



Journal of Coloproctology

www.jcol.org.br



Review Article

Computed tomography enterography and magnetic resonance enterography in small intestine of Crohn's disease



Aida Cristina Correia Oliveira Azevedo^{a,b}, Sandra Fátima Fernandes Martins^{a,b,c,*}

^a Universidade do Minho, Escola de Ciências da Saúde, Life and Health Sciences Research Institute (ICVS), Braga, Portugal

^b ICVS/3B's, PT Government Associate Laboratory, Braga/Guimarães, Portugal

^c Centro Hospitalar de Trás-os-Montes e Alto Douro, Departamento de Cirurgia, Vila Real, Portugal

ARTICLE INFO

Keywords:

Inflammatory bowel disease
Crohn's disease
CR enterography
MRI enterography

ABSTRACT

Crohn disease is defined as a chronic inflammatory and idiopathic process that can affect any portion of the gastrointestinal tract. The small intestine is the most frequently affected place, so small bowel morphology investigation is often mandatory.

For decades small bowel was almost inaccessible to endoscopies, and, studies like enteroclysis and bowel transit time test, were considered gold standard tests. Recently, innovative imaging techniques, improved diagnosis and follow-up of Crohn disease patients by allowing the exploration of this gut segment.

Authors review literature, concerning the role of computed tomography enterography and magnetic resonance enterography in the evaluation of small bowel Crohn disease.

Authors conclude that the choice of examination to be made should be weighted considering several factors such as the age of the patient, their tolerability, the Crohn's disease phenotype and the availability of hospital resources.

© 2017 Sociedade Brasileira de Coloproctologia. Published by Elsevier Editora Ltda. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Enterografia por tomografia computadorizada e por ressonância magnética na avaliação da Doença de Crohn do intestino delgado

RESUMO

A doença de Crohn é definida como um processo inflamatório e idiopático crônico que pode afetar qualquer parte do trato gastrintestinal. O intestino delgado é o local mais frequentemente afetado e, assim, com frequência torna-se obrigatória uma investigação da morfologia do intestino delgado.

Durante décadas, o intestino delgado era praticamente inacessível às endoscopias; nesse contexto, estudos como a enteroclise e a determinação do tempo de trânsito intestinal eram

Palavras-chave:

Doença inflamatória intestinal
Doença de Crohn
Enterografia por TC
Enterografia por IRM

* Corresponding author.

E-mail: sandramartins@ecsau.de.uminho.pt (S.F. Martins).

<http://dx.doi.org/10.1016/j.jcol.2017.06.002>

2237-9363/© 2017 Sociedade Brasileira de Coloproctologia. Published by Elsevier Editora Ltda. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

considerados como os critérios diagnósticos principais. Recentemente, técnicas imaginológicas inovadoras aperfeiçoaram o diagnóstico e seguimento de pacientes com doença de Crohn, por permitirem a exploração desse segmento intestinal.

Os autores revisam a literatura pertinente ao papel da enterografia por tomografia computadorizada e da enterografia por ressonância magnética na avaliação da doença de Crohn no intestino delgado.

Os autores concluem que a escolha do exame a ser realizado deve levar em conta diversos fatores, como a idade do paciente, tolerabilidade, o fenótipo da doença de Crohn e a disponibilidade dos recursos hospitalares.

© 2017 Sociedade Brasileira de Coloproctologia. Publicado por Elsevier Editora Ltda. Este é um artigo Open Access sob uma licença CC BY-NC-ND (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Inflammatory bowel disease (IBD) encompasses a group of disorders characterized by an inappropriate immune response to endogenous intestinal microbial flora, with or without a component of autoimmunity.¹

Geographical distribution of IBD is not homogeneous, around the world, and a higher incidence is observed in Western countries, on the other hand, it is also an emerging disease, in countries that have adopted more westernized habits and styles of life.^{1,2}

IBD, incidence has been increasing over the last years, in all age groups. With regard specifically to Crohn's disease (CD) its incidence is of 0.1–16 cases per 100 000 inhabitants, worldwide.³ In Europe, it is estimated that 12.7 new cases of CD are diagnosed per year, per 100 000 inhabitants.⁴

CD can affect any portion of the gastrointestinal tract, from the mouth to the anus. However, in approximately 30–40% of patients with CD, only the small intestine is affected, particularly the terminal ileum, in 15–25% only the colon is affected and both colon and small intestine is affected in 40–55% of the patients.^{1,5}

