MR Colonography Without Bowel Purgation for the Assessment of Inflammatory Bowel Diseases: Diagnostic Accuracy and Patient Acceptance

Jost Langhorst, MD, Christiane A. Kühle, MD,† Waleed Ajaj, MD,‡ Michael Nüfer, MD,† Jörg Barkhausen, MD,† Andreas Michalsen, MD,* Gustav J. Dobos, MD, PhD,* and Thomas C. Lauenstein, MD†,§*

Background: The purpose of this pilot study was to assess the diagnostic accuracy of MR colonography (MRC) without bowel cleansing regarding its ability to quantify inflammatory bowel disease (IBD). In addition, patient acceptance was compared with conventional colonoscopy (CC).

Methods: In all, 29 patients with IBD (17 ulcerative colitis; 12 Crohn's disease) were included. While CC was performed after bowel cleansing as the gold standard, MRC was based on a fecal tagging technique and performed 48–72 hours prior to CC. The presence of inflammation in each of 7 ileocolonic segments was rated for every procedure. Patients evaluated both modalities and dedicated aspects of the examination according to a 10-point-scale (1 = good, 10 = poor acceptance). Furthermore, preferences for future examinations were investigated.

Results: Inflammatory segments were found by means of CC in 23 and by MRC in 14 patients. Overall sensitivity and specificity of MRC in a segment-based detection were 32% and 88%, respectively. Concerning severely inflamed segments, sensitivity increased to 53% for MRC. Overall acceptance of CC was significantly higher compared to MRC (mean value (mv) for MRT = 6.0; CC = 4.1; $P = 0.003$). For MRC, the placement of the rectal tube (mv = 7.3), and for CC bowel purgation (mv = 6.5), were rated as the most unpleasant. A total of 67% of patients voted for CC as the favorable tool for future examinations.

Conclusions: The presented data indicate that 'fecal tagging MRC' is not suitable for an adequate quantification of inflammatory diseases of the large bowel. Furthermore, overall acceptance of endoscopic colonoscopy was superior to MRC.

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Key Words: MR colonography, colonoscopy, inflammatory bowel diseases, diagnostic accuracy, patient acceptance

Conventional colonoscopy (CC) in conjunction with histopathological biopsy is considered the gold standard for the detection and quantification of inflammatory bowel diseases (IBD) such as ulcerative colitis (UC) and Crohn's disease (CD).[1–3] However, there are several drawbacks related to the invasiveness, procedure-related discomfort, risk of bowel perforation, and relatively poor patient acceptance for CC.[4–8] Hence, the use of other techniques including leukocyte scintigraphy and computed tomography (CT) have been used for the diagnosis of IBD.[9–15] In addition to a lack of diagnostic accuracy, exposure to ionizing radiation is a relevant limitation of these alternatives, especially in light of the patients' frequently young age.[16,17]

Magnetic resonance colonography (MRC) has the potential to overcome these limitations. It is characterized by a superb soft-tissue contrast, lack of ionizing radiation, and the use of nonnephrotoxic intravenous contrast agents. MRC has been evaluated with different diagnostic outcomes in patients with IBD. While Ajaj et al[18] found MRC to be highly accurate for monitoring IBD activity, Schreyer et al[19] reported that only severely inflamed bowel segments could be visualized by means of MRC. Beyond this discordance, another aspect needs to be addressed. In the past, bowel cleansing was considered mandatory prior to virtual or optical colonoscopy. However, it was proven in a series of trials that bowel purgation is considered by patients the most unpleasant part of these procedures.[20–25] Thus, new strategies have been proposed to obviate bowel cleansing for MRC, such as fecal tagging. The concept of fecal tagging is based on altering the signal intensity of stool by adding contrast-modifying substances to regular meals. Hence, fecal material becomes virtually invisible on MR images. The first data in patients with colorectal masses showed promising results.[26,27]

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From the *Department of Internal and Integrative Medicine, Kliniken Essen-Mitte, Germany, †Department of Diagnostic and Interventional Radiology and Neuroradiology, University Hospital Essen, Germany, ‡Department of Radiology, University Hospital Hamburg-Eppendorf, Hamburg, Germany, §Department of Radiology, Emory University Hospital, Atlanta, Georgia.

