News & Views

Research Highlights

Highlights from the latest articles in imaging

MR enterography in stricturing Crohn's disease

Roberto Lorenzetti*[1], Cesare Hassan[1], Angelo Zullo[1] & Cristiano Spada[2]

[1]Gastroenterology Unit ONRM Hospital Via Morosini 30 00153 Rome, Italy
[2]Surgical Endoscopy Policlinico Gemelli Università Cattolica "Agostino Gemelli", Rome, Italy
**Author for correspondence: rlorenzetti2004@yahoo.it*

Evaluation of: Ha CY, Kumar N, Raptis CA, Narra VR, Ciorba MA. Magnetic resonance enterography: safe and effective imaging for stricturing Crohn's disease. *Dig. Dis. Sci.* 56(10), 2906–2913 (2011).

MR enterography (MRE) is a cross-sectional imaging technique that allows the simultaneous visualization of both the luminal pathology and extraintestinal complications of Crohn's disease (CD) without exposure to ionizing radiation. In addition, experienced radiologists can differentiate findings consistent with active inflammation from the chronic changes of fibrosis based on different enhancement patterns. This would appear clinically useful in choosing surgical versus medical management options, particularly among those patients presenting with obstructive symptoms.

This study aimed to evaluate the diagnostic role of MRE in symptomatic patients with established CD, particularly those presenting with suspected obstructive disease. One hundred and nineteen patients – including 36 presenting with obstructive symptoms – undergoing MRE at a tertiary inflammatory bowel disease referral center over a 3-year study period were included in this retrospective study. All MRE studies were performed using the standardized protocol of the Mallinckrodt Institute of Radiology of the Washington University in St Louis School of Medicine (MO, USA). MRE findings of stricture, active inflammation and fibrosis were classified according to the conventional radiographic criteria. Positive and negative findings from MRE were correlated with either the medical outcome over the subsequent 90-day period or with pathology reports for the patients' subgroups who underwent surgery.

A significantly higher prevalence of positive findings, including active inflammation, stricturing and penetrating disease, was found in patients undergoing MRE for obstructive symptoms (87.5%) compared with those referred for other indications (58.1%, p = 0.001). In this group, 55% of patients received an escalation of medical therapy and 32.5% underwent surgery, showing that MRE findings greatly impacted on clinical management. Moreover, in 92% of the cases undergoing surgery, MRE findings of disease activity and fibrosis were found to be concordant to alterations found in surgical resection specimens.

The results of this study, in agreement with current inflammatory bowel disease management guidelines, confirm MRE as a well-tolerated and safe cross-sectional imaging technique, providing meaningful information to assess disease activity, chronicity and complications in newly diagnosed or established CD patients. MRE may be useful in distinguishing between inflammatory and fibrotic stricturing, therefore impacting on subsequent management regarding surgical or medical therapies. Although the study is retrospective, the analysis represents a practice-based use at a tertiary inflammatory bowel disease referral center of MRE. One limitation, opportunely stressed by the authors, is the feasibility of MRE as a first-line cross-sectional imaging technique for CD in clinical practice. This is due to the lack of standardized MRE protocols, additional costs compared with conventional CT, lack of insurance coverage and a lack of experienced MRE radiologists. Conversely, the radiation-free exposure is an advantage compared with CT scanning and its inherent risk of radiation-associated malignancy.

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Is contrast-enhanced ultrasound truly useful in Crohn's disease?

Evaluation of: Wong DD, Forbes GM, Zelesco M, Mason R, Pawlik J, Mendelson RM. Crohn's disease activity: quantitative contrast-enhanced ultrasound assessment. *Abdom. Imaging* doi:10.1007/s00261-011-9792-z (2011) (Epub ahead of print).