Regardless of the advances that have occurred at the level of knowledge of the basic mechanisms of inflammation and pathogenesis of CD, its etiology remains unknown. It is accepted, however, that some genetic, microbiological, immunological, environmental, dietary, vascular and psychosocial factors, such as smoking, use of oral contraceptives and nonsteroidal anti-inflammatory drugs, have influence in the individual susceptibility to develop the disease.^{1,6}

Clinical presentation of the disease is characterized by asymptomatic periods alternating with exacerbation periods, with variable time intervals.⁵ A panoply of symptoms and signs, can be observed, being the most frequent, abdominal pain, diarrhea, weight loss and fever.⁷ Rectal bleeding and vitamin deficits, although less frequent, can also be present.^{1,8} Extra-intestinal manifestations, can also be seen in 15–20% of patients, mostly women with colic CD, like oral lesions, erythema nodosum, episcleritis and involvement of the musculoskeletal and hepatobiliary systems.^{1,8} More rarely, lung, kidney, pancreas, heart and central nervous system involvement and psychosocial disorders such as depression, anxiety and difficulties in accepting body image can be documented.⁹

In order to facilitate the characterization of CD, particularly in regard to its severity, it is possible to categorize the disease based on the Montreal Classification, that classifies patients

based in the age of presentation; maximal location of disease before the first surgery and disease behavior. The application of this classification is recommended 5 years after diagnosis of the disease.⁶

CD diagnosis is based on four pillars: clinical history, endoscopy, imaging/radiology exams and histopathology.⁸ Undoubtedly, colonoscopy is the election test for CD diagnosis by allowing a complete view of the entire colon, ileocecal valve and terminal ileum, which are the anatomical areas most commonly affected, as well as, performing biopsies of the involved areas,^{10,11} mandatory for definitive diagnosis. The characteristic endoscopic findings include skip lesions, aphthous ulcers and a mucosal pattern in cobble stone, frequently involving the terminal ileum and sparing the rectum.¹⁰ Histological findings in favor of the chronicity of the inflammatory process are the distortion of architecture, increased cellularity in the lamina propria, metaplasia of the pyloric gland and Paneth cells. Although the presence of granulomas is highly suggestive of CD, it is not considered pathognomonic and can be found in many other conditions including CU, tuberculosis and sarcoidosis.¹⁰

Colonoscopy also allows to evaluate treatments outcomes, namely; after treatment with biological and standard therapy; strictures dilation with the balloon technique. Prospective studies have shown that colonoscopy is a safe method with a low rate of adverse effects in patients with IBD.¹²

The small bowel is the segment more often affected by CD.^{1,5} The evaluation of this segment is hindered by several factors such as its length and position in the abdominal cavity, its tortuosity and overlapping handles and for having a pleated mucosa.¹³ Regarding the investigation of the disease in this location, for decades, studies with barium, for example, enteroclysis and bowel transit time test, were considered gold standard tests, with great impact on diagnosis, assessment of their anatomical distribution and detection of *fistulae*, abscesses and signs of the disease's active phase or exacerbations.^{1,13} However, given the progress that has been operated in the field of imaging, especially in terms of improvement of imaging techniques, enterography, either CT (CTE) or magnetic resonance imaging (MRIE), has been supplanting the previous techniques that were used to study the disease in the small intestine.^{1,14}

Indeed, the CTE has the advantage of presenting a high spatial resolution, allowing the visualization of the entire bowel,

Table 1 – Overall sensitivity and specificity of computed tomography enterography and magnetic resonance enterography in the evaluation of small bowel Crohn disease.

	CTE		MRIE	
	Sensitivity (%)	Specificity (%)	Sensitivity (%)	Specificity (%)
Cakmakci et al. ¹¹	100	53.9		nr
Ohtsuka et al. ¹⁸	85.8	83.6	87.9	81.2

CTE, computed tomography enterography; MRIE, magnetic resonance enterography; nr, not reported.

with no overlap of intestinal loops, allowing the observation of the intestinal wall, the detection of extra-luminal disease and other potential alterations associated.¹¹ In fact, the fine cuts and multiplanar reconstructions that this imaging technique allows, can overcome barriers to view the small intestine such as the superposition of loops and its extension.^{1,11}

The distinction between active disease and disease in chronic phase is very important particularly so that the most appropriate treatment can be applied, this is, patients with imaging findings characteristic of acute disease benefit from treatment with corticosteroids while in the chronic phase the best treatment option involves surgery or other invasive procedures.¹⁵