Reprints: Jost Langhorst, MD, Department of Internal and Integrative Medicine, University of Duisburg-Essen, Am Deimelsberg 34 a, D-45276 Essen, Germany (e-mail: jost.langhorst@gmx.de).

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The aim of this study was to compare a fecal-tagging-based MR colonography strategy to conventional colonoscopy in patients with IBD with regard to diagnostic accuracy, patient comfort, and acceptance ratings.

MATERIALS AND METHODS

Subjects

Between August 2004 and August 2005, 34 patients (23 women, 11 men; mean age 29.5 years, range 18–69 years) with IBD (19 patients with UC, 15 with CD) were prospectively enrolled in this study. Only patients with diagnosed UC or CD based on prior colonoscopy and histopathology were included. While no patient had ever undergone an MRC exam, every subject had experienced at least 1 CC, with an average of 4.9 procedures in the past (range 1–17 procedures; UC: 5.5 ± 4.0 SD (standard deviation); CD: 4.0 ± 2.8). IBD had been diagnosed 9.2 years on average prior to this trial (range 1–33 years; UC: 9.4 ± 10.0; CD: 9.1 ± 9.0).

Detailed information about the examination was given to patients prior to participation. Possible risks and side effects of MRC and CC were explained. None of the patients showed contraindications to MR imaging, such as the presence of metallic implants, presence of cardiac pacemakers, or severe claustrophobia. The study protocol was approved by the local Ethics Committee and all patients gave informed consent for participation.

MR Colonography

No bowel cleansing was applied prior to the MR examination. Instead, participants underwent a fecal tagging-based preparation protocol. A solution containing 5% Gastrografin (Schering, Germany), 1% barium (Polibar, EZ-EM, Westbury, NY), and 0.2% locust bean gum (Roeper, Germany) was ingested in portions of 250 mL with each regular meal starting 48 hours prior to the MR examination. No dietary restrictions had to be considered. Patients were encouraged to have a high fluid uptake of at least 2000 cc per day. MRC was performed on a 1.5 T MR system (Magnetom Sonata, Siemens Medical Solutions, Germany). The examination was supervised by a radiologist (S.K., C.A.K., T.C.L., S.C.L.) with a minimum of 2 years of experience in MRC. Following the placement of a rectal tube (EZ-EM), the colon was filled in prone position with ≈2000 cc of warm tap water using hydrostatic pressure. Prior to the rectal enema, a spasmolytic agent was administered intravenously. Either 40 mg of scopolamine (Buscopan; Boehringer Ingelheim, Germany) or 1 mg glucagon hydrochloride (Glucagen; Novo Nordisk, Germany) was given to minimize bowel peristalsis and alleviate bowel spasm. Neither analgesic agents nor sedatives were administered. MR data collection was based on TrueFISP images and T1w gradient echo images, which were acquired pre- and postintravenous contrast (0.2 mmol/kg body weight of Gd-DOTA; Dotarem, Guerbet, France). After completion of data collection the rectal enema was drained back into the bag. The rectal tube was removed and the patient was free to leave the scanner room.

MR data collection was based on TrueFISP images (TR/TE/flip: 3.9/1.9/70°; slice thickness: 6 mm; matrix: 205 × 256; acquisition time: 18 s) and 3D T1w gradient echo images with integrated fat suppression (TR/TE/flip: 3.1/1.1/15°; slice thickness: 2 mm; matrix: 168 × 256; acquisition time: 20 s), which were acquired pre-, 70 seconds, and 120 seconds postintravenous contrast.

Endoscopy

All patients underwent endoscopic colonoscopy 48–72 hours following the MR examination. Patients consumed a low-fiber diet on the day prior to the colonoscopy. In addition, 3000 cc of an electrolyte solution (Golytely, Braintree Laboratories, Braintree MA) were ingested on the evening before the examination. All procedures were performed by gastroenterologists with a minimum of 3 years of experience in conventional colonoscopy using standard equipment (CFQ 140 L; Olympus, Japan). The attending gastroenterologist was unaware of the MR findings. Sedatives (midazolam hydrochloride, Dormicum; Roche, Germany) and/or analgesics (pethidin, Dolantin; Hoechst, Germany) were routinely administered. Suspicious inflammatory lesions were recorded and biopsies were taken, which were subsequently analyzed by histopathology. Each patient was monitored for at least 1 hour following colonoscopy at the endoscopy unit.

