

ADVANCES IN IBD

Current Developments in the Treatment of Inflammatory Bowel Diseases

Section Editor: Stephen B. Hanauer, MD

Using CT and MR Enterography to Diagnose and Monitor IBD

Edward V. Loftus, MD
 Professor of Medicine
 Department of Gastroenterology and Hepatology
 Mayo Clinic
 Rochester, Minnesota

G&H How frequently is computed tomography or magnetic resonance enterography used to diagnose or monitor patients with inflammatory bowel disease?

EL Use of these technologies varies by institution, but many institutions are increasingly using computed tomography (CT) or magnetic resonance (MR) enterography rather than barium-based small bowel imaging to monitor patients with known or suspected inflammatory bowel disease (IBD). In 2002, for example, virtually all of our small bowel imaging was barium based, but now 80–90% of our small bowel imaging is performed using CT or MR enterography.

G&H When would you want to use CT or MR enterography to diagnose or monitor patients with IBD?

EL If a patient presents with suspected IBD, then CT or MR enterography is often indicated. For example, if a patient has diarrhea, abdominal pain, weight loss or microcytic anemia, and an elevated level of C-reactive protein, then the pretest suspicion of Crohn's disease would be high. CT or MR enterography is also indicated when the clinician needs to make a major treatment decision or the patient is suspected of having an intestinal complication such as a stricture, abscess, or fistula. In such cases, CT or MR enterography can be quite helpful.

In addition, there is an emerging paradigm in which serial enterography is used to monitor response to ther-

apy. While this is not yet standard practice for the average clinician, some gastroenterologists are increasingly entertaining the idea that to truly alter the natural history of IBD, we need to monitor patients based on radiographic and/or endoscopic imaging rather than symptoms.

G&H What are the advantages of CT or MR enterography compared to endoscopy?

EL Enterography and endoscopy look at slightly different areas, so I view the tests as being complementary. With endoscopy, the clinician can obtain a great view of the mucosal layer. On the other hand, imaging allows the clinician to see beyond the mucosa; with imaging, the clinician gets a full transmural view of the entire bowel wall and can see if the patient has any extra-enteric complications such as fistulas or abscesses. Imaging can also show whether there is obstruction with proximal bowel dilatation.

G&H How do CT and MR enterography compare in terms of safety and efficacy?

EL There are pros and cons with both technologies. CT has been available longer, CT is faster, and CT yields somewhat higher-quality images. However, recent articles in the medical literature and the lay press have expressed concern about the cumulative exposure to diagnostic radiation associated with CT. There is still much debate among physicists about whether it is possible to extrapolate from atomic bomb survivors or nuclear industry workers to patients who are receiving smaller doses of radiation; thus, the absolute risk associated with this pattern of radiation exposure has not been well established. Nonetheless, there is a potential

concern about the cumulative effects of radiation and how it might increase the risk of cancer.

Even if this risk is a cause for concern, the risk is not the same for all patients. According to models in which researchers extrapolated from nuclear bomb survivors and nuclear industry accidents, the human body seems to become somewhat immune to the effects of radiation after a certain age—somewhere between 35 and 50 years—at which point the risk of developing a radiation-induced cancer declines significantly.

Because of these concerns, CT enterography is now being used a bit more selectively. Rather than ordering CT enterography for all patients, many clinicians are now more likely to opt for MR enterography in a younger patient. In a patient over the age of 50 years, however, it is reasonable to proceed with CT enterography.

G&H Why does CT enterography produce better-quality images than MR enterography?

EL One main reason for the difference in image quality is the difference in scan speed. For example, it currently takes less than 30 seconds to perform a CT scan, but the same scan might take 30 minutes using an MR imaging machine. As a result, the chance of having some motion artifact is higher with MR enterography.

While a side-by-side comparison of scans produced via CT and MR enterography shows that CT images are much crisper and have a higher resolution than MR enterography images, the difference between the 2 tests is narrowing. If I had been asked that question 5 years ago, I would have said that CT enterography was unequivocally better than MR enterography, but now some studies have compared the 2 tests and shown that they are roughly equivalent for detecting intestinal complications such as strictures or fistulas. Nonetheless, I think many radiologists still feel that CT enterography provides better resolution than MR enterography.