Regarding CTE, the presence of wall thickening, increased enhancement of the intestinal wall, wall stratification, densification of the mesenteric fat, engorgement of the vasa recta, lymphadenopathy, fistulae and abscesses, are considered suggestive imaging findings of CD's active phase.^{2,16}

Recent studies with CTE revealed a sensitivity of 100% and a specificity of 53.9% for the diagnosis of active CD.¹¹

Concerning MRIE, the translation of CD's active phase is supported by the visualization of enhancement of the mucosa, wall stratification, ulcers, densification of the mesenteric fat, wall thickening, engorgement of the vasa recta, strictures, mesenteric lymphadenopathy, fistulae and abscesses.^{11,17}

Data from a meta-analysis of 290 patients with CD from 6 studies, set the sensitivity and specificity of CTE in the evaluation and monitoring of CD's active phase in 85.8% and 83.6%, respectively; in the case of MRIE, the sensitivity is 87.9% and specificity of 81.2%.¹⁸

The fistulae, strictures and abscesses detection rate is 96.3%, 61.6% and 89.9% respectively, when using the CTE and 93.6%, 93.1% and 99.6% when using the MRIE.¹⁸

The main disadvantage of using CTE is the use of ionizing radiation which is of particular importance in young patients with the need of frequent imaging monitoring of the response to therapy.¹⁵

The MRIE, an imaging technique that works without the use of ionizing radiation, has good soft tissue contrast and a better distinction between the fluid content and edema. It also allows to infer the intestinal motility, which is not possible with CTE.¹⁹ However, it should be noted that there are some contraindications for performing MRIE such as if the patient has implants, allergy to contrast or decreased renal function.²⁰

Finally, it should be noted that studies where MRIE was compared with CTE, no statistically significant differences were found in the effectiveness of the evaluation of CD's activity. A meta-analysis by Horsthuis et al. also reported no significant differences between the CTE and MRIE and its diagnostic capacity and inflammatory bowel disease monitoring.²¹

Table 2 – Percentage of detection of the principal's findings of Crohn disease, by computed tomography enterography and magnetic resonance enterography.¹⁸

	CTE (%)	MRIE (%)
Fistulae detection rate	96.3	93.6
Strictures detection rate	61.6	93.1
Abscesses detection rate	89.9	99.6

CTE, computed tomography enterography; MRIE, magnetic resonance enterography.

Tables 1 and 2 summarize the principal results of computed tomography enterography and magnetic resonance enterography in the evaluation of small bowel Crohn disease.

Considering, now, the treatment of CD, the primary endpoint is the induction of remission and, often, this is achieved with the use of corticosteroids orally administered. In case of relapse with the use of corticosteroids alone, it is recommended the association of an immunomodulator, such as azathioprine. Reference to a specialized center and the use of biological therapy (including anti-TNF alpha antibodies: adalimumab, infliximab, and others) should be considered in cases of relapsing disease or resistance to corticosteroids.^{1,8}

Compliance with the treatment also has secondary objectives, as the maintenance of remission and prevention of late complications. Maintenance of remission is achieved with azathioprine which is the first-line drug. Methotrexate is an alternative, with the same degree of efficacy, being the drug used in case of intolerance to thiopurines.^{1,8}

Early use of biological therapy brings benefits in terms of reducing the number of hospitalizations and surgeries, however, besides being a costly therapy, it is not free from infectious risks or reactions associated with the infusion.^{1,8}

The identification of individuals with CD likely to develop complications in the course of the disease can be made by taking into account some factors such as early age at diagnosis, perianal disease, phenotypically stricturing disease, severity of disease at diagnosis (based on the percentage of weight loss or need for corticosteroids at diagnosis). It is known that 90% of patients who present three or more of these factors, will have a worse outcome in 5 years and may require two or more resections, a definitive stoma or develop complex perianal disease.⁸

Conclusion

Detection of characteristic DC signs in active phase is essential for the institution of the most appropriate treatment in order to avoid the progression of the disease.

Different techniques such as EDB, ETC and ERM, can be used to follow CD.

The choice of examination to be made should be weighted considering several factors such as the age of the patient, their tolerability, the CD phenotype and the availability of hospital resources.

Conflicts of interest

The authors declare no conflicts of interest.

