Disease behaviour (Vienna and Montreal Classification) in Crohn’s disease patients assessed by MR enterography

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Purpose

MRI of the bowel is an increasingly used modality to evaluate patients with Crohn's disease (CD). The Montreal classification of the disease behavior is considered an excellent prognostic and therapeutic parameter for these patients. In our study we correlate the behavior assessment performed by a radiologist based on MRI with the surgeon's clinical assessment based on the assessment during abdominal surgery.

Methods and Materials

All patients with an endoscopically, histologically and radiologically proven Crohn's disease (CD) undergoing bowel resection between 2005 and 2009 were included in our evaluation resulting in a total of 174 patients with bowel resection. The surgical database of all included patients was acquired prospectively. Data evaluation of the radiological and clinical data was performed retrospectively. We only analyzed patients, who had an MRE within 4 weeks before surgery (mean 8.3 days; median 6.5 days; range 1-26 days). Based on these criteria, we were able to include 76 patients (mean age: 35.6 years; median age: 31.5 years; age range: 16-76 years; 36 female, 40 male). In 79 of the 174 patients, an adequate MRE examination was not performed in our department. These patients had CT or MRI examinations from another hospital not performed with our MR protocol. The time between surgery and MRE was more than 4 weeks in 19 of the 174 patients.

For small bowel contrast and distention all patients had to drink 1.5 to 2 liters of a hyperosmotic water-mannitol solution continuously for 45 minutes before imaging. For this solution 25 g mannitol and 5 g carob seed (Nestargel; Nestle, Munich, Germany) were added to 1 liter of tap water. The efficiency of this contrast medium for the so called "dark lumen technique" was already demonstrated in previous studies. Intestinal peristalsis was reduced by an iv application of 40 mg Butylscopolaminumbromid (Buscopan, Boehringer Ingelheim, Ingelheim, Germany) immediately before MRE, provided no contraindication was given. Additionally, we performed a rectal application of 0.5 to 1 liter NaCl to improve the colonic distension.

Images were acquired with patients in a head first/supine position using a 1.5-T MR imaging unit with the manufacturer’s body and spine array coils. Prior to intravenous contrast media injection coronal true fast imaging with steady-state precession (true FISP) images, transversal T1 fast low-angle shot (T1-FLASH) and half fourier-acquired single shot turbo spin echo (T2- HASTE) images were acquired. Additionally transversal and coronal fat- saturated, 3D T1 VIBE (Volume Interpolated Breathhold Examination) images and fat-saturated 2D T1-FLASH images were acquired 70 seconds after the injection of 0.2 ml/kg bodyweight Gadopentetat-Dimeglumin.
For image analysis, a commercially available workstation was used. Image analysis was performed by a board certified radiologist, who is an expert for abdominal MRI (12 years of experience) and a radiological resident (5 years experience) in consensus. MRE was analyzed retrospectively with reference to the following parameters: mural edema, target-sign, regional lymph nodes increased in number and size, comb-sign, abscess, fistula, inflammatory mass and stricture. The radiologists were blinded to the results of surgery, histology and endoscopy.

Mural edema was defined as circumscribed hyperintensity on T2-weighted sequences of the bowel wall relative to the signal of the psoas muscle. Layered contrast enhancement of the intestinal wall (enhancement of the mucosa and serosa/muscularis propria, low signal of the submucosa on T1 weighted imaging) was defined as a positive target sign. Local lymph nodes were assessed as pathological if measuring over 10 mm in their short axis and/or appearing as more than 3 local clustered lymph nodes. The presence of increased mesenteric vascularity in terms of mesenteric hyperemia was defined as a positive comb-sign. A constant constriction of the bowel lumen along with signs of obstruction was assessed as stricture. As MRE provides no functional imaging, prestenotic dilatation was regarded as a required associated feature for the diagnosis of a stricture.

Based on the radiological evaluation of the MRE we subdivided the disease behavior of Crohn's disease to the defined subgroups B1, B2 and B3 according to Montreal classification.

The Montreal classification defines the disease behavior B1 as inflammatory disease without stricturing or penetrating behavior and without the onset of any complications at any time during the disease's course. B2 behavior is considered a stricturing disease presenting with prestenotic dilatation and signs of obstruction without penetrating disease at any time during disease's course. B3 behavior is defined as a penetrating disease presenting as intra-abdominal fistula, inflammatory mass and/or an abscess.