Data Collection and Statistical Analysis

For data interpretation the bowel was divided into 7 segments: terminal ileum, cecum, ascending / transverse / descending / sigmoid colon, and rectum. Results of CC were used as the standard of reference. Each bowel segment was coded regarding inflammation: 0 for "no acute inflammation,", 1 for "mild acute inflammation," 2 for "moderate acute inflammation," and 3 for "high acute inflammation"; "mild inflammation" was defined by erythema, decreased or absent vascular pattern, friability of mucosa, and single aphthous lesions; "moderate inflammation" was characterized by additional multiple aphthous lesions and small ulcers; "high inflammation" was determined by the additional presence of spontaneous bleeding, large ulcerous lesions, nodules, and/or lumen narrowing.

MR datasets were assessed in a consensus mode by 2 radiologists. Assessment criteria included increased contrast uptake in the colonic wall, bowel wall thickening, increased number of mesenteric lymph nodes, pericolic stranding, and loss of haustral folds. For each colonic segment an inflammatory score was determined. It was again classified as mild (1), moderate (2), or high (3) inflammation when at least 1, 2, or more than 2 typical MR signs of inflammation were

present. The accuracy of the inflammatory scores determined by MR-colonography was assessed by calculating point estimates for sensitivity and specificity using the endoscopic data as the standard of reference. Furthermore, MR image quality regarding effectiveness of fecal tagging, bowel distension, and motion artifacts was evaluated using a visual 3-grade ranking (3 = good, 2 = moderate, 1 = poor image quality). Examples of CC and MRC pictures are shown in Figure 1.

Standardized questionnaires and instructions were given to the participants prior to the MR examination and the colonoscopy. To avoid confounding due to the administration of sedatives after CC and to allow for comparable conditions after both examinations, the surveys were completed 24 hours after MRC and CC and were sent back to our institution by mail. Reminders were sent if no answer was received after 4 weeks. Both surveys for MRC and CC were structured in a similar manner. Using a 10-point scale with higher scores denoting a worse experience, patients were asked to give an overall rating for MRC and CC ("How is your overall rating of the conventional colonoscopy / MR examination?"). Furthermore, the aspect of fecal tagging preparation and placement of the rectal tube were evaluated on an identical 10-point scale for MRC ("How unpleasant was the intake of the contrast agent 48 h before MRI?"; "How unpleasant was the placement of the rectal tube?"). Similarly, the questionnaire for CC included an assessment of bowel cleansing procedure and insertion of the endoscope ("How unpleasant was the bowel cleansing?"; "How unpleasant was the insertion of the endoscope?"). Participants were also requested to indicate which of the 2 exams they would prefer in the future ("Which examination would you prefer for screening in the future?"). Findings were evaluated for the entire patient cohort as well as for the groups of CD patients and UC patients.

Overall ratings of both modalities as well as of single aspects (fecal tagging versus bowel cleansing and placement of the rectal tube versus endoscope) were compared by a Wilcoxon signed rank sum test. Furthermore, findings of both subgroups (UC versus CD) were compared by a Mann–Whitney test. P-values < 0.05 were considered statistically significant.

RESULTS

Out of the 34 initially included subjects, MRC could not be completed in 3 patients due to abdominal complaints and 1 additional patient declined intravenous contrast. Furthermore, 1 patient refused endoscopic colonoscopy. Thus, a total of 29 patients with IBD (UC = 17, CD = 12; 9 male, 20 female) was included in the analyses.

In all 29 patients a complete colonoscopy was performed. One UC patient had a left hemicolectomy and 1 CD patient a resection of the terminal ileum. In 4 UC patients the terminal ileum could not be intubated due to technical limitations. Hence, 4 of the total 200 segments could not be classified (2%). As for MRC, image quality of the 200 segments was rated as good in 126 segments, moderate in 64 segments, and nondiagnostic in 10 segments (2 patients). Thus, 95% of segments could be evaluated.

