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Comparison of Diagnostic Accuracy and Impact of Magnetic Resonance Imaging and Colonoscopy for the Management of Crohn's Disease

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Abstract

Aims: The objective of the current study was to compare two patient assessment strategies using colonoscopy and MRI alternatively as first- and second-line examinations.

Methods: Clinical data, endoscopy and magnetic resonance imaging (MRI) examinations of 100 patients diagnosed with ileocolonic Crohn's disease (CD) performed within 1 week were blindly reviewed by 4 clinical investigators. Two investigators evaluated MRI followed by colonoscopy for 50 cases and the same examinations in reverse order for another 50 cases; the other 2 investigators evaluated the same cases switching the order of examinations.The assessments included the likelihood of the presence of inflammation, stenosis, fistula and abscess, and therapeutic recommendations.

Results: Information from the first examination was considered sufficient for management in 80% of cases for MRI and only 34% of cases for colonoscopy ($p < 0.001$). Adding MRI to the information from colonoscopy changed the clinicians' confidence grade in a higher proportion of patients than adding colonoscopy to information from MRI for the diagnosis of disease activity (10 vs 4%, $p = 0.03$), stenosis (25 vs 9%, $p < 0.001$), fistula (31 vs 0%, $p < 0.001$) and internal abscess (27 vs 0%, $p < 0.001$). Indications for anti-tumour necrosis factor (TNF) therapy (51 vs 37%, $F = 0.006$), and surgery (12 vs 5%, $F = 0.019$) were more frequent after MRI than after colonoscopy as first examination. As a second examination, MRI led to change in therapy in a higher proportion of patients than colonoscopy (28 vs 8%, $p < 0.001$).

Conclusions: In CD, information provided by MRI has a higher impact on patient management than colonoscopy and may be considered as a first-line examination for CD assessment.

Keywords: Crohn's disease; magnetic resonance imaging; disease management

1. Introduction

In Crohn's disease (CD) an accurate assessment of disease characteristics is essential for proper management and has prognostic implications. Ileocolonoscopy is the gold standard for assessment of ileocolonic CD, although the examination has certain limitations: it cannot always be complete due to the presence of severe disease,

stenotic lesions or technical difficulties; it may not provide information on the functional relevance of a stenotic lesion; and it is not sufficient to assess penetrating complications. Cross-sectional imaging is commonly considered a complementary diagnostic approach following endoscopy to provide information on these aspects.[1] A growing body of evidence shows that cross-sectional imaging techniques, including magnetic resonance imaging (MRI), computed tomography and ultrasonography, can provide an accurate assessment of disease activity in CD.[2] Among these techniques MRI is being used increasingly because it is less operator-dependent than ultrasonography and is devoid of the ionizing radiation of computed tomography.[3] These imaging techniques do not have the above-mentioned limitations of endoscopy, although their sensitivity for the detection of mild and moderate lesions is lower than that of endoscopy.[4]

Previous work has assessed the diagnostic and therapeutic impact of MRI in patients under investigation for small-bowel CD, showing that MRI findings influenced the therapeutic strategy in 61% of cases.[5] In that study, comparison with the impact of endoscopic assessment of the small bowel was not performed. With regard to the accuracy of MRI for assessment of disease activity in ileocolonic CD[4,6] and the ability of cross-sectional imaging to provide information on transmural and extramural components of CD lesions in the entire small bowel and colon, it should be considered whether MRI could be not only a complementary tool but an alternative to ileocolonoscopy in patients with CD.

The aim of the present study was to compare two strategies of assessment of patients with an established diagnosis of CD using colonoscopy or MRI as first- and second-line examinations in alternative sequences.

2. Methods

2.1. Patient population

One hundred consecutive patients with an established diagnosis of CD of more than 3 months' duration and with suspicion of active disease based on clinical symptoms or altered biomarkers were included in this prospective observational study performed between June 2006 and June 2010. All patients gave their written informed consent to participation in the study after its approval by the ethics committee of the Hospital Clinic of Barcelona. The study was performed according to the good clinical practice guidelines of the European Medicines Agency (CPMP/ICH/135/95, July 2002). Clinical evaluation, MRI and endoscopy were performed within a period of 7 days. Technical details of MRI and endoscopy were as described previously.[4,6]

2.1. Clinical evaluation

Clinical evaluation was based on a detailed analysis of the clinical symptoms of CD, physical examination and blood tests, including full blood cell counts, C-reactive protein (CRP), erythrocyte sedimentation rate and albumin. From these evaluations the investigators derived the likelihood of the presence of active disease, stenosis, fistula or abscess. Formal calculation of an activity index was not performed. Relevant clinical history information, previous surgeries and past and current medications, as well as responses to these medications, were provided along with the rest of the clinical data in a predefined anonymized report form.