Mural edema, target-sign, enlarged local lymph nodes and the comb-sign were considered as general signs of inflammation. Patients without an abscess, fistula, inflammatory mass or stricture, who showed general signs of inflammation, were assessed as B1. Patients who had a bowel stricture with or without signs of additional inflammation of the bowel wall but no abscess, fistula or inflammatory mass were considered as B2. Patients who showed an abscess, fistula or inflammatory mass or a combination of those characteristics as a sign for penetrating disease were distributed to behavior group B3, regardless of additionally existing strictures.

The clinical assessment of the disease behavior (B1-3) was performed prospectively during the entire study period (2005 to 2009) by the surgeon, who performed the bowel surgery, based on the intraoperative findings and the histological results. In all cases evaluated in our study, the same surgeon performed the resection as well as the clinical assessment. The same distribution criteria were used as described for MR imaging.
All patients with inflammatory mass, fistula or an abscess found during surgery and confirmed histologically were considered as patients with penetrating disease (B3), while a stricture without signs of penetration was considered as B2. Patients without a stricture or signs of penetration were considered as B1.

**Results**

76 patients satisfied the inclusion criteria of bowel surgery within 4 weeks after MRI.

Clinical indications for surgery were an abscess with fistulas in 5 patients and abscess with inflammatory mass in 10 cases. Just fistulas were the reason for surgery in 4 cases while fistulas with inflammatory masses (n=25) represented the majority of these cases. In 20 cases a stenosis was the surgical indication, which included 1 case with an additional fistula and 3 cases with fistula and inflammatory mass. In 8 patients an inflammatory mass was recorded as the surgical indication.

Based on the radiological assessment of the MRE, the disease behavior was classified as B1 in 6.6% (n=5), B2 in 21% (n=16) and B3 in 72.4% (n=55) of all analyzed patients. The intraoperative findings were: B1 in 5.3% (n=4), B2 in 21% (n=16) and B3 in 73.7% (n=56) (table 1). There were 4 patients with bowel surgery, which were categorized as B1 by the surgeon. Two patients were suffering from a therapy-refractory Crohn's colitis and one patient had a toxic megacolon, resulting in a right hemicolectomy and a colectomie respectively. One patient, who was under continuous steroid treatment without significant improvement, required an ileo-cecal resection.

In 97.4% (n=74) of all analyzed patients, the intraoperative and radiological classification were identical resulting in a #-value for the inter-observer agreement of 0.937. Lin's concordance correlation coefficient \( r_c \) was 0.9612 (95% CI: 0.9400; 0.9750) showing substantial agreement regarding radiological and surgical assessment. In two cases, there was no agreement regarding the B classification. In one case, the radiological classification was B1 (inflammation) versus the surgical classification of B2 (figure 1). In the second case, radiological classification was B2 (stricturing) while surgical classification was B3 (penetrating disease).

**Images for this section:**
**Fig. 1:** Contrast enhanced T1 weighted fat saturated coronal MRI showing a thickened and contrast enhancing bowel wall of the terminal ileum (arrow) with a consecutive
narrowing of the bowel lumen without any prestenotic dilatation. The radiologists considered this lesion as a Montreal B1 (non-stricturing, non-penetrating) behavior, surgically and histologically the behavior was assessed as B2 (stricturing).

<table>
<thead>
<tr>
<th>Evaluation of disease behavior based on MRE</th>
<th>B1</th>
<th>B2</th>
<th>B3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>B2</td>
<td>0</td>
<td>15</td>
<td>1</td>
<td>16</td>
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<td>55</td>
</tr>
<tr>
<td>Total</td>
<td>4</td>
<td>16</td>
<td>56</td>
<td>76</td>
</tr>
</tbody>
</table>

**Table 1:** Radiological evaluation of disease behavior based on MRE according to Montreal classification compared to the surgical evaluation.
Fig. 2: Axial contrast enhanced T1 weighted fat saturated MRI of the lower abdomen shows a thickened three-layer bowel wall (black arrowhead) with multiple small abscesses (curved black arrow).
Conclusion

In conclusion, we showed that MRE represents an excellent and promising imaging modality to correctly diagnose the disease behavior according to the Montreal classification. The assessment of stricturing and penetrating complications of Crohn's disease by MRE will help clinicians to make the necessary therapeutic decisions.

References


Personal Information