Magnetic resonance enteroclysis in patients with Crohn's disease: Fat saturated T2-weighted sequences for evaluation of inflammatory activity[☆]

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Abstract

Background and aims: To evaluate fat saturated (fs) T2-weighted (w) fast relaxation fast spin echo (FRFSE)-sequences compared to the standard protocol with contrast agent for the evaluation of inflammatory activity in patients with Crohn's Disease (CD).
Methods: Forty-eight patients (male, 17; female, 33; mean age, 37 years) with suspicion of inflammatory activity in proven CD who underwent MR enteroclysis (MRE) at 1.5 T (GE Healthcare) were retrospectively included. Two blinded radiologists analyzed MRE images for presence and extent of CD lesions and degree of local inflammation for fs T2-w FRFSE and contrast enhanced T1-w images (T2-activity; T1-activity; score, 1–4) in consensus. Furthermore, mural signal

intensity (SI) ratios (T2-ratio; T1-ratio) were recorded. Patient based MRE findings were correlated with endoscopic (45 patients), surgical (6 patients), histopathological, and clinical data (CDAI) as a surrogate reference standard.

Results: In total, 24 of 48 eligible patients presented with acute inflammatory activity with 123 affected bowel segments. ROC analysis of the total inflammatory score presented an AUC of 0.93 (p<0.001) for T2-activity (T1-activity, AUC 0.63; p=0.019). ROC analysis revealed an AUC of 0.76 (p<0.001) for the T2-ratio (T1-ratio, AUC 0.51; p=0.93). General linear regression model revealed T2-activity (p=0.001) and age (p=0.024) as predictive factors of acute bowel inflammation.

Conclusions: T2-w FRFSE-sequences can depict CD lesions and help to assess the inflammation activity, even with improved accuracy as compared to contrast-enhanced T1-w sequences.

1. Introduction

Crohn's Disease (CD) is a chronic relapsing inflammatory disease of the gastrointestinal tract involving all the layers of the bowel wall. Possible complications are fibrostenotic strictures, fistulas and abscesses. The course of the disease is characterized by remitting and relapsing episodes. For optimizing the therapeutic strategy, evaluation of CD activity is essential.[1] Patients with active inflammation should receive different medical therapy as patients with chronic disease without active inflammation. Also, the localization of the inflammatory activity is important to allow an optimized treatment of the patients. Assessment of disease activity is based on a variety of clinical and inflammation parameters and scores, e.g. the Crohn's Disease Activity Index (CDAI), as well as endoscopic findings. However, upper and lower endoscopy are not always complete and do not sufficiently allow the evaluation of the small bowel as well as the full transmural extent of the disease. Furthermore, biochemical markers may be normal in patients with acute inflammation. Different types of radiological investigations are used to study the small bowel in CD; however, Magnetic Resonance Enteroclysis (MRE) has developed into the method of choice.[2–9] Various Magnetic Resonance Imaging (MRI) findings such as contrast enhancement of the bowel wall have been proposed as accurate markers of disease activity,[5,10,11] however, in acute and chronic disease an overestimation of disease activity based on contrast enhancement is possible.[12,13] A promising alternative is the assessment of bowel wall edema by evaluating T2-w images.[14,15] Therefore, the purpose of the present study was to evaluate fat saturated (fs) T2-weighted (w) Fast Relaxation Fast Spin Echo (FRFSE)-sequences compared to the standard protocol with contrast agents for the evaluation of inflammatory activity in patients with CD.

2. Material and methods

2.1. Patients

For retrospective enrolment it was required that patients had an either by endoscopy or surgery histologically proven CD and had undergone MRE for evaluation of inflammatory activity. In total, 48 consecutive patients (female, 32; male, 16; mean age, 37±11 years) in a time interval of 2.5 years were enrolled. A complete digital MRE-dataset and a comprehensive clinical documentation including histopathologic data had to be present. In 45 of 48 eligible patients, ileocolonoscopy within

3 days after the MRE was performed. Furthermore, in a subset of patients surgical exploration was performed within a maximum of 10 days (n=6; including the 3 patients with missing ileocolonoscopy). In all patients, evaluation of CDAI on the day of MRE was performed. The institutional review board approved this retrospective study.

2.2. Imaging techniques

MRE data were obtained with a standard imaging protocol at 1.5 T (Twin Speed, GE Healthcare, Milwaukee, IL) using a phased-array body coil. All patients were asked to fast eight hours prior to the examination. Under fluoroscopy, a nasointestinal probe was positioned with its tip in the area of the duodenojejunal flexure and 1 to 2 l of warm tap water was delivered via a pump at a flow rate of approximately 80 ml/min about 20 min before initiation of the MRE examination. Fluid application was continued via the nasointestinal probe during the MRE examination using a pump positioned outside of the examination room at a rate of approximately 30 ml/min. To reduce intestinal motility, ten milligram of butylscopolamine (Buscopan, Boehringer Ingelheim, Germany) was intravenously injected immediately before the start of the examination.

The scan protocol used in all patients was the following:

1. Steady-state free precession sequences (SSFP) and Fast Imaging Employing Steady State Acquisition (FIESTA), two-dimensional (2D) coronal: TR, 6.4 ms; TE, 1.7 ms; flip angle, 55°; BW, 125 kHz; field of view (FOV), 48 cm; matrix, 256×192 pixels; slice thickness, 4.5 mm; acquisition time, 40 slices in 1 min 50 s.
2. SSFP and FIESTA, 2D axial: TR, 6.9 ms; TE, 1.7 ms; flip angle, 55°; BW, 125 kHz; FOV, 40 cm; matrix, 256×256 pixels; slice thickness, 4.5 mm; acquisition time, 60 slices in 3 min.
3. T1-w fs spoiled gradient echo (SPGR) coronal: TR, 3.9; TE, 1.7; flip angle, 12°; BW, 62.5 kHz; FOV, 48 cm; matrix, 256×160 pixels; slice thickness, 4 mm; gap=2 mm; acquisition time, 40 slices in 28 s.
4. T1-w FS SPGR axial: TR, 3.9; TE, 1.8; flip angle, 12°; BW, 62.5 kHz; FOV, 40 cm; matrix, 256×160 pixels; slice thickness, 4 mm; gap, 2 mm; acquisition time, 60 slices in 41 s.
5. Axial Fast Relaxation Fast Spin Echo (FRFSE)-2D: TRS, 3.4 ms; TE, 1.5 ms; flip angle, 45°; BW, 125 Hz; FOV, 48 cm; matrix, 224×224 pixels; slice thickness, 3 mm; gap, 20 mm; acquisition time, 1 min 42 s.

The T1-w sequences listed as point 3 and 4 were performed 60−70 s after intravenous application of a paramagnetic