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Magnetic resonance enterography with oral mannitol solution: Diagnostic efficacy and image quality in Crohn disease

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MR-enterography;
Small bowel

Abstract
Purpose: The aim of this study was to investigate the diagnostic efficacy and image quality of magnetic resonance enterography (MRE) using oral mannitol solution for the evaluation Crohn disease (CD).
Materials and methods: We retrospectively evaluated MRE examinations of 153 patients with an assumed or definitive diagnosis of CD. There were 65 men and 88 women, with a mean age of 35.7 years (range: 6—73 years). MRE findings of the patients were compared to histopathologic results obtained by surgery-fiberoptic endoscopy. The sensitivity, specificity and diagnostic efficacy rate were calculated. Additionally, image quality of MRE was evaluated using a four-point scale (1 = excellent, 4 = poor/non-diagnostic).
Results: Sensitivity, specificity and diagnostic efficacy were 92.5%, 93% and 92.8%, respectively. Six patients had false-positive and five patients had false-negative findings. Three falsely positive patients had ulcerative colitis and three had non-specific terminal ileitis. A total of 765 small bowel segments were analyzed; 475 (62%) had an image quality score of 1 and 15 (2%), an image quality score of 4.
Conclusion: MRE using oral mannitol solution provides excellent image quality for MRE and has high degrees of diagnostic efficacy in CD patients.

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Inflammatory bowel disease (IBD) affects 1.4 million people in North America, with an associated incidence of 20,000—100,000 new cases developing each year [1—3]. IBD includes Crohn disease (CD) and ulcerative colitis (UC) [4,5]. CD is a chronic inflammatory condition with a relapsing and remitting course that can affect any segment of the gastrointestinal tract from the mouth to the anus. CD can also involve the pelvis thus mimicking actual pelvic disease [6]. However, CD most frequently affects the small bowel and colon, and terminal ileum is the most common site of onset. The early diagnosis of acute inflammatory activity, fibrostenotic changes, and presence of an intestinal obstruction will determine the medical or surgical treatment options [7]. Medical treatment is applied for the non-stricturing and non-penetrating type of CD. The other types are more likely to need surgical therapy during the course of the disease.

Imaging is important in CD diagnosis by demonstrating the presence and distribution of the lesions [8,9]. Endoscopy has been considered the gold standard in the diagnosis of CD, but is restricted to the intraluminal evaluation [10]. Cross-sectional non-invasive imaging modalities such as computed tomography (CT) and magnetic resonance (MR) enterography have advantages over endoscopy in the evaluation of the small bowel by demonstrating extraluminal and extraintestinal disease [4] and revealing malignant extraintestinal complications of CD [11]. Imaging features of the bowel on MR-enterography are indicators of disease activity and treatment response [8]. MR-enterography has advantages over CT enterography including the absence of ionizing radiation exposure, less abdominal discomfort, and superior soft tissue contrast, compared to CT, which leads to a better evaluation of CD and its complications [5,12]. Exposure to ionizing radiation is especially significant in CD, since CD patients usually undergo multiple follow-up examinations. The other advantages of MR-enterography are multiplanar imaging, high sensitivity for fluid, edema, and mucosal changes, use of diffusion-weighted sequences, and accurate differentiation of inflammatory strictures from fibrostenotic strictures [13,14].

The aim of this study was to investigate the diagnostic efficacy and image quality of MR-enterography using oral mannitol solution for the evaluation of CD.

Materials and methods

Patients

One hundred sixty-five consecutive patients who were known or suspected to have IBD with abdominal pain, diarrhea, and weight loss, were referred to our institution for IBD assessment, and had undergone MR enterography from May 2013 to December 2016, were reviewed retrospectively for this study. However, six patients with masses, two patients with poor image quality, and four patients with UC at follow-up were excluded from the study. There was no contraindication in our patients, such as renal failure, allergy history, pregnancy, and hemodynamic instability. The 153 patients who were evaluated with MR-enterography, with at least three months of clinical follow-up, and with histopathology and/or endoscopy (ileocolonoscopy) were included in the study. Among the 153 patients enrolled in the study, 65 (42.5%) were men, and 88 (57.5%) were women. The mean age of the patients was 35.7 years (range: 6—73 years). Seventy patients (45.8%) were children, and 83 (54.2%) were adults. The mean age of the patients was 13.5 years (range: 6—17 years) in the pediatric population and 46.8 years (range: 18—73 years) in the adult population.

MR-enterography was performed within the two weeks following admission. The study protocol had Institutional Review Board approval, and all patients provided informed consent prior to participating in the study.

MR-enterography protocol

All patients fasted for four to six hours prior to examination. A 3% mannitol solution was used as an enteric contrast agent. It was orally administered to patients weighing less than 50 kg as follows: 10 mL/kg one hour prior MR-enterography examination, 5 mL/kg 30 minutes prior to the examination, and 5 mL/kg just before examination. It was orally administered to patients weighing more than 50 kg as follows: 500 mL one hour prior to the MR-enterography examination, 500 mL 30 minutes prior to the examination, and 300—500 mL just before examination. Before obtaining MR images, the goal was that the enteric contrast agent would reach the terminal ileum and/or right hemicolon on T2-weighted images. If not, MR-enterography images were obtained after 15—30 minutes with administration of additional 500 mL of enteric contrast agent.

Hyoscine N-butylbromide (Buscopan®, Boehringer Ingelheim, Eczasibasi, Turkey) was slowly injected intravenously to the patients before the MR-enterography (twice at 0.3 mg/kg to the patients weighing less than 50 kg, and twice at 20 mg to the patients weighing more than 50 kg).

Gadoterate meglumine (Dotarem®, Guerbet, Roissy-Charles de Gaulle, France) was intravenously administered at a rate of 2—3 mL/s to the patients at a dose of 0.2 mL/kg.

MR-enterography examinations were performed with a 1.5 Tesla MR scanner (Magnetom Aera®; Siemens, Erlangen, Germany). The study protocol included images of T2-weighted half-Fourier acquisition single-shot turbo spin-echo (HASTE), fast imaging with steady-state free precession (TrueFISP) sequences and three-dimensional (3D) T1-weighted volumetric interpolated breath hold examination (VIBE) sequences before and after administration of the contrast material, and diffusion-weighted imaging (DWI) (b values: 50, 400 and 800 s/mm^2). The parameters of the sequences used for MR-enterography are presented in Table 1. For each sequence, the upper and lower abdomen were scanned separately, and acquisition time for each sequence ranged from 15 sec—3 min. Total scan time was between 13 and 30 min.

Image analysis

All images were evaluated and scored by two radiologists with four and 10 years of experience. The two radiologists were blinded to the results of endoscopic and histopathological examinations. The small bowel segments were defined using coronal T2-weighted images as duodenum, jejunum, proximal ileum, distal ileum, and terminal ileum (10 cm up to ileal valve).

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