Weekday II: Session (Tuesday): Gastrointestinal

Title: MR Enterography to Assess Disease Activity in Crohn’s Disease

Speaker: Martin P. Smith, MD

Target Audience:
- Radiologists who interpret MR Enterography
- Translational Researchers looking to understand current challenges in MRI for staging activity in Crohn’s disease

Objectives:
- To understand how MR Enterography is important in the management of Crohn’s disease particularly in differentiating chronic disease from active inflammation and staging the degrees of each.
- To understand the technical aspects of MR Enterography in evaluating Crohn’s disease
- To understand the most sensitive and specific findings for active Crohn’s disease
- To learn about new strategies for assessing the degree of inflammatory activity in patients with Crohn’s disease

Background:
Medical management of small bowel Crohn’s disease (CD) depends on knowing the presence and degree of active inflammation versus chronic disease. If there is not active inflammation, then medications will not be effective and surgical or therapeutic endoscopic intervention will be needed. If present, then the degree of active inflammation (e.g., mild, moderate, severe) influences what medications are used, as there are many options. Also with greater degrees of active inflammation other intervention are more likely to be needed for effective therapy.

Imaging assessment of small bowel CD is crucial because of overlap in the clinical presentation of patients with complications of chronic CD, active inflammation from CD, and other abdominal pathology in patients with CD. MR Enterography/Enteroclysis have become the preeminent modality for primary assessment and follow up of small bowel CD because of their accuracy and reproducibility for detecting and characterizing intra- and extraluminal abnormalities in a minimally invasive way.¹

Technique:

MR Enteroclysis achieves more consistent luminal distension of the jejunum and ileum than MR Enterography to allow complete assessment of the small bowel, however, because it is more time consuming, requires more technical and staff resources, uses ionizing radiation for tube placement, and causes more patient discomfort, MR Enterography is more commonly performed.

MR Enterography is most commonly performed at 1.5T using a torso surface phased-array coil with the patient in the supine position. Usually a volume of 1350-1500 mL of biphasic oral contrast is ingested prior to the examination with an anti-peristaltic agent administered during the examination to reduce bowel motion for improved image quality.

After initial imaging to ensure adequate passage of oral contrast and small bowel distension, the following sequences are usually obtained:

- Half-Fourier single-shot fast or turbo spin-echo T2-weighted imaging in the coronal and/or transverse planes with at least one plane employing fat suppression.
- Balanced gradient-echo or steady-state free precession imaging (e.g., TruFISP, FIEST, b-FFE) in the coronal and/or transverse planes.
- Three-dimensional spoiled gradient echo fat-suppressed T1-weighted imaging before, during, and after administration of a gadolinium-based contrast agent (GBCA).

A sequence to evaluate small bowel motility and distensibility, such as a cine steady-state free precession or cine thick section heavily T2-weighted turbo or fast spin-echo imaging, is sometimes used.

Diffusion-weighted imaging (DWI) is sometimes used to detect inflammation with or without a calculated apparent diffusion coefficient (ADC) for quantitative analysis of inflammation.

**Discussion:**

Findings that have been reported to correlate with active inflammation in CD include mucosal hyperenhancement, fold thickening, ulcers, mural thickening and edema, mesenteric edema, mesenteric vascular engorgement (“comb sign”), mesenteric lymph node enlargement and hyperenhancement, fistulae and sinuses, and abscesses.

Several studies have reported sensitivity of >90% for MRI in detection of active inflammation in CD. Increased wall thickness and mural hyperintensity on T2-weighted images have been reported to have very high correlation with active inflammation at histopathology.

One study reported that ulceration seen on MR Enterography in the terminal ileum of patients with CD had the strongest correlation with the CD Endoscopic Index of Severity. However, a few mild cases of CD seen on endoscopy were falsely negative on MRI and there were a few false positive MRI exams in patients with normal endoscopic studies, mostly from perceived increased enhancement; both problems in other studies as well.
MRI using T1-weighted imaging after administration of a GBCA improves the detection of inflammation with mucosal/mural hyperenhancement reported as the most sensitive imaging finding of active disease.\textsuperscript{4,7} Mucosal hyperenhancement on delayed GBCA-enhanced imaging and enhancing fistulae have been reported to have very high correlation with active inflammation at histopathology.\textsuperscript{4} Mural stratification, which is a hyperenhancing mucosa and serosa with intervening mural edema that relatively hypoenhances, has very high specificity for active inflammation.\textsuperscript{5,7,8}

Dynamic contrast-enhanced (DCE) MRI with high temporal resolution for kinetic analysis of signal variation after GBCA administration has been evaluated for disease activity assessment; in one study it was reported that the mural enhancement parameters correlated significantly but weakly with Crohn’s disease activity clinically\textsuperscript{9} and in another mural enhancement parameters did not correlate with histologic or clinical markers of inflammation.\textsuperscript{10}

There have been several investigations recently of diffusion weighted imaging (DWI) for assessment of activity in CD with some reporting better sensitivity of DWI than DCE MRI for active CD in the terminal ileum by histopathology.\textsuperscript{11}

Luminal narrowing can be seen in active disease because of marked inflammation or in chronic disease from fibrostenosis, but lack of variability in luminal diameter (distensibility) of a narrowed segment over time suggests a fixed stenosis. The overall decreased motility of segments of small bowel affected by CD has led some to develop methods of quantification of segmental bowel motility and have reported negative correlation of motility with activity of CD in affected small bowel segments.\textsuperscript{12}

Several groups have investigated the value of MRI scoring systems combining many of the factors discussed above to assess small bowel CD activity.\textsuperscript{13,14} These have had encouraging results but they vary in the findings used and methods applied and have been performed in small, single-site studies.

Conclusion:

MR Enterography has a reproducibly high sensitivity for detection of active small bowel CD, primarily from increased contrast enhancement on T1-weighted imaging after administration of a GBCA. However, subtle mucosally limited CD remains problematic to detect and there is a lack of specificity of contrast enhancement, particularly in patients with long-standing CD. Improved rapid T2-weighted imaging along with improvements in DWI and segmental motility assessment have the potential to improve specificity and possibly sensitivity. The best combination of parameters remains an area of active investigation.

References:


