Usefulness of imaging techniques in therapeutic decisions in patients with crohn’s disease: a prospective comparison of contrast-enhanced ultrasound and magnetic resonance enterography.

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Aims and objectives

CURRENT STATUS OF THE PROBLEM AND JUSTIFICATION OF THE STUDY

The different imaging techniques (ultrasound, CT or MRI) help in establishing a solid initial diagnosis of Crohn's disease (CD) with the clinical history, laboratory data and endoscopy study. The information obtained through imaging techniques allows to determine the location, length (including the detection of lesions not achievable through the endoscopy), inflammatory activity and disease severity, or assess whether it corresponds to a stenosing or penetrating disease and monitor effectiveness treatment.

In order to plan the appropriate treatment during the following of patients with CD, especially in symptomatic patients and those are treated with immunosuppressive or biologic therapy, repeated assessment of inflammatory activity and severity disease is required as well as a control of transmural complications (fistulas, phlegmons and abscesses) that may occur in their clinical course. These controls are usually performed with colonoscopy and / or imaging techniques (ultrasound, CT or MRI).

The CD is mostly diagnosed in young adults and it presents a chronic recurrent clinical course and patients must undergo multiple imaging studies throughout their life. Therefore, the use of CT is limited by the significant risk of cumulative exposure to ionizing radiation. Based on these considerations, the assessment of patients with image techniques should be preferably done by ultrasound or entero-MRI.

Recent meta-analysis has demonstrated no significant differences between ultrasound and entero-MRI; both techniques are similar in diagnostic accuracy, detection of transmural complications, medium-high grade stenosis and measurement of inflammatory activity. All these parameters influence therapeutic decisions.

Despite these results, in recent years have been published numerous articles where is argued that MRI is the technique of choice in the evaluation of patients with CD relying on the good results obtained with entero-MRI. On the other hand, note the advantages of an objective technique such as MRI against ultrasound that is a operator-dependent technique. However, ultrasound is cheaper, more accessible and better tolerated than MRI.

AIMS AND OBJECTIVES:
The main objective of the study is to evaluate the usefulness of the information provided by contrast-enhanced ultrasound (CEUS) or magnetic resonance enterography (MRE) in therapeutic decision of patients with Crohn's disease and to analyze the differences between the two techniques influencing this decision.
Methods and materials

Prospective comparative study between ultrasound and entero-MRI about of the clinical relevance of the information provided by these two techniques.

We prospectively evaluated 100 episodes in 71 patients (mean age: 37±10 years) with established diagnosis of Crohn’s disease who underwent CEUS as well as MRE requested for clinical assessment.

All patients were informed of the nature and purpose of the examinations that were performed and written informed consent to participate in the study was obtained.

The indication of the studies was clinical suspicion of inflammatory episode, prior to initiation or withdrawal of immunomodulatory therapy, developmental control of transmural complications or suspected stenosis.

Inclusion criteria:

- Patients of both sexes with age equal to or greater than 18 years diagnosed with CD and under control of digestive medicine as a result of their underlying disease.

Exclusion criteria

- Patients less than 18 years.
- Patient refusal to participate in the study.
- Pregnancy.
- Contraindications of ultrasound contrast: recent acute coronary syndrome, unstable ischemic cardiomyopathy or severe heart rhythm disorders.

Ultrasound:

The ultrasound study begins by examining B-mode and color Doppler in a Toshiba Aplio 80, using a 3-6 MHz multifrequency convex transducer. The location of affected bowel segment or segments (measured in mm wall thickness) is assessed. The presence of stenosis or transmural complications such as blind sinus tracts, fistulas, phlegmons or abscesses should be sought. Also, color Doppler signal in the affected segment is measured and it is assessed according to the scale presented in Table 1.
The contrast study is performed in harmonic mode with pulse inversion technique (Toshiba Aplio), selecting a low mechanical index (MI <0.10). Second generation contrast (SonoVue®, Bracco, Milan, Italy) is injected as a bolus in units of 1.2 ml through a three-way 20-gauge catheter in a forearm vein, followed by 10 ml of a normal saline solution (0.9% NaCl). A different range of 1.2-ml boluses of contrast agent can be used for each patient, depending on the number of involved bowel segments. Each test is recorded in the form of video. For each examination the recording starts a few seconds before the intravenous administration of the contrast agent and continuous imaging is performed for 40 s. A predetermined region of interest (ROI) is selected and the software determines the brightness over a defined time period. It provides an accurate mapping of the intraparietal vasculature and we can evaluate the increase in vascularisation of the bowel wall that occurs in patients with active CD.