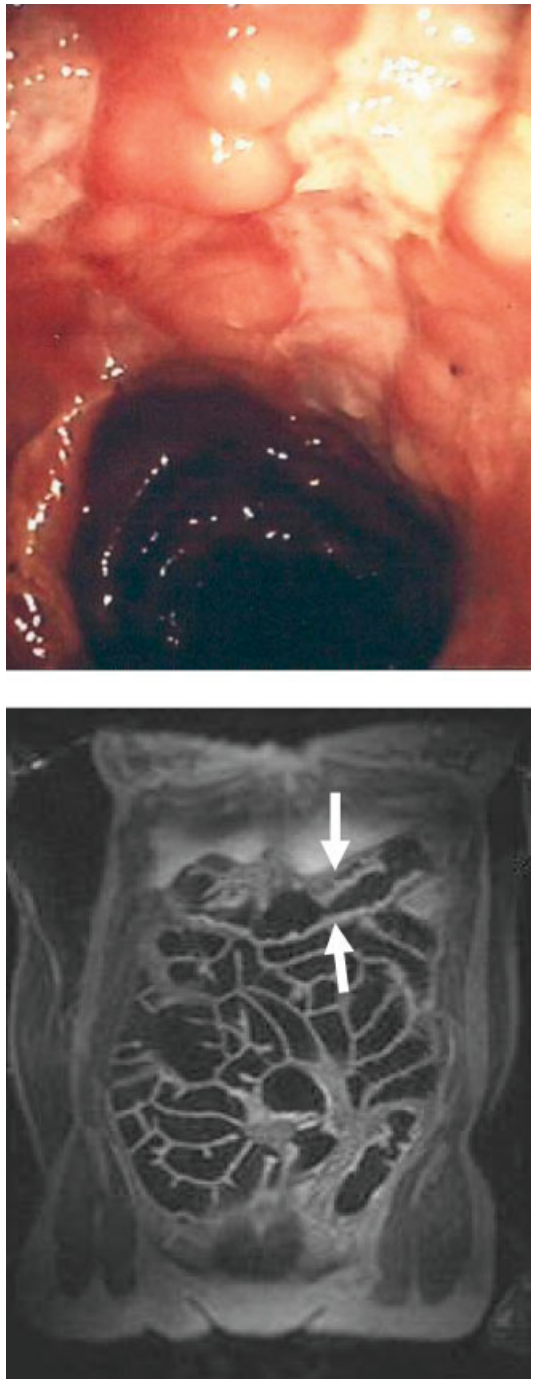

FIGURE 1. Representative images of the large bowel. Signs of inflammation in the colon transversum shown in conventional colonoscopy (upper) and MR colonography (lower). [Color figure can be viewed in the online issue, which is available at www.interscience.wiley.com.]

TABLE 1. Diagnostic Accuracy of MRC Compared to CC

		Total $N = 29$	UC $N = 17$	CD $N = 12$	Severe Inflamed Segments	No Inflammation
Segment-based	n (CC)	66	30	36	17	120
	n (MRC)	21	7	14	9	105
	Sens	32%	23%	39%	53%	88%
Patient-based	n (CC)	23	13	10	9	6
	n (MRC)	14	6	8	7	3
	Sens	63%	46%	80%	78%	50%

UC, ulcerative colitis; CD, Crohn's disease; CC, conventional colonoscopy; MRC, MR colonography; Sens, sensitivity.

Overall Diagnostic Accuracy

In the 17 patients with UC, 3 had a pancolitis, 10 a left-sided colitis, and 4 showed no signs of acute inflammation. Regarding the 12 patients with CD, 4 were classified A1L2B1, 3 were classified A1L3B1, 1 A1L1B1, 1 A1L2B2, and 1 A1L3B2 according to the Vienna Classification. Two patients showed no signs of acute inflammation.

A total of 186 segments were analyzed both by MRI and CC. Colonic segments were classified as inflamed by means of CC in 23 patients, whereas MRC revealed inflammatory processes in 14 of these 23 subjects (63%). Severe or moderate inflammation was found in 17 (10) patients (59%) by means of CC (MRC). Five of the 7 individuals with false-negative findings on MRC showed signs of proctitis or left-sided colitis in CC. By means of CC, 66 bowel segments were rated as inflamed, of which 21 were also depicted by MRC (Table 1). Thus, overall sensitivity of MRC on a segment basis was 32%. Even for severely inflamed bowel segments, the sensitivity for MRC was only 53%. CC rated 120 segments as not inflamed. However, MRC showed false-positive findings in 15 segments, resulting in a specificity of 88%. Overall, only 60% (111/186) of colonic segments had identical results in MRC and CC. All results are summarized in Table 1.

