Small Bowel Imaging

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Introduction

The mesenteric small intestine is a difficult organ to examine. Long-term experience has shown that there are no shortcuts to achieving a reliable examination, and several parameters need to be respected if a confident diagnosis is to be made. These include: selection of patients, closely supervised studies, background data, image quality, familiarity with imaging findings and utilization of radiologic-pathologic correlations.

Thoughtful selection of patients by clinicians is essential to make radiologic examination cost-effective. Closed supervised studies, incorporating an adequate index of clinical suspicion, co-operation between a focused radiologist and a keen physician, expertise, and time are important. Familiarity with imaging findings and image quality, are necessary to guarantee demonstration of fine surface mucosal detail and transitional morphological changes. Applying the principles of radiologic-pathologic correlation to the interpretation of radiological findings offers a certain advantage and in association with the background data available, including localization and distribution of changes, extent of involvement, the solitary or multiple nature of the lesions present and the clinical history, enable a confident differential diagnosis.

Based on its long-term follow-up results and its high negative predictive value, enteroclysis has been shown as a most reliable screening examination for the assessment of possible small bowel disease.

Enteroclysis combined with computed tomography (CT) offers the advantages of both techniques. Distention of small bowel lumen and cross-sectional display are proven imaging qualities gained with CT enteroclysis. Available prospective data suggest that the technique is advisable in patients with obstructive symptoms, in patients with known or suspected malignancy and when assessing complications of small bowel Crohn’s disease.

Magnetic resonance enteroclysis (MRE), a combined functional and morphological imaging method, has only recently been performed routinely in clinical practice with adequate image quality and sufficient small bowel distention (Fig. 1). Thus far, results have shown that the functional information provided by MRE equals that of enteroclysis alone, whereas the inherent advantages of an MR imaging approach over enteroclysis include detection of extra-luminal pathologic conditions, and detailed morphological evaluation of the bowel wall, as well as of the entire abdomen. Moreover, MRE has a distinct advantage over the currently available CT enteroclysis technique, due to its ability to provide real-time functional information.

Clinical entities that may require radiological investigation of the small intestine most frequently include Crohn’s disease, small bowel neoplasms and Meckel’s diverticulum.

Fig. 1. Coronal true FISP section demonstrating small bowel at its entire length. The use of an iso-osmotic water solution as an intraluminal contrast agent resulted in homogeneous opacification of the bowel lumen. Note the increased conspicuity of the normal bowel wall due to the high resolution capabilities and total absence of motion.
Crohn’s Disease

The most characteristic features of Crohn’s disease of the small intestine are the variety of its radiological appearances and the multiplicity of radiological features often present in the majority of patients. Categorization of these radiological features has been defined in terms of stenotic and non-stenotic forms, active and chronic, early and late or advanced, or into superficial, transmural and extramural changes.

Most information on the sequence of progression of the pathological lesions in Crohn’s disease is derived from radiological descriptions. The early lesions of Crohn’s disease are: blunting, flattening, thickening, distortion and straightening of the valvulae conniventes. These changes are followed by discrete ulcers and by longitudinal and transverse ulcers. The stenotic phase eventually develops and the involved segment is transformed into a rigid, cast-like tube; fistulae may be seen at this stage. Deep ulcers precede sinuses and fistulae to other organs.

Discrete ulcers are seen as small collections of barium with surrounding radiolucent margins. Fissure ulcers are seen in profile and may penetrate deep into the thickened intestinal wall; small abscess cavities are occasionally seen at the base of deep fissure ulcers. Longitudinal ulcers running along the mesenteric border of the ileum are a characteristic feature of Crohn’s disease, although they are only occasionally present. Cobblestoning is caused mostly by a combination of longitudinal and traverse ulceration. Discontinuous involvement of the intestinal wall shows either as skip lesions or asymmetry. Asymmetrical involvement of the intestinal wall produces the characteristic “pseudodiverticulae” appearance. The pseudodiverticulae represent small patches of normal intestine in an otherwise severely involved segment. The involved segment contracts and the normal areas become pseudodiverticula. Inflammatory polyps (pseudopolyps) are occasionally seen in Crohn’s disease and are seen as small discrete filling defects in a severely involved segment.

Cross-sectional imaging modalities offer an important complementary diagnostic perspective in patients with Crohn’s disease, due to their ability to directly image the intestinal wall and surrounding mesentery and therefore to determine the extramucosal extent and spread of the disease process.

CT is being performed with increasing frequency and has been shown to be extremely valuable in documenting mesenteric disease, including fibrofatty proliferation, abscess or phlegmon formation, microadenopathy and in adequately evaluating perirectal and/or perianal extension of Crohn’s disease. It has also been suggested that CT is the most sensitive means of demonstrating an enterovesical fistula. In addition, the ability of CT to simultaneously evaluate extraintestinal organs may allow the detection of concurrent hepatobiliary, urinary or musculoskeletal complications, that may well lead to significant changes in the management of the individual patient.

MRE is emerging as a valuable technique for the evaluation of small bowel in patients with Crohn’s disease. Administration of 1.5-2 liters of iso-osmotic water solution through a nasojugal catheter ensures bowel distention and facilitates identification of bowel wall abnormalities. True fast imaging steady-state free precession (FISP), half-acquisition Fourier-transformed single shot turbo spin echo (HASTE) and post-gadolinium T1-weighted 3D FLASH sequences can be employed in a comprehensive and integrated MRE examination protocol. The characteristic transmural lesions of Crohn’s disease, such as bowel wall thickening, linear and fissure ulcers, and cobblestoning are accurately depicted by MRE, especially when using true FISP sequence (Fig. 2, 3). MRE is of equal value with conventional enteroclysis in assessing the number and extent of involved small bowel segments and in disclosing lumen narrowing and/or prestenotic dilatation. MRE has a clear advantage over conventional enteroclysis in demonstrating extramural manifestations and/or complications of Crohn’s disease, including fibrofatty proliferation, mesenteric lymphadenopathy, sinus tracts and fistulae or abscesses. Disease activity may be accurately appreciated by contrast-enhanced 3D FLASH images, by gadolinium uptake in the wall of the involved seg-

Fig. 2. A 23-year-old female patient with active Crohn’s disease (CDAI = 196). Coronal true FISP spot view demonstrates a distal ileum transmural involvement with a fissure ulcer (arrow). Increased mesenteric vascularity and fibrofatty proliferation is also noted.