MR aids evaluation of pediatric Crohn's disease

February 18, 2005 | Vendors [1]
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Crohn's disease can involve any part of the gastrointestinal tract but most often affects the distal ileum and colon. It is characterized by chronic inflammation that extends through all layers of the intestinal wall and involves both mesentery and regional lymph nodes.

The bowel wall appears thickened with a narrowed lumen as the disease progresses. This stenosis can occur in any portion of the intestine and may be associated with varying degrees of intestinal obstruction. The mesentery appears thickened and fatty and often extends over the serosal surface of the bowel in characteristic fingerlike projections ("creeping fat," or fibrofatty proliferation). The appearance of mucosa may be normal, but in more advanced cases it can have a nodular, "cobblestoned" look caused by submucosal thickening and mucosal ulceration.

Crohn's disease is often discontinuous. Involved segments are separated from one another by segments of normal bowel called skip areas. The rectum is spared in more than 50% of cases. The transmural inflammatory process of Crohn's may lead to fistula and abscess formation. Serosal inflammation can also cause adjacent loops of small intestine to become matted together. Fistula formation may occur between adjacent bowel loops that have matted and adhered to one another or between bowel loops and the bladder or vagina. The number of children observed with Crohn's disease has increased progressively over the past two decades. Clinical presentation in children is usually similar to that in adults, although important differences must be recognized. Systemic and extraintestinal manifestations of Crohn's disease may predominate in children, and gastrointestinal symptoms may be minimal.

Common mistaken diagnoses include iron deficiency anemia, juvenile rheumatoid arthritis, eating disorders, idiopathic growth failure, and endocrine disease. Options for radiological evaluation include conventional studies, such as barium imaging and enteroclysis, which provide general information on disease localization and extension, and ultrasound and CT, which permit superior assessment of mural and extramural involvement. Radiologists experimenting with MRI to study patients with Crohn's disease were initially hampered by motion artifacts and the lack of good oral contrast agents. These drawbacks weighed against such potential advantages as multiplanar projections and lack of ionizing radiation. The advent of new sequences with breath-hold acquisition times and the availability of suitable oral contrast agents, however, have stimulated further studies on the role of MRI in inflammatory bowel diseases, with encouraging results.

We perform MRI on all children affected by Crohn's disease at our institution and compare the data with those obtained by endoscopy and ultrasound. This helps us improve assessments of the disease's extension and activity and detect possible complications. We do not routinely perform barium or CT enema studies.

Patients are studied in the supine position with a phased-array body coil using an Edge 1.5T scanner (Marconi-Picker, now Philips Medical Systems). Maximum gradient field strength for the examination is 16 mT. We first perform coronal and axial T2-weighted express fat-saturated breath-hold scans. We then inject 0.3 mmol/kg gadolinium chelate (Dotarem, Guerbet) intravenously to enhance the bowel wall and continue the examination with 2D T1-weighted fast fat-saturated sequences (7-mm slice thickness).

Oral administration of 1000 mL iso-osmotic polyethylene glycol (PEG) electrolyte-balanced solution (Isocolan, Bracco) is used for small bowel distention. We divide this solution into two doses of 750 mL and 250 mL and administer them at 60 minutes and 15 minutes, respectively, before the examination. Patients generally tolerate the PEG solution well, and bowel distention is obtained in most cases. Minor complaints include occasional nausea, abdominal distention, and, very rarely, diarrhea during MR scanning. Inhibition of bowel peristalsis, essential to avoid motion artifacts, is
obtained by IV injection of hyoscine N-butylbromide (Buscopan, Boehringer-Ingelheim). A dose of 10 mg for eight to 14-year-olds and 20 mg for older patients is administered as the patient lies supine on the MR table. The entire study usually requires 30 minutes.

**TYPICAL FINDINGS**

We use 3 mm as the cutoff between normal and pathologic bowel wall thickness and consider marked gadolinium contrast enhancement of the bowel wall a sign of increased vascularization in loops affected by Crohn's disease.

