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EDITORIAL

Small bowel imaging of inflammatory bowel disease

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Abstract

The study of the small bowel (SB) has always been challenging both for clinicians and radiologist. It is a long and tortuous tube that can be affected by various pathologies whose signs and symptoms are usually non specific and can mimic other acute abdominal disorders. For these reasons, imaging plays a central role in the diagnosis of the different pathological conditions that can occur. They are important also in the management and follow up of chronic diseases. We expose and evaluate all the radiological methods that are now available for the study of the SB with particular emphasis on the technological improvement of cross-sectional imaging, such as computed tomography (CT) and magnetic resonance imaging (MRI). These techniques have, infact, highly improved in terms of execution times (fast acquisitions images), patients discomfort and radiation dose, for CT, with consequent reduced biological risks. Moreover, the new post-processing options with multiplanar reconstruction and isotropic images have made significant changes in the evaluation of the exams. Especially MRI scans have been improved by the advent of new sequences, such as diffusion weighted imaging and cine-MRI, parallel imaging and breath-hold sequences and can provide excellent soft-tissue contrast without the use of ionizing radiations.

Key words: Small bowel imaging; Magnetic resonance; Cross-sectional imaging; Computed tomography; Positron emission tomography-computed tomography

Core tip: The small bowel (SB) has always been a challenging organ for clinical and radiologic evaluation. The purpose of our article is to evaluate all the imaging methods now available for the study of the SB with particular emphasis on the technological improvement of cross-sectional imaging.

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INTRODUCTION

Radiological studies of the small bowel were firstly performed at the beginning of this century by Morse and Cole[1] in 1927 and Pesquera[2] in 1929. From then until the early 2000s, barium contrast studies have been the only imaging methods to study the small bowel. In the last decade, a tremendous technological improvement of cross-sectional imaging [Ultrasound (US), computed tomography (CT), and magnetic resonance imaging (MRI)] have occurred. US scanners have significantly improved, now allowing a good visualization of the small bowel loops. Both CT and MRI scanners have become very fast (short execution times and less discomfort for the patients) and can create multiplanar reconstruction and isotropic images, the former with less radiation dose and the latter in the lack of ionizing radiations, particularly important in young patients who need periodic imaging examinations. Especially MRI scans have been improved by the advent of new sequences, such as diffusion weighted (DWI) and cine-MRI, parallel imaging and breath-hold sequences and can provide excellent soft-tissue contrast.

A complete exam requires the use of both intravenous and endoluminal contrast. The latter is necessary to obtain a good distension of the bowel loops and can be administered orally (MRI-Enterography) or through a nasojejunal tube (MRI-Enteroclysis). The MRI-Enterography is more comfortable for the patient but the MRI-Enteroclysis provides a better bowel distension, especially of the proximal loops, and, for this reason, is always the method of choice in patients with suspected jejunal lesions or recurrent intestinal subocclusion. Finally, since 2001, wireless capsule endoscopy has been introduced as another non-invasive technique for the evaluation of the entire small bowel, in which traditional endoscopy had severe limits[3]. Despite the important diagnostic innovation, the impossibility to perform therapeutic interventions is a high limit and, for this reason new endoscopic method were proposed in the subsequent years, such as Double-balloon endoscopy, in 2003, Single-balloon enteroscopy in 2007 and spiral enteroscopy in 2008[3].

Alternatively, also scintigraphy and positron emission tomography/computed tomography (PET/CT) has been reported, in several studies[4-6], as valid and non-invasive method to diagnose and assess disease activity in IBD. Regarding Scintigraphy, various biomarkers of inflammation, used to label white blood cells, such as technetium-99m hexamethylpropylene amine oxime (Tc-99m HMPAO WBC), pentavalent Tc-99m dimercaptosuccinic acid [Tc-99m (V) DMSA] and fluorine-18 fluorodeoxyglucose (18F-FDG), are widely accepted as accurate for the diagnosis of IBD[4]. Studies on ^{18}F-FDG PET/CT showed a significant correlation between the ^{18}F-FDG uptake PET-CT and the Crohn's disease endoscopy index of severity especially in segments with moderate to severe lesions. Moreover, ^{18}F-FDG PET may potentially provide information on the dynamic inflammatory changes occurring in inflammatory bowel disease (IBD), particularly Crohn's disease, being useful not only in the diagnosis but also in the follow up of the disease[5,6].