Transabdominal ultrasound (US) examination is widely used as a first-line test in the diagnosis of Crohn's disease (CD), particularly to detect terminal ileum involvement and abscesses. This noninvasive, accurate and ionizing radiation-free technique can be easily repeated and is relatively inexpensive. More recently, disease inflammation assessment was possible due to the introduction of second generation intravenous contrast agents in combination with low mechanical index harmonic US. To date, however, results from studies using contrast-enhanced US (CE-US) have been inconsistent.

The aim of this study was to determine whether quantitative parameters obtained by CE-US correlated with established clinical, biochemical and endoscopic parameters, and to assess its utility in the patients' follow-up.

Overall, 30 CD patients requiring colonoscopy or flexible sigmoidoscopy were included in this prospective study. Within 7 days of endoscopy, CE-US with intravenous Perflutren lipid microsphere was performed by sonographers blinded to the clinical, biochemical and endoscopic findings.

The correlation between three quantitative parameters automatically calculated at CE-US and clinical, biochemical and endoscopic indices of CD severity was evaluated by Pearson's correlation analysis and multivariate linear regression.

No significant correlation between clinical/endoscopic disease activity indices and CE-US parameters was found. Peak intensity (TTP) values only correlated with a reduction of PCR and Crohn's Disease Activity Index values following medical therapy ($p = 0.05$).

The authors identified two possible explanations for the lack of any correlation between indices of CD severity and CE-US parameters. First, CE-US performed in this study focused on a single intestinal loop having the thickest wall, whereas endoscopy globally evaluated all large bowel and terminal ileum. Furthermore, endoscopy reveals only mucosal inflammation, whereas US allows a transmural evaluation of inflammatory activity. Second, the arteriolar stenosis and the consistent reduction of regional blood flow ultrastructurally observed in CD could explain why the mural microvascularity may not be truly increased in active disease.

Overall, results of this study do not confirm the role of CE-US in the evaluation of disease activity of CD observed in previous studies. However, CE-US appears to be useful in the serial assessment of treatment outcome. Finally, in contrast to common opinion that US is an operator-dependent technique, a high interobserver agreement was demonstrated in this study.

Low-radiation dose CT to study Crohn's disease

Evaluation of: Kielar AZ, Tao H, McKeever C, El-Maraghi RH. Low-radiation-dose modified small bowel CT for evaluation of recurrent Crohn's disease. *Gastroenterol. Res. Pract.* 2012, 598418 (2012).

CT has been recognized as an accurate tool for evaluating both intestinal and extraintestinal Crohn's disease (CD) complications in the abdomen and pelvis. However, there are some concerns regarding the potential long-term effects of repeated exposure to ionizing radiation from CT scans. Therefore, the use of other nonionizing radiation-based cross-sectional imaging modalities have been introduced especially for those CD patients who undergo repeated imaging studies.

In this study, interobserver agreement about findings of a low-radiation dose unenhanced CT (modified small bowel CT [MBCT]) was evaluated in patients with recurrent symptoms of established CD. An MBCT protocol that uses hyperdense oral contrast, 9% ioxitalamic acid, was developed. A noise index of 28 was used with auto-mA modulation on 16- or 64-slice scanners. The combination of high noise index and auto-mA modulation was aimed to reduce patient radiation dose in MBCT. No bowel preparation or nasogastric tube insertion was used. The oral solution of 9% Telebrix-38 that was administered has a high attenuation (500–600 HU), increasing contrast resolution. To increase diagnostic confidence the CT scan images were postprocessed and reformatted on a 3D workstation. Each modified small bowel CT image set was retrospectively reviewed by two radiologists who were blinded about prior reports and images. Statistical analysis software was used to calculate the κ-scores (interobserver agreement) for presence of obstruction, active inflammation versus chronic stricture, and ancillary findings. Ninety-eight patients with previously biopsy-proved CD were included in this retrospective analysis.