Diagnostic Accuracy in CD and UC

In 10 of 12 patients with CD, at least 1 bowel segment showed signs of inflammation as assessed by CC. In 8 of these 10 patients at least 1 inflamed segment was visualized as well by means of MRC. In addition, pseudopolyposis could be detected in 5 patients by both means. A total 36 bowel segments were rated as inflamed in CD patients by means of CC, of which 14 were also depicted by MRC (sensitivity: 39%). Sensitivity for the detection of severely inflamed segments amounted to 50%.

As for patients with UC, 13 of 17 subjects showed at least 1 inflamed segment shown by CC. In 8 of these 13 patients (62%) MRC confirmed this diagnosis. In 5 patients MRC could not demonstrate any inflammatory signs, whereas mild bowel inflammation was described in CC in at least 1 of the segments. Four of these 5 patients had a left-sided colitis. Furthermore, pseudopolyposis could be detected in 4 CU patients by both methods. In patients with UC, 30 bowel segments were rated as inflamed by means of CC, of which 7 were also depicted by MRC (23%). Two out of 3 highly inflamed segments could be detected by MRC. Overall, MRC showed identical findings as CC in 68% of all segments for UC patients (71/105) and 49% for CD patients (40/81). Table 1 provides an overview of the results.

Acceptance of CC/MRC

Twenty-seven out of 29 patients returned all questionnaires (93%). Overall acceptance of MRC was significantly worse compared to CC (Table 2). For MRC, the placement of the rectal tube was rated as the most unpleasant part, whereas bowel purgation was regarded most bothersome for CC. As

TABLE 2. Rating of CC/MRC and Dedicated Examination Aspects[a]

	MR Colonography	Conventional Coloscopy	*P*-value
Overall acceptance (mean ± SD)	6.0 ± 1.9	4.1 ± 2.7	0.003[b]
Preparation protocols: (mean ± SD)			0.002[b]
Fecal tagging	5.0 ± 2.5		
Bowel purgation		6.5 ± 2.1	
Procedures: (mean ± SD)			<0.001[b]
Placement of rectal tube	7.3 ± 2.1		
Placement of endoscope		3.8 ± 2.3	

CC, conventional colonoscopy; MRC, MR colonography.
[a]10-point-scale (1, good, 10, poor acceptance).
[b]Results of chi-square tests with $P < 0.05$.

TABLE 3. Rating of CC / MRC and Dedicated Examination Aspects[a] for the 2 Subgroups CD and UC

	CD	UC	*P*-value
Overall acceptance (mean ± SD)			
MR Colonography	6.3 ± 2.0	5.8 ± 1.7	0.467
Conventional colonoscopy	4.7 ± 2.6	3.7 ± 2.0	0.265
Preparation protocols (mean ± SD)			
Fecal tagging	6.4 ± 2.6	3.9 ± 1.9	0.009[b]
Bowel purgation	7.2 ± 1.8	5.9 ± 2.2	0.138
Procedures: (mean ± SD)			
Placement of rectal tube	7.5 ± 2.3	7.1 ± 1.9	0.654
Placement of endoscope	4.2 ± 2.7	3.5 ± 2.0	0.485

UC, ulcerative colitis; CD, Crohn's disease; CC, conventional colonoscopy; MRC, MR colonography.
[a]10-point-scale (1 = good, 10 = poor acceptance).
[b]Results of chi-square tests with $P < 0.05$.

for the comparison of preparation protocols, a statistically significant difference between fecal tagging and bowel purgation could be determined. Comparing placement of the endoscope and rectal tube, placement of the rectal tube was rated significantly more unpleasant. Table 2 provides an overview of all average ratings.

Five patients (19%) gave best scores for endoscopy (rating score 1), whereas no patient did the same for MR colonography. Comparing the single examination steps, optimal scores were assigned for fecal tagging by 2 patients; however, no patient did so for bowel cleansing. On the other hand, no patient gave optimal scores for the placement of the rectal tube, but 4 patients for the placement of the endoscope. The comparison of acceptance rates between the 2 groups of CD and UC showed no statistically significant difference. Only the difference for the scoring of fecal tagging showed a statistically significant difference (Table 3).