2.2. Endoscopic evaluation

Evaluation of endoscopic activity was based on the Crohn's Disease Endoscopic Index of Severity (CDEIS).[7] All endoscopic procedures were performed by experienced gastroenterologists blinded to patient clinical data. To provide accuracy of endoscopic data collection, endoscopists performing the procedures completed endoscopic findings on a predefined data collection form immediately after finishing the examination.

2.3. MRI evaluation

All MRI examinations were performed with a 3.0-T unit (TrioTim; Siemens Medical Solutions, Erlangen, Germany). MRI was used to evaluate wall thickness (mm), the presence of mucosal ulcers (defined as depressions in the mucosal surface), the presence of oedema (hiperintensity in T2 sequences in relation to the signal of the psoas muscle), pre- and post-contrast wall signal intensity, and relative contrast enhancement. Then, the MRI index of disease activity (MaRIA score) was calculated according to an established formula[4] for each segment and a global score (per patient) was obtained as the sum of the segmental scores. For each examination, an experienced radiologist (JR or SR) provided the calculation of the MaRIA score, as well as the diagnosis of the presence of stenosis, fistula and abscess in written form. Radiologists were blinded to the patient's symptoms and to the results of endoscopic findings.

2.4. Diagnostic assessment

Four inflammatory bowel disease (IBD) specialists at a single tertiary centre assessed the data blindly. Initially, these investigators were provided with the clinical evaluation, and thereafter information on MRI and endoscopy examinations was provided following 2 different sequences: first colonoscopy and second MRI; and first MRI and second colonoscopy. For this purpose, the 100 patients included in the study were divided into two groups of 50: A and B (Figure 1). Investigators 1 and 2 evaluated group A with one sequence and group B with the inverse sequence. The same patients were evaluated using the inverse sequence by investigators 3 and 4. The final result was that each investigator evaluated 50% of the patients with each sequence of examinations, and each patient was evaluated by 2 investigators following one sequence and by the other 2 investigators following the inverse sequence. The aim of this design was to overcome individual differences among the IBD specialists in establishing a firm diagnosis based on MRI or endoscopy, and in establishing therapeutic recommendations on the basis of the findings of each examination.

The IBD specialists were asked to provide a diagnosis of disease activity and the presence of stenosis, fistula and abscess in each of 3 steps: (1) using only clinical data and biomarkers; (2) after adding information from the first test; and (3) after adding information from the second test. The Clinicians rated the likelihood for the presence of each of these 4 assessments (activity, stenosis, fistula, abscess) on a scale of 1–5 (very unlikely, unlikely, not sure, likely, very likely) as previously described.[8] Perianal disease was excluded from the analysis since the role of MRI in this complication is well established.

The evaluations of each specialist were recorded and analysed independently. A consensus assessment was not pursued.

2.5. Therapeutic recommendations

Investigators provided therapeutic recommendations for the management of patients at each step of evaluation: baseline; after the results of the first examination were revealed; and after the results of the second examination were revealed. These recommendations were based on clinical information, the presence of signs of active inflammation and the presence of complications. Considering all these factors, clinicians provided recommendations for the use of antibiotics, steroids, immunosuppressants, anti-tumour necrosis