A very good interobserver agreement was demonstrated for both identifying normal versus abnormal examinations (κ-value: 0.84), and distinguishing active inflammation versus chronic stricture (κ-value: 0.89). Level of agreement for presence of skip areas, abscess formation and fistula were 0.62, 0.75 and 0.78, respectively. Moreover, in a subset of 54 patients who underwent surgery or colonoscopy with ileal intubation or had follow-up cross-sectional imaging

within 4 months, an 85% of agreement with MBCT findings was found.

Correctly, the authors pointed out several potential limitations of the study, such as the retrospective design and the lack of a gold standard for comparison in all cases. Consequently, the true sensitivity, specificity and accuracy of MBCT could not be calculated.

In conclusion, MBCT appears to be an interesting new imaging technique with a good interobserver agreement for evaluating significant clinical parameters in CD patients. The low absorbed radiation dose (2.55 mSv) as compared with conventional CT enterography (10.71 mSv) is a necessary advantage when dealing with repeated exposure to ionizing radiation.

A novel ultrasound technique in animal models of Crohn's disease and humans

Evaluation of: Stidham RW, Xu J, Johnson LA *et al.* Ultrasound elasticity imaging for detecting intestinal fibrosis and inflammation in rats and humans with Crohn's disease. *Gastroenterology* 141(3), 819.e1–826.e1 (2011).

Knowledge of stricture composition is a crucial issue for clinical management and therapeutic decision-making in Crohn's disease (CD). Indeed, inflammatory strictures are likely to respond to medical therapy, whereas fibrotic strictures often require surgical intervention. Unfortunately, the cross-sectional imaging techniques currently used in CD, including CT enterography and MR enterography, do not allow radiologists to reliably distinguish active inflammation from fibrotic strictures. Ultrasound elasticity imaging (UEI) was conceived as a novel, noninvasive technique to assess tissue mechanical properties by measuring the strain developed in the tissue in response to a force applied to a fixed area. In recent years, UEI has been applied successfully to differentiate acute versus chronic deep venous thrombosis, to identify diastolic heart failure with cardiac elasticity imaging and to differentiate rejection versus healthy kidney in renal transplants. Recently, this technique has been demonstrated to be able to identify intestinal fibrosis in animal models of CD. This study aimed to confirm the ability of intestinal UEI to detect the presence and extent of diseased bowel and to differentiate inflammatory from fibrotic changes in animal models of colitis. In addition, UEI technique was applied to humans with CD in order to assess its feasibility in the evaluation of strictures and to compare UEI results with other mechanical measurements and histopathology.

A well-accepted model of colitis (n = 5) and chronic fibrosis (n = 6) was induced in Lewis rats; UEI was performed using a novel speckle-tracking algorithm to estimate tissue strain. The scanning results were compared with inflammation and fibrosis as found in resected bowel segments. Seven CD patients, scheduled for elective resection of symptomatic small bowel strictures, underwent UEI within 2 days prior to surgery using the same ultrasound machine utilized in the animal experiments. After surgery their resected stenotic and normal bowel segments were evaluated by *ex vivo* elastometry and histopathology.

The results of this study clearly demonstrate that transcutaneous UEI can differentiate active inflammation from fibrotic tissue in an animal model of CD and distinguish fibrosis from normal tissue in a pilot study in humans with CD. Indeed, the UEI strain values detected on stenotic intestinal segments are significantly different from those observed on normal tissue ($p = 0.0008$) and these measurements are well correlated with the gold standard for *ex vivo* elastometry ($r = -0.81$). Of note, the study demonstrated the feasibility of UEI in patients with CD. This technique appears to be particularly valuable for follow-up evaluation of known stenotic lesions over the period when the role of repeated CT enterography is hampered by radiation exposure and the value of repeated MR enterography is limited by the cumulative cost.

In conclusion, this study presents a new noninvasive diagnostic strategy for CD management and prospective studies are needed to assess whether in clinical practice UEI could be a reliable tool to discriminate between CD patients requiring medical therapy and those who are candidates for surgery.