G&H How do CT and MR enterography compare in terms of cost and other practical considerations?

EL Currently, MR enterography is more expensive than CT enterography, so cost can be a potential barrier. Also, there are fewer MR imaging machines available to perform MR enterography, so clinicians sometimes face a longer wait time when ordering MR enterography compared to CT enterography. Finally, CT scans are performed in a relatively open, donut-shaped machine, whereas MR enterography is generally performed in a closed machine that might cause problems for patients who have claustrophobia.

G&H Do these tests have other limitations that clinicians need to consider?

EL One limitation is that both types of enterography require patients to drink a large volume (1.5–2 L) of oral contrast before the examination, which may preclude the use of these tests in some patients. Also, since intravenous (IV) contrast is needed in order for CT or MR enterography to be most effective, renal insufficiency could be a concern with either of these procedures. Specifically, the iodine contrast used with CT enterography can sometimes cause worsening of renal insufficiency, and the gadolinium-based agents used with MR enterography can potentially cause a rare but very disabling and sometimes fatal condition called nephrogenic systemic fibrosis, the risk of which is highest in patients with renal insufficiency.

G&H Aside from CT and MR enterography, what other technologies can aid in the diagnosis and monitoring of IBD?

EL There are a few emerging technologies that may prove useful for assessing IBD patients. In Europe, real-time transabdominal ultrasound is fairly widely available. In this highly operator-dependent procedure, oral or IV contrast agents are administered to enhance ultrasonography, and clinicians look for some of the same findings that they would look for using enterography, such as bowel wall thickening. In Europe, the procedure is usually performed by gastroenterologists. Given the way that healthcare is delivered in North America, however, transabdominal ultrasound may not be a feasible option for assessing IBD patients in the United States.

Another interesting technology that I believe will become more common in the future involves testing for fecal markers of inflammation. By taking a stool sample and testing for various proteins that are associated with white blood cells, such as lactoferrin and calprotectin, clinicians can obtain information about the degree of bowel inflammation, since higher levels of these proteins in the stool likely reflect increased inflammation in the bowel itself. These tests are noninvasive and relatively inexpensive compared to some of the other imaging modalities currently being used, so I hope to see increasing use of these tests in the future.

Another imaging technology that could potentially be used to assess IBD is positron emission tomography (PET) scanning. This test involves administering radioactively labeled glucose, which will be more readily taken up by cells that are inflamed or cancerous, thus allowing clinicians to see areas of active inflammation. A few preliminary studies have looked at using PET scanning as a tool in IBD, but cost will likely be a barrier;

PET scanning is even more expensive than MR imaging scanning, so until the cost of PET scanning decreases, this technology probably will not be a major tool for diagnosing or monitoring IBD.

G&H As new technologies continue to evolve, do you think they will become the standard of care for monitoring IBD?

EL I would argue that enterography has already become the standard of care, although many people would debate that point. Certainly enterography has become the standard of care for monitoring IBD in my practice and at Mayo Clinic, but it will take time for these technologies to diffuse out to all practitioners in all communities.

Suggested Reading

Siddiki HA, Fidler JL, Fletcher JG, et al. Prospective comparison of state-of-the-art MR enterography and CT enterography in small-bowel Crohn's disease. *AJR Am J Roentgenol.* 2009;193:113-121.

Moscandrew ME, Loftus EV Jr. Diagnostic advances in inflammatory bowel disease (imaging and laboratory). *Curr Gastroenterol Rep.* 2009;11:488-495.

Halpenny DF, Burke JP, Lawlor GO, O'Connell M. Role of PET and combination PET/CT in the evaluation of patients with inflammatory bowel disease. *Inflamm Bowel Dis.* 2009;15:951-958.

Pascu M, Roznowski AB, Müller HP, Adler A, Wiedenmann B, Dignass AU. Clinical relevance of transabdominal ultrasonography and magnetic resonance imaging in patients with inflammatory bowel disease of the terminal ileum and large bowel. *Inflamm Bowel Dis.* 2004;10:373-382.

Krocker KI, Lam S, Birchall I, Fedorak RN. Patients with IBD are exposed to high levels of ionizing radiation through CT scan diagnostic imaging: A five-year study. *J Clin Gastroenterol.* 2010 Jul 27. Epub ahead of print.