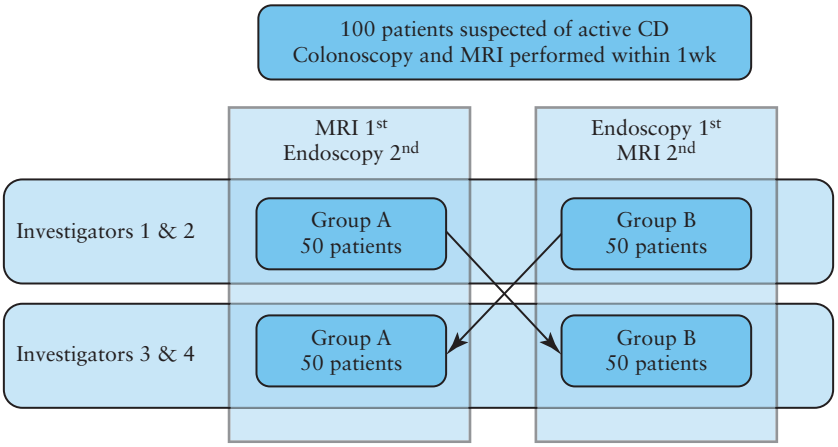

Figure 1. Schematic representation of assessment of patients by four evaluators. Information on MRI and endoscopy examinations were provided following two different sequences: first colonoscopy and second MRI or first MRI and second colonoscopy. Each investigator evaluated patients following the two different sequences, and each patient is evaluated in different sequence by the two groups of investigators.

factor (TNF) therapy and surgery. Reasons for change of therapeutic management as a result of the information from a particular examination were also captured. The need to perform additional examinations was indicated after providing the information of the first test (colonoscopy or MRI).

2.6. Statistical analysis

All data were analysed using the statistical package SPSS version 17.0. Data are expressed as a percentage for qualitative variables and as median and interquartile range (IQR) for quantitative variables. Univariate analysis of qualitative variables was performed using the χ^2 test. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated to assess risk where appropriate. Quantitative variables were analysed with Student's *t*-test. Significant variables in the univariate analysis were identified and subsequently included in a binary logistic regression analysis to determine independent predictive variables. Statistical significance was established at $p < 0.05$. A value of *F* (Fisher's exact test) of <0.05 for the χ^2 test was used when statistical conditions were not met for calculating the *p*-value.

3. Results

3.1. Patients and examinations

Demographic and clinical characteristics of the 100 patients included in the study are summarized in Table 1. Colonoscopy assessed the entire length of the colon in 77% and could also assess the terminal ileum in 57%. Reasons for incomplete ileocolonoscopy included presence of unpassable stenosis in 19%, technical impossibility in 7%, severe activity in 15% and intolerance in 2%. In the multivariate analysis, incomplete colonoscopy was more frequent in patients with high CRP (OR 1.7, 95% CI 1.2–2.3), colonic involvement (OR 2.1, 95% CI 1.6–2.8) and penetrating behaviour (OR 1.7, 95% CI 1.4–2). Taking into account the 6 potentially evaluable intestinal segments (rectum, sigmoid, descending, transverse and ascending colon and ileum), MRI evaluated 99.5% of segments (591/594) whereas endoscopy evaluated 86.3% (513/594) ($p < 0.001$). MRI showed disease activity in the ileum in the 61.7% of patients without ileal assessment by endoscopy. No serious adverse events were observed related to either MRI or colonoscopy.

Investigators considered that colonoscopy as a first examination provided enough information for a correct assessment of the disease and for providing therapeutic recommendations in only 33.5% (67/200) of case assessments compared with 80% (160/200) when MRI was used as a first examination ($p < 0.0001$; OR 0.42, 95% CI 0.34–0.52). This consideration was not dependent on disease location or behaviour. MRI was considered necessary as an additional examination in 66% of case assessments (132/200); in most of these cases (49%, 65/132) MRI was indicated for small bowel assessment. MRI was also considered necessary after ileocolonoscopy to assess the presence of extraluminal complications in 39% of cases (78/200).

Table 1. Baseline characteristics of patients.

Female gender (%)	61
Age at inclusion (y), median (IQR)	34.5 (27.1–43.6)
Smoking status: active/never/ex-smoker (%)	38/31/31
Disease duration (y), median (IQR)	6.6 (IQR 1.3–10.8)
CRP (mg/L), median (IQR)	2.1 (0.5–8)
ESR, median (IQR)	31 (12–65)
Haemoglobin (g/dl), mean (SD)	12.3 (2.1)
Leucocyte count ($\times 10^9$/L), mean (SD)	9 (3.5)
Platelet count ($\times 10^3$/mm^3), mean (SD)	296.8 (100.3)
Harvey–Bradshaw index, median (IQR)	6 (3–9.8)
Location (Montreal classification)	
L1/L2/L3/L4 as modifier (%)	39/25/36/6
Behaviour (Montreal classification)	
B1/B2/B3 (%)	62/24/14
Previous surgery (%)	29
Treatment at inclusion (%)	
Steroids	
Oral	19
Intravenous	2
Immunomodulators	46
Anti-TNF	14
Antibiotics	7
CDEIS, median (IQR)	7.2 (2.4–15.9)
CDEIS >7 (%)	50
MaRIA global, median (IQR)	59.9 (46.9–83.6)
MaRIA >50 (severe disease) (%)	68.5

CDEIS, Crohn's Disease Endoscopic Index of Severity; CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; IQR, interquartile range; MaRIA, MRI index of disease activity; TNF, tumour necrosis factor.