Table 1. Severity Scale with Color Doppler ultrasound

<table>
<thead>
<tr>
<th>Grade 0 (Normal)</th>
<th>&lt;2 Doppler signals</th>
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</thead>
<tbody>
<tr>
<td>Grade 1 (Mild)</td>
<td>2-4 Doppler signals</td>
</tr>
<tr>
<td>Grade 2 (Moderate)</td>
<td>5-10 Doppler signals</td>
</tr>
<tr>
<td>Grade 3 (Severe)</td>
<td>&gt;10 Doppler signals</td>
</tr>
</tbody>
</table>

**Entero-MRI:**

It is performed on a 1.5 Tesla (Intera Master, Philips, Netherlands). The preparation for the study includes a 250 ml rectal enema the night before, intake of 1.5 l of water with diluted osmotic agent (100 g macrogol, Moviprep, Norgine, Spain) and water enema (1000-1500 ml) immediately before the test. T2-weighted sequences (including Balance and SPAIR in axial, coronal and perpendicular to the long axis of the handles affected), diffusion with calculation of ADC and a dynamic study after administration of intravenous contrast are acquired. The median duration of complete study is approximately 30 minutes.

The two procedures were performed in the same day and the reports of both techniques were performed independently at the end of the test. Following parameters were analized:

- Segment or segments affected.
- Length of the affected intestinal segments: <10 cm, 10-20 cm, >20cm.
- Number and location of stenosis.
- Signs of intestinal obstruction.

- Signs of inflammatory activity (yes or no):

  a) In ultrasound: color doppler hyperemia (grade 2 or 3), increased of parietal enhancement (46% or more increase of enhancement).

  b) MRI: parietal hyperintensity on T2, type of mural enhancement (stratified, homogeneous, mucous), restricted diffusion, engorgement of mesenteric vessels (comb sign) and mesenteric edema.

- Transmural complications (sinus tracts, fistulas, phlegmons, abscesses).

Inflammatory activity findings, in addition to the presence of fistulas, abscesses and stenosis were evaluated by both techniques. Response to treatment defined as improvement, no change or deterioration of the imaging findings was also assessed.

Based on all the information available, current medical history, laboratory data and from the imaging techniques, the gastroenterologist proposed a therapeutic approach (maintenance or change in treatment strategy).
Results

Based on the findings of imaging examinations a change in the therapeutic strategy was decided in 69 episodes.

Treatment remained unchanged in 31 episodes.

Change in treatment strategy consisted of intensification (n=52) or decrease (n=4) of the treatment, surgery (n=10) or abscess drainage (n=3).

The information from both techniques was similar in 85% of the episodes. Fig. 1 on page 8  Fig. 2 on page 8  Fig. 3 on page 9 Fig. 4 on page 10

Additional information from CEUS prompted a change in treatment strategy 7 times by detecting stenosis (n=2), fistula Fig. 5 on page 11 (n=2) or persistence of inflammatory activity (n=3).

Supplementary information provided by MR enterography induced the treatment in 8 episodes by detection of stenosis (n=3), fistula Fig. 6 on page 12 (n=1), abscess (n=1) Fig. 7 on page 13 or persistent inflammatory activity (n=3).

The inter-technique agreement was good (kappa = 0,676).

There were no statistically significant differences between CEUS and MRI (p = 1,0, McNemar test)
Fig. 1: B-mode US and CEUS scan, axial and coronal contrast-enhanced spoiled gradient-echo MR images. The involved ileal segment (IT) shows wall thickening, involvement of the surrounding fat and an abscess (arrow). There was agreement between both studies. US also shows thickening of the appendix (AP).

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**Fig. 2:** B-mode US and MRI (Coronal T2-weighted). Both techniques show involvement of the terminal ileum (12 cm of length) and the presence of complex fistula (arrows) involving the ileum, sigmoid colon and bladder.

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Fig. 3: B-mode US and contrast-enhanced spoiled gradient-echo MR images. The images show the presence of a perienteric phlegmon (arrow). There is concordance between the two techniques.

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Fig. 4: B-mode US and CEUS, and MRI images (axial T2 with fat-suppressed and axial post-gadolinium) There is ileal recurrence (R) and a phlegmon (arrow) adjacent to the neoterminal ileum. There is agreement between both studies.

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Fig. 5: US scan depicts a blind-end hypoechoic tract (arrows) originating from the thickened intestinal wall that represents a sinus tract penetrating the mesentery. Coronal and axial post-gadolinium MRI images: fissure was erroneously interpreted as a loop.

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Fig. 6: B-mode US, and MRI images (Coronal TRUF1 T2-left- and coronal contrast-enhanced spoiled gradient-echo MR). Ultrasound shows deep ulceration on the wall of the terminal ileum while MRI shows a epithelialized fistula (arrow) (not detected at ultrasound) between an ileal loop and the terminal ileum simulating an intestinal loop.

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Fig. 7: B-mode US and CEUS, and MRI images (post-gadolinium -left- and axial T2 balanced-right). There is wall thickening of the terminal ileum identifying inflammatory involvement of the mesentery and several deep fissures (red arrowheads). MRI also depicts an additional small abscess (arrow) that was unnoticed in the ultrasonographic examination possibly because of its deep location.

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Conclusion

Cross-sectional imaging techniques add information to clinical management in patients with Crohn’s disease and alter the treatment plans in more than half of patients.

There are no differences between the information provided by CEUS and MR enterography in the decision to perform therapeutic changes.
References