Thanks to these technical improvements in imaging, the cross-sectional techniques are replacing barium exams in the study of the small intestine, especially in IBD, both in adult and pediatric patients.

The "Porto criteria" recommend small-bowel follow-through (SBFT) as the imaging modality of choice in children[7]. However, SBFT requires high radiation dose with associated risks and, when possible, should be replaced by alternative techniques, such as low-dose CT or MRI[8-10], whose high accuracy is stated in the European Crohn's and Colitis Organization (ECCO) guidelines[10]. Particularly, ECCO guidelines, in the pediatric section[11,12], report dynamic contrast-enhanced MRI as the best imaging method to study CD's lesions. Also the Appropriateness Criteria of the American College of Radiology[13] confirm the high sensitivity and specificity of MRI (enterography or enteroclysis) in pediatric patients, similar to that of CT enterography but without the use of ionizing radiation.

However, many questions remain unsolved. First of all, it is important to determine whether these non-invasive imaging techniques can replace endoscopy in the evaluation of the mucosal healing. In a recent study, MRE has shown an accuracy of 90% and 84% in determining ulcer healing and endoscopic remission, respectively[14], but these data need to be confirmed.

In the last years, the eradication of bowel inflammation at the level of all wall layers has been suggested as a goal of treatment more appropriate than the mucosal healing alone that seems to be too superficial.

Compared to endoscopy, cross sectional imaging, especially MRI, can provide information on the entire bowel wall. However, transmural healing has not yet been studied as the primary therapeutic endpoint in CD patients, unlike the mucosal healing that is becoming more and more a therapeutic goal[15].

Preliminary studies have reported encouraging results on the diagnostic accuracy of DWI sequence in patients with IBD so that it can be considered, in the future, as an alternative to contrast-enhanced sequences[16,17].

Future studies should also consider the interobserver variability due to the different experience of radiologists in evaluating DWI images and standard MRI images.

Another concrete future possibility for the diagnosis and management of IBD is represented by the new hybrid imaging modalities, such as PET/CT and PET/MRI, which combine the morphological CT or MRI images with the functional PET information in a single diagnostic investigation. CT enterography combined

with the ^{18}F-FDG PET exam seems to be particularly promising[18].

Groshar *et al*[19] reported a good accuracy of PET/CT in the differential diagnosis between acute and chronic inflammation. Infact, they found an important relation between the maximum standardized uptake value [SUV(max)] and the mural CT patterns, such as submucosal edema or fat, expression of active and chronic inflammation, respectively. However, a high number of false positive results have been registered due to the physiologic ^{18}F-FDG uptake by the bowel wall[20,21]. Another important limitation is the high cumulative radiation dose required for the PET/CT exam, particularly because the IBD patients require numerous and repeated examinations[18].

Finally, no articles have been published on the use of PET/MRI in the diagnosis and follow up of IBD, even though this combined use of nuclear medicine and MRI, providing information on molecular and morphological events without the use of ionizing radiations, could change the future diagnostic approach. Infact, they seem to have high potential and can count on the advent of new MRI techniques, such as DWI and Spectroscopy, and new radiopharmaceuticals to label cells, such as radionuclides, fluorescent or bioluminescent markers (optical imaging) and MRI contrast agents (molecular MRI)[22]. A great hope is placed in this imaging investigation which could effectively help in the diagnosis and follow up of IBD providing information on involved inflammatory cells and cytokines.

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