Following clinical assessment and MRI, ileocolonoscopy was considered necessary in 15.5% cases (31/200), in 9.5% (19/200) to rule out disease activity not observed by MRI and in 6% (12/200) to rule out other causes of symptoms, and in 2.5% (5/200) it was considered necessary prior to surgery. Additionally, in 2% (4/200) of case assessments colonoscopy was considered necessary for screening of dysplasia. Investigators' agreement for requiring the second examination for proper assessment was moderate (κ = 0.558, 95% CI 0.395–0.721, for investigators 1 and 2; κ = 0.443, 95% CI 0.257–0.609, for investigators 3 and 4). In 4.5% (9/200) of cases ileocolonoscopy was not considered necessary after MRI but other endoscopic examinations, including small bowel capsule endoscopy and enteroscopy, were required.

3.2. Impact of colonoscopy and MRI on clinician's perception of diagnostic likelihood

After assessment of clinical data (signs, symptoms and blood tests) the investigators considered likely (grades 4 or 5 on the scale) the presence of mucosal inflammation in 77.3%, significant stenosis in 21.8%, the presence of internal fistulae in 5% and the presence of abdominal abscess in 4.3% of cases. A firm positive or negative diagnosis [grade 1 (very unlikely) or 5 (very likely)] was established in 56.8% of cases for disease activity, 30.3% for the presence of stenosis, 38.9% for the presence of fistula and 39.8% for the presence of abdominal abscess (Figure 2).

As in a previous study, a significant impact of an examination on the diagnostic likelihood perceived by the clinician was defined as a change of 2 points on the 5-point likelihood scale.[8] Colonoscopy and MRI respectively led to a change in the diagnostic likelihood of disease activity in 20 vs 20% of cases (not significant), the presence of stenosis in 26.5 vs 28% (not significant), the presence of fistula in 2.5 vs 20% (F < 0.001) and the presence of intra-abdominal abscess in 1 vs 19.5% (F < 0.001). After adding the information from colonoscopy or MRI to the clinical assessment, a firm diagnosis (very likely or very unlikely) was established in 86.5 vs 86.5% (not significant) for the presence of disease activity, 66 vs 90% (p < 0.001) for the presence of stenosis, 39 vs 97.5% (p < 0.001) for the presence of fistula and 40 vs 99% (p < 0.001) for the presence of intra-abdominal abscess (Figure 2).

Adding the data from colonoscopy and MRI respectively as a second examination, a significant change in the likelihood scale occurred in 4 vs 10% (p = 0.03) for the presence of disease activity, 9 vs 25% (p < 0.001) for the presence of stenosis, 0 vs 31% (p < 0.001) for the presence of fistula and 0 vs 27% (p < 0.001) for the presence of intra-abdominal abscess. A change to firm diagnosis occurred in 74.7 vs 88.9% (not significant) for the presence of active disease, 60 vs 89.7% (F = 0.004) for the presence of stenosis, 0 vs 95.9% (F < 0.001) for the presence of fistula and 0 vs 95.8% (F = 0.003) for the presence of intra-abdominal abscess. A firm diagnosis after both examinations was obtained in 96.5% of cases for disease activity, 93% for stenosis, 97.3% for fistula and 98% for intra-abdominal abscess (Figure 2). Colonoscopy was the only examination able to detect disease activity in 3.5% of the evaluations, whereas MRI was the only examination able to detect disease activity in 7.5% of the evaluations; 5.5% correspond to incomplete ileocolonoscopies and 2% to complete examinations. Colonoscopy as a first examination established a diagnosis of stenosis with a high likelihood (grade 4 or 5 on the confidence scale) in 35% of evaluations, whereas MRI as a first examination established the diagnosis of stenosis with a high likelihood in 25.5%. Combination of both examinations detected stenosis in 30.8% of evaluations. For those patients with incomplete ileocolonoscopy (46/100), MRI detected additional stenosis not detected by endoscopy in 14 cases: 9 located in the terminal ileum, 1 in the distal ileum, 2 in the ascending colon and 2 in the descending colon. In patients with complete colonoscopy (54/100), MRI detected additional stenosing lesions in the terminal ileum in 4 cases.