REFERENCES

- Friedman S, Blumberg RS. Inflammatory bowel disease. *Artmed. Harrison's principles of internal medicine*. 19th ed. New York: McGraw-Hill Education; 2015. p. 7870–927.
- Santos CH, Menezes JN, Nunes TF, Martins LA. CT enterography in the evaluation of Crohn's disease. *J Coloproctol*. 2015;35:217–22.
- Foundation. Crohn's Colitis & Cancer International Research. "Statistics". Available from <http://c3rf.org/statistics> [accessed 30.07.16].
- Molodecky NA, Soon IS, Rabi DM, Ghali WA, Ferris M, Chernoff G, et al. Increasing incidence and prevalence of the inflammatory bowel diseases with time based on systematic review. *Gastroenterology*. 2012;142:46–54.
- Farmer RG, Hawk WA, Turnbull RB. Clinical patterns in Crohn's disease: a statistical study of 615 cases. *Gastroenterology*. 1975;68 Pt 1:627–35.
- Lago P, Cerqueira RM. Factores Clínicos Preditivos de Complicações na Doença de Crohn. *Acta Med Port*. 2011;24(S4):1057–62.
- Sands BE, Siegel CA. Crohn's disease. In: *Gastrointestinal and liver disease: pathophysiology/diagnosis/management*. 9th ed. Philadelphia: Elsevier/Saunders; 2010. p. 1941–74.
- Walsh AJ, Buchel OC, Collier J, Travis SPL. *Oxford case histories in gastroenterology and hepatology*. New York: Oxford; 2010. p. 110–7.
- Mackner LM, Bickmeier RM, Crandall WV. Academic achievement, attendance, and school-related quality of life in pediatric inflammatory bowel disease. *J Dev Behav Pediatr*. 2012;33:106–11.
- The role of endoscopy in inflammatory bowel disease – guideline. *Am Soc Gastrointest Endosc*. 2015;81:1101–5.
- Cakmakci E, Erturk SM, Cakmarkci S, Bayram A, Tokgoz S, Caliskan KC, et al. Comparison of the results of computerized tomographic and diffusion-weighted magnetic resonance imaging techniques in inflammatory bowel diseases. *Quant Imaging Med Surg*. 2013;3:327–33.
- Neumann H. Endoscopic findings in Crohn's disease. *Video J Encycloped GI Endosc*. 2012;1:328–9.
- Horsthuis K, Stokkers PC, Stoker J. Detection of inflammatory bowel disease: diagnostic performance of cross-sectional imaging modalities. *Abdom Imaging*. 2008;33:407–16.
- Paulsen SR, Huprich J, Fletcher JG, Booya F, Young BM, Fidler JL, et al. CT enterography as a diagnostic tool in evaluating small bowel disorders: review of clinical experience with over 700 cases. *Radiographics*. 2006;26:641–62.
- Costa-Silva L, Martins T, Passos MC. Enterografia por tomografia computadorizada: experiência inicial na avaliação das doenças do intestino delgado. *Colégio Brasileiro de Radiologia e Diagnóstico por Imagem*. 2010;43:303–8.
- Hara AK, Leighton JA, Heigh RI, Sharma VK, Silva AC, De Petris G, et al. Crohn disease of the small bowel: preliminary comparison among CT enterography, capsule endoscopy, small-bowel follow-through and ileoscopy. *Radiology*. 2006;238:128–34.
- Ramalho M, Herédia V, Cardoso C, Matos AP, Palas J, De Freitas J, et al. Magnetic resonance imaging of small bowel Crohn's disease. *Ata Méd Portug*. 2012;25:231–40.
- Ohtsuka K, Takenaka K, Kitazume Y, Fujii T, Matsuoka K, Kimura M, et al. Magnetic resonance enterography for the evaluation of deep small intestine in Crohn's disease. *Int Res*. 2016;14:120–6.
- Aryan A, Azizi Z, Teimouri A, Daryani NE, Aletaha N, Jahanbakhsh A, et al. The diagnostic role of magnetic resonance enterography as a complementary test to colonoscopy in active Crohn's disease. *Middle East J Dig Dis*. 2016;8:93–101.
- Greer ML. How we do it: MR enterography. *Pediatr Radiol*. 2016;46:818–28.
- Horsthuis K, Bipat S, Bennink RJ, Stoker J. Inflammatory bowel disease diagnosed with US, MR, scintigraphy, and CT: meta-analysis of prospective studies. *Radiology*. 2008;247:64–79.