Future Preferences

Out of 26 participants, 17 (65%) voted for CC as a favorable tool for future bowel examinations, while 9 (35%) preferred MRC. This difference was more pronounced for CD patients (8 versus 3 patients; 73% versus 27%) compared to UC patients (9 versus 6 patients; 60% versus 40%). Out of 27 subjects, 15 (56%) would generally consider MRC as a possible tool for future examinations.

DISCUSSION

The present pilot study carries 3 messages that we believe are important. First, MR colonography without prior bowel cleansing is technically feasible and leads to diagnostic image quality in 95% of all examined bowel segments. However, and this is the second relevant finding, the overall patient-based detection rate of inflamed bowel segments was only moderate, indicating that 'fecal tagging MRC' in its current form is not suitable for an adequate quantification of IBDs. Finally, patients' overall acceptance of endoscopic colonoscopy was superior to MRC, and two-thirds of IBD patients chose CC as their preferred method for future examinations.

Conventional colonoscopy in conjunction with histopathology has been considered crucial for the diagnosis and reevaluation of IBDs, especially in UC patients with pancolitis indicating a statistically higher risk for colon cancer.[28] However, there are some drawbacks inherent to this endoscopic technique. Depending on the experience of the endoscopist, the procedure may be incomplete in up to 19% of cases, thereby not allowing for a full assessment of the large bowel and the terminal ileum.[29,30] Furthermore, there is a small but existing risk of bowel perforation.[31] Thus, alternative modalities have been introduced for the assessment of IBD. Virtual colonoscopy (VC) based on CT or MRI has gained access in clinical routine as a means of assessing the large bowel. There are generally accepted indications for VC, especially in patients with incomplete endoscopic colonoscopy and patients with high-grade stenoses of the large bowel.[32–36] Most strategies have focused on MRI due to its excellent soft-tissue contrast, which ensures the depiction of extraluminal pathologies including abscesses or fistulae.[37–39] Furthermore, MRI lacks ionizing radiation, which is advantageous particularly for young patients.

The diagnostic potential of MRC in patients with IBD has been assessed in 3 previous trials,[18,19] 2 of which were performed in conjunction with bowel cleansing protocols. Ajaj et al[18] found MRI to be very accurate for the assessment of IBD activity. In that study the authors studied 23 patients with CD or UC and determined a score rate for every patient based on different MRI features. In contrast to these results, Schreyer at al. reported that only severely inflamed bowel segments could be properly visualized by means of MRI. The overall sensitivity for the depiction of Crohn's disease was 31.6% and 58.8% for ulcerative colitis, respectively. Even severe inflammation was not always depicted by MRI. In a more recent study, Schreyer et al[19] performed a combination of small bowel MRI enteroclysis together with MRC in patients with CD without a particular colonic preparation with a segment-based sensitivity of 55.1% and a specificity of 98.2% for MRC.[40] Considering only more extensive inflammation, the sensitivity of MRC increased to 70.2% with a specificity of 99.2%. Our data with sensitivity rates of slightly over 50% for the detection of severely inflamed bowel segments are inferior to the findings by Schreyer et al. In UC patients with left-sided colitis or proctitis, we found the

detection rate of MRC to be especially poor. While CD is characterized by transmural inflammation of the bowel wall, inflammatory processes in UC are solely located in the mucosa, thereby limiting the detection by MRC. Furthermore, the placement of a rectal tube and the inflation of a balloon in the rectum may allow only a limited evaluation of the rectum, which is especially problematic in patients with proctitis. Hence, MRC with fecal tagging did not result in an adequate quality of data serving for diagnosis or tailoring of therapy in IBD patients.