3.3. Diagnostic accuracy of clinical evaluations

Using the combination of ileocolonoscopy and MRI as the gold standard for the presence of disease activity and the presence of stenosis, fistula and abscess, we determined the accuracy of the clinical evaluation alone to diagnose these aspects of the disease. For this

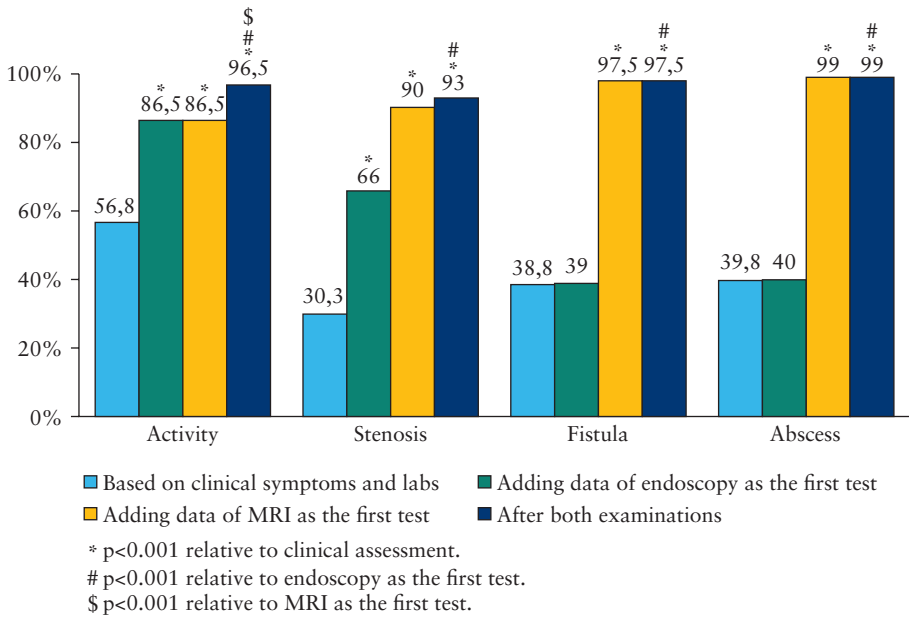

Figure 2. Firm positive or negative diagnosis (grades 1 or 5) for the assessment of disease activity and complication.

calculation, categorizations as likely or very likely were considered positive diagnoses, and unlikely and very unlikely as negative diagnoses. The sensitivities, specificities, positive predictive value (PPV) and negative predictive value (NPV) of the clinical assessment are presented in Table 2. Whereas clinical evaluation had acceptable sensitivity for the presence of active disease, its sensitivity was low for the presence of stricturing and penetrating complications. Specificity for diagnosing activity based on clinical assessment was low, but moderate for diagnosis of the presence of structuring and penetrating complications.

3.4. Impact of MRI and ileocolonoscopy on therapeutic recommendations

Based exclusively on the clinical evaluation, a recommendation for continued or new therapy with antibiotics was established in 23.5% of cases, steroids in 32.3%, immunosuppressants in 51.5% and anti-TNF therapy in 21.3%.

When information from the first examination (ileocolonoscopy or MRI) was added to the clinical evaluation, therapeutic recommendations relative to baseline were changed in a high proportion of patients, but to an overall similar extent for ileocolonoscopy (80%) and MRI (86%, not significant) (Table 3). However, compared with ileocolonoscopy, the information provided by MRI led in a higher proportion of cases to the recommendation of using anti-TNF therapy (37 vs 51%, $F < 0.006$) and to a definitive indication for surgical treatment (5 vs 12%, $F = 0.019$). The proportion of cases in which the use of antibiotics, steroids or immunosuppressants was recommended was similar when the information from MRI or ileocolonoscopy data was added to the clinical data (Table 3).

After adding ileocolonoscopy information to previous MRI data, the management changed globally in 8% of the evaluations. By contrast, adding MRI data to previous ileocolonoscopy led to a change in therapeutic recommendations in 29% of cases ($p < 0.001$). A higher proportion of changes in management as a result of adding the information from MRI to ileocolonoscopy was observed for each individual drug class: antibiotics, 0.5 vs 6% ($F = 0.003$); steroids, 5 vs 14% ($F = 0.003$); immunosuppressants 2.5 vs 7.5% ($F = 0.036$); and anti-TNF drugs, 3 vs 19% ($p < 0.001$). There were no statistically significant differences in changes in indication for surgery (2.5 vs 6%, not significant), although the number of cases in which the indication of surgery was only established after the second examination was low (Table 4).

