performed within the study period, you may choose to use consecutive cases; every second, third or fourth case until the target number have been selected; all of the cases done on a specific day or set of days; or any other strategy that will result in a set of the target number of cases identified at random. Categorize the CTE report findings as: definitely positive for active inflammatory Crohn's of the TI, definitely negative for active inflammatory Crohn's disease, and equivocal.

Then, access colonoscopy and biopsy reports for the same cases. Categorize the cases based on these findings as definitively active inflammatory Crohn's disease, equivocal and inactive/absent, using the criteria established by Bodily et al (Radiology 2006; 238: 128).

Baseline Data Analysis

Create a 3 x 3 table:

	Scope/biopsy Positive	**Scope/biopsy Negative**	**Scope/biopsy Equivocal**
CTE Positive	True Positive	False Positive	
CTE Negative	False Negative	True Negative	
CTE Equivocal			

Sort the cases into their appropriate boxes.

Data should be evaluated in the aggregate for the practice and, if numbers allow, by individual radiologist.

In particular, determine if your practice's efficacy is equivalent to published standards (at least 80% sensitive for active inflammatory Crohn's disease of the terminal ileum).

Factors that Can Influence Performance

After analyzing the baseline data, determine where there is room for improvement. Analyze the false positive and false negative cases, as well as those cases with equivocal findings on CTE that were judged to be definitive by ileocolonoscopy and/or biopsy. Look for any patterns of contributing factors. If your rates are not equivalent to published standards, try to determine why. Are there too many equivocal readings? If so, why are they equivocal? Is it missed findings?

Reflect on your setting and practice, and identify factors that may have influenced your results. Design an intervention to address these factors.

The most likely intervention is an education program for your interpreting radiologists to increase their understanding of CTE findings of active inflammatory Crohn's disease. Potential educational interventions might include grand rounds, educational resources available through professional societies, journal discussion groups, or visits to sites of excellence.

If certain radiologists have better performance statistics, consider whether studies should be selectively interpreted by those members of your practice.

Post-Intervention Data Collection and Analysis

Plan to collect data again at a set interval —three to six months after baseline or the intervention

if there is a time lag for education—and then at specified intervals thereafter for the duration of the project (one to three years is typical).

Make sure that cases are collected, tallies are performed and metrics are analyzed the same way as at baseline. The only exceptions to this would be to adjust the number of cases collected if more cases are needed for analysis or to correct a problem identified with the baseline data collection procedure. If so, once the procedure has been corrected use it consistently going forward.

The process is iterative and should be repeated at frequent intervals until steady state is reached. Special attention should be given to those radiologists who are more likely to interpret a CTE as equivocal to determine whether intervention has made a difference. It is important to determine if the quest for improving sensitivity has inappropriately altered accuracy.

Data should continue to be collected over time. If improvement is continuing, the same intervals for data collection should be recommended. As improvement plateaus the interval for measuring and the number of exams that are measured can be reduced—as long as the metrics are stable. If a significant decrease in performance is seen, the project should start anew with analysis as to cause and potential fix.

You may want to make a chart or graph of your performance over time to identify trends and patterns. Review the data with your project team after every data collection period.

If you are meeting your goals, no further changes may be necessary. However, you should plan to take steps to institutionalize whatever changes contributed to successful performance. If additional improvement is possible, look at your processes again and design additional interventions. It is generally best to only make one intervention per study cycle so that conclusions can be drawn about what caused the observed effect.