Gastrointestinal tract lesions related to Crohn's can be classified as superficial, transmural, or extramural abnormalities. Characteristic superficial lesions include aphthoid and mesenteric border ulcers and blunting and thickening of the valvulae conniventes. These lesions are not generally seen on MR enteroclysis.5

Deep transverse and longitudinal ulcerations penetrating the submucosa and muscular coat constitute the disease's typical transmural abnormalities. These ulcers cause the so-called cobblestoning or ulceronodular pattern that is typical of Crohn's disease (Figure 1). In our experience, ileal or colonic cobblestoning is observed in 75% of cases, and small bowel or colonic stenoses are seen in 95% of cases. Bowel wall thickness and increased wall vascularization, suggesting active disease, are detected easily on MRI (Figure 2). These MR findings correlate well with those from gray-scale and Doppler ultrasound (95% and 80%, respectively).5

Extramural abnormalities, prominent vasa recta, and venous and lymphatic dilatation in the mesenterium may generate the "comb sign," seen clearly on MRI as a series of linear structures perpendicular to the longitudinal intestinal axis (Figure 3). Abundance of mesenteric fat, a relatively common finding in Crohn's disease, may cause separation of small bowel loops. This feature, known as fibrofatty proliferation, is also seen on MR enteroclysis (Figure 4). Enlarged lymph nodes (>10 mm) are observed, typically along the course of the mesenteric vessels in proximity to the bowel wall or at the root of the small mesentery (Figure 5).

Abscesses originating from sinuses deriving from bowel loops appear as an oval mass with fluid content and wall enhancement (Figure 6). We did not observe enteroenteric fistulas in patients who underwent conventional enteroclysis to rule out this condition, nor did MRI detect fistulas extending from bowel loops to other epithelium-lined organs. We were consequently unable to verify the ability of MR enteroclysis to show these lesions.3

**WEIGHING ALTERNATIVES**

Endoscopy and barium studies remain important tools for the study of patients with known or suspected Crohn's disease. Both examinations permit excellent evaluation of bowel mucosa and luminal caliber but can provide only indirect information about the disease's transmural and extramural extension. Nonetheless, reliable assessment of pathologic changes involving bowel wall, mesenteric attachments, and adjacent structures is essential to evaluating disease activity and planning suitable treatment.

Absence of ionizing radiation and the ability to evaluate both gut wall and extramural extension of the disease make ultrasound a valuable imaging technique for Crohn's disease. Ultrasound can detect stenoses, wall thickening, mesenteric inflammatory proliferation, lymphadenopathy, and abscesses.6 Addition of Doppler imaging to detect increased bowel wall vascularization may allow differentiation of chronic from active bowel wall thickening.5,7 Ultrasound is an excellent tool for following disease course and evaluating relapse and extramural manifestations. But even skilled operators can miss abnormalities located behind air-filled bowel loops, as ultrasound is unable to penetrate gas.

CT's unparalleled ability to depict mural and extramural abnormalities has assured it an important role in evaluating patients with Crohn's disease.8,9 The modality can identify bowel wall thickening and inflammation, transmural fibrosis and cicatrization, fibrofatty proliferation and vascular abnormalities of the mesentery, lymph node involvement, abscesses, phlegmons, fistulas, and sinus tracts. But patients with Crohn's disease may require many radiological investigations over time, resulting in a high cumulative radiation dose, which is of special concern in children.

MR's lack of ionizing radiation, capacity for multiplanar imaging, and superior soft-tissue contrast make it a potentially ideal technique for evaluating Crohn's disease, particularly in pediatric patients. Our experience shows that MRI in children with Crohn's disease yields diagnostic information on extension and grade of both intramural and extramural abnormalities that is at least comparable with endoscopy, gray-scale ultrasound, and Doppler studies. Multiplanar projections improve visualization without the need for ionizing radiation.

Optimal distention of bowel loops is essential for evaluating wall thickness and mural contrast enhancement on MR studies; PEG solution is suitable for this function. It progresses rapidly along the
bowel and is not absorbed, due to its iso-osmotic nature. PEG, with its acceptable taste, can be administered orally to children, avoiding the need of duodenojejunal fluoroscopic catheterization. Additional studies are needed to confirm the potential of MR enteroclysis in diagnosing Crohn's disease. MR's ability to detect all significant intra- and extramural findings, however, makes it a viable adjunct to endoscopy and other conventional modalities, providing valuable data on complications and disease activity. The future availability of dedicated sequences and higher gradients may allow detection of mucosal superficial lesions, which are not at present detectable on MRI in most cases.

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References

Disclosures:

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