The main reasons for a management change after adding MRI to previous information provided by ileocolonoscopy were the detection of extraluminal complications in 15.5% (31/200), the presence of disease activity not detected by ileocolonoscopy in 8% (16/200), and both factors in 5.5% (11/200). In comparison, the main reasons for changes in management as a result of adding the information from ileocolonoscopy to MRI were detection of mild to moderate disease activity in 2.5% (5/200) of cases and other causes in 5.5% (11/200) (assessment of rectal activity, diagnosis of cytomegalovirus colitis, exclusion of dysplasia or cancer).

Baseline factors that were independent predictors of a change in management derived from the information from MRI performed after colonoscopy included elevated CRP (OR 1.23, 95% CI 1.03–1.46) and suspicion of the presence of abscess based on clinical evaluation (OR 2.74, 95% CI 1.7–4.2). In addition, having an incomplete colonoscopy was also a predictor of a change of management after adding MRI (OR 1.5, 95% CI 1.1–1.9). No predictors of changes in

Table 2. Accuracy (%) of clinical symptoms for diagnosis of disease activity and complications using the combination of endoscopy and MRI as gold standard.

	Disease activity	Stenosis	Fistula	Abscess
Sensitivity (95% CI)	80.7 (78.6–82.3)	46.3 (37.5–55.1)	28.3 (15.3–41.3)	28.6 (13.6–43.6)
Specificity (95% CI)	17.1 (4.8–29.3)	68.6 (63.1–74.1)	79 (74.6–83.2)	79.7 (75.6–83.8)
PPV (95% CI)	94.8 (92.3–97.3)	65.5 (60.4–70.6)	65 (44.1–85.9)	58.8 (35.4–82.2)
NPV (95% CI)	22.2 (6.5–37.9)	81.2 (76.2–86.2)	94.9 (92.4–97.4)	97.7 (95.9–99.4)

CI, confidence interval; PPV, positive predictive value; PPV, negative predictive value.

Table 3. Impact of endoscopy or MRI as a first diagnostic test on the therapeutic recommendations.

	Clinical assessment plus colonoscopy (%)	Clinical assessment plus MRI (%)	
Global therapy changes	80	86	n.s.
Changes in antibiotics	15	15	n.s.
Changes in steroids	39.5	35	n.s.
Start	27.5	22	
Stop	12	13	
Changes in immunomodulators	27.5	31.5	n.s.
Start	25	29.5	
Stop	2.5	2	
Changes in anti-TNF drugs	37	51	$F = 0.006$
Start	27	40.5	
Dose change	4.5	5	
Switch drug	2	1.5	
Stop	3.5	4	
Indication for surgery	5	12	$F = 0.019$
Endoscopic treatment	2	1	n.s.

MRI, magnetic resonance imaging; n.s., not significant; TNF, tumour necrosis factor.

Table 4. Impact colonoscopy and MRI as a second diagnostic test on therapeutic recommendations.

	Colonoscopy after MRI (%) $n = 200$	MRI after colonoscopy (%) $n = 200$	
Global therapy changes	8	29	$F < 0.001$
Changes in antibiotics	0.5	6	$F = 0.003$
Changes in steroids	5	14	$F = 0.003$
Start	3.5	5	
Stop	1.5	9	
Changes in inmunomodulators	2.5	7.5	$F = 0.036$
Start	0.5	6	
Change drug	0	1	
Stop	2	0.5	
Changes in anti-TNF drugs	3	19	$F < 0.001$
Start	1.5	17	
Dose change	0.5	0	
Switch drug	0	0.5	
Stop	1	1.5	
Indication for surgery	2.5	6	n.s.
Endoscopic treatment	1	1	n.s.

MRI, magnetic resonance imaging; n.s., not significant; TNF, tumour necrosis factor.

management using ileocolonoscopy as a second examination could be identified, although the number of events was very low.