Beyond the need for high diagnostic accuracy, patient acceptance of a diagnostic tool is a major key in the search for a reliable screening and reevaluation instrument. Patients are less likely to undergo a diagnostic procedure if they expect pain or discomfort.[41] Bowel cleansing prior to virtual or conventional colonoscopy has been considered the most inconvenient part of the examination,[20–25] which we observed in our patient group as well. Patient acceptance of endoscopic colonoscopy and VC has been evaluated by several trials in screening populations. In most studies virtual endoscopy was judged to be less unpleasant than colonoscopy.[20–22] However, in 2 other trials more patients classified CC less unpleasant than VC,[42,43] and in 1 study patients showed almost identical discomfort ratings for CC and VC.[23] These inconsistencies may be related to different patient populations and examination protocols. The results of the present report can be compared with former findings only to a limited extent. IBD patients might be especially sensitive to diagnostic procedures of the bowel. Clearly, the introduction of the fecal tagging technique constitutes a significant improvement with regard to patients' acceptance of bowel preparation when compared to bowel cleansing. However, the overall acceptance of MRC in our study was significantly inferior to CC despite the implementation of a fecal tagging protocol for MRC. The placement of the rectal tube was rated as most unpleasant of all investigated parts of the procedures. However, all patients had former experience in CC but none in MRC, which might have influenced their preferences in favor of CC. Furthermore, sedatives and analgesics were administered during CC, thereby reducing the perception of discomfort or pain. However, it should also be taken into account that the implementation of such medications results in side effects and inconveniences, such as impairment in the ability to drive a car for up to 24 hours. Beyond the potential risks of cardiopulmonary complications associated with the application of sedatives, patients often need to be monitored for a certain time after the endoscopy, which extends the overall examination time. Interestingly, in a similar MRC study for colorectal cancer (CRC) screening, patients age 55 years and older perceived most aspects of the procedure less unpleasant than younger patients.[44]

Clearly, there are certain limitations of our study regarding the outlined MRC concept with fecal tagging in IBD patients. First and foremost, we investigated a small patient cohort with known IBD. Thus, the results need to be confirmed by examining larger patient numbers. Another drawback is related to the nonrandomized order of the tests. For practical reasons it was preferable first to perform the MRC and subsequently the CC procedure such that a possible intervention could be accomplished within the same endoscopic examination. The state of inflammation may have changed in the 72 hours between MRC and CC, influencing the documented results, although the patients with active disease remained on identical antiinflammatory medication during this time. Even though inflammation may conceivably have tended to decrease slightly, the fact remains that nearly 50% of severe inflamed bowel segments were missed by MRC. Another important shortcoming is that ≈5% of all investigated bowel segments did not provide acceptable diagnostic image quality due to a failure of fecal tagging or motion artifacts. It is yet speculative whether patients were incompliant for the ingestion of the tagging agent or if other factors, such as bowel transit times, may be the reason. However, compared to other studies evaluating MRC without fecal tagging, this failure rate still seems to be in the acceptable range. Furthermore, clinical settings are different for both procedures, the most significant being the implementation of sedatives for CC. Irrespective of these considerations, our goal was to perform both MRC and CC as independent tools, accepting their own properties and simulating a situation as close as possible to reality.

It is discussable if bowel preparation (either in terms of cleansing or fecal tagging) is necessary at all for MRI, because IBD is limited to the bowel wall and lesions are not protruding into the colonic lumen. However, especially the feature of bowel wall thickening can only be reliably assessed if the colonic lumen and colonic wall provide different signal characteristics. Otherwise, abundant nontagged stool may mimic bowel wall thickening. Therefore, we are convinced that bowel preparation is crucial for a most accurate evaluation of bowel wall pathologies.

Clearly, the present findings underline the need to improve MRC to assess IBD. In order to also depict mucosal changes the spatial resolution must be improved. Parallel imaging might be one way to accomplish this goal. Furthermore, other sequence types may be helpful, especially the acquisition of T2w images with fat saturation. On these images edema of the bowel wall can be depicted very accurately,[45] which might be an additional useful indicator of inflammatory activity. Furthermore, there are apparent differences depending on the type of tagging agent not necessarily providing higher acceptance values.[46] Therefore, it is important to implement tagging agents that are significantly better accepted than bowel cleansing agents. The cumbersome aspects, especially the placement of the rectal tube, should encourage investigators to be as cautious as possible during

this step and to use small tubes or even flexible catheters if possible. A study by Taylor et al[47] showed that the clinical implementation of thin tubes allowed sufficient bowel distension.

In conclusion, the outlined drawbacks limit the diagnostic accuracy as well as patient acceptance of MRC on a fecal tagging basis in the diagnostic and reevaluation of IBD. Further progress is necessary to implement it as an adequate and accepted alternative to endoscopic colonoscopy in the assessment of IBDs of the large bowel and the terminal ileum.

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