4. Discussion

The low accuracy of clinical assessment based on evaluation of signs, symptoms and biomarkers for the diagnosis of disease activity and the presence of complications in CD is becoming apparent[9,10] and was confirmed in the current study. Thus, there is a need for objective measures of disease activity and evaluation of stricturing and penetrating complications to guide appropriate and individualized management. Endoscopy continues to be considered the gold standard for the assessment of disease activity and the presence of stricturing lesions, whereas cross-sectional imaging is considered the preferred diagnostic approach to evaluate the presence of penetrating complications. Considering that recent publications from various groups are concordant in showing a high accuracy of MRI for assessing the presence and severity of active inflammation in both the small bowel and the colon in patients with CD,[4,6,11] the possibility of providing a better characterization of a stenotic lesion in terms of length and functional consequences, and its accepted superiority compared with colonoscopy for detection of penetrating lesions,[1] we asked whether MRI should continue to be considered as a complement to endoscopy or may be a preferable alternative for the evaluation of CD.

In the current study we determined how the information provided by ileocolonoscopy and MRI influences the diagnosis of disease activity and the presence of complications established by four clinicians who were experts in IBD, and the impact of this information on patient management. Our results show that for the assessment of disease activity the changes in perception of likelihood of active disease after adding ileocolonoscopy or MRI to the clinical assessment were similar, and the clinicians could establish a firm diagnosis that was either positive (very likely) or negative (very unlikely) in a high and equal proportion of patients (86.5%) with either technique. However, for the presence of complications, MRI led to the establishment of a firm positive or negative diagnosis in a significantly higher proportion of cases than ileocolonoscopy. The exceptions were cases with mild disease activity that escaped detection by MRI, a fact that has already been reported in previous studies.[4]

The superior diagnostic accuracy of MRI, particularly for the assessment of stricturing and penetrating complications, led, as expected, to a higher impact on management decisions, particularly for establishing indications of anti-TNF therapy and surgery. For these two indications, ensuring whether penetrating complications are present or not and the precise anatomy of these complications (e.g. length and location of a stenosis) are critical in deciding management. This aspect also explains why, in a considerable proportion of cases that had been evaluated by the investigators considering clinical and endoscopy data, adding information from MRI led to a higher proportion of changes in management, whereas adding information from endoscopy in cases that had already been evaluated by clinical data and MRI led to fewer changes, which were mostly related to the presence of mild disease. Interestingly these results also indicate that management decisions are not only based on the severity of inflammation, but also on the presence of established damage, such as stenosis or fistula, and suggest that a quantitative measure of damage such as that provided by the Lémann score may be also helpful in clinical practice.[12]

The current study has limitations. The main one is that it was a single-centre study, performed by a group of investigators with long experience in the use of MRI for IBD management, and relying on the interpretation of MRI by two dedicated radiologists. In addition, to evaluate colonic lesions we used luminal contrast (water enema), which is not standard practice in every centre. Clearly, the use of colonic distension would not affect the diagnosis of penetrating complications, which were the findings that led to differential effects on management following MRI compared with ileocolonoscopy, but the use of this contrast may have increased the accuracy of MRI for the diagnosis of inflammatory activity. Another limitation of the study may be the relatively low rate of ileal intubation during ileocolonoscopy, but it should be considered that all patients had clinically active disease, severe in some cases, and a relatively high proportion of patients had stenosis. Inclusion of patients was less restrictive than in therapeutic clinical trials and this may have led to the recruitment of a population with more severe disease. The results may be generalizable to the population of patients with CD from a tertiary referral centre, provided MRI examinations are performed and interpreted in optimal conditions.

Overall, these observations suggest that, in patients with moderate or severe CD, MRI may be considered a first-choice diagnostic technique, particularly in centres with experienced radiologists, allowing assessment of activity and complications, whereas ileocolonoscopy may be preferable for patients with mild disease. The presence of a high CRP level and suspicion of complications would also favour the use of MRI as a first-line examination. Cases initially evaluated with ileocolonoscopy in which the examination was incomplete should also be reassessed using MRI.

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Conflict of Interest

None related to the information presented in the current study.

Author Contributions

OGB was involved in study design, recruitment of patients, review of patients' clinical history for drafting the Case Report Form (CRF), statistical analysis of data and drafting the manuscript. IO, MA and ER were responsible for completing the CRFs. AMR and MG were involved in patient recruitment. SR and JR were the radiologists that performed and interpreted MRI examinations. JP was involved in study design, completing the CRFs and drafting the manuscript. All authors approved the final version submitted.

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