Noninflammatory Conditions of the Small Bowel

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KEYWORDS

• Magnetic resonance imaging • Small bowel • Neoplasm • Enteroclysis • Enterography
• Obstruction

KEY POINTS

- Magnetic resonance (MR) enteroclysis provides adequate distension of the entire small bowel and can exclude small-bowel disease reliably.
- MR enteroclysis is an effective diagnostic technique in patients suspected of having small-bowel neoplasms.
- MR enteroclysis may also be used to distinguish neoplasms from inflammatory diseases.
- Small polypoid masses that do not cause an obstruction may be difficult to detect using MR enterography.
- Intraintestinal and extraintestinal features detected with MR imaging may be helpful in establishing a diagnosis of celiac disease and in clarifying the causes of nonspecific gastrointestinal symptoms in patients with previously undiagnosed celiac disease.

INTRODUCTION

Tumors of the small bowel are infrequent, accounting for about 3% to 6% of all gastrointestinal (GI) neoplasms. Diagnosis is not easy, owing to the nonspecific symptoms and because the mesenteric small bowel is traditionally the most difficult portion of the GI tract to investigate.

Most tumors are not determined by obstruction, and very often manifest with obscure GI bleeding, anemia, and abdominal pain. In the case of neuroendocrine tumors, the clinical manifestation depends on the hormones produced by the tumors.

Conventional enteroclysis and capsule endoscopy are the procedures most commonly used to visualize mucosal abnormalities, but are limited in the evaluation of mural and extramural extent of small-bowel tumors.[1,2] Therefore, radiologists assume a major role in the detection of small-bowel tumors. However, inadequate radiologic studies may cause incorrect interpretation of radiologic findings, leading to crucial delay in diagnosing primary malignancies of the small intestine.

Magnetic resonance (MR) imaging has a leading role in the diagnosis not only of tumors but also of many diseases of the small intestine. The lack of ionizing radiation, the possibility of combining the morphologic information of cross-sectional imaging with functional information, the excellent soft-tissue contrast, and a relatively safe intravenous contrast agent profile make MR imaging the method of choice for the study of the small intestine. Moreover, the opportunity of studying surrounding structures (eg, for detection of any metastases in the liver) make MR imaging an excellent method not only for diagnosis but also for staging and prognosis. The intraluminal and extraluminal MR findings, combined with contrast enhancement and functional information, help to make an accurate diagnosis and, consequently, characterize small-bowel neoplasms.

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Celiac disease is characterized by malabsorption of the intestine, which develops as a result of gluten and/or gluten-related protein intake. MR imaging provides morphologic information obtained noninvasively, such as fold pattern abnormalities and bowel dilatation, as well as extraintestinal findings such as mesenteric vascular congestion, lymphadenopathy, hyposplenism, and intussusception.

This article describes MR findings of primary small-bowel neoplasms and celiac disease, and discusses MR findings for the differential diagnosis.

TECHNICAL CONSIDERATIONS

Contrast Agents

A substance to be considered a good enteral agent should guarantee uniform and homogeneous opacification, adequate distension of small-bowel lumen, high contrast between the lumen and the small bowel, low cost, and the absence of serious adverse side effects.

A several number of enteral agents have been proposed for use in MR imaging of the small bowel. All of these substances are classified according to the intensity produced: positive, negative, or biphasic contrast enteral agents.

Positive contrast enteral agents have high signal intensity on T1-weighted images; gadolinium chelates,[3] manganese ions,[4] ferrous ions,[5] and foods such as blueberry juice[6] belong to this group. Using these contrast agents it is possible to show wall thickening on T1-weighted images; their limitation is the detection of more subtle mucosal or wall hyperenhancement after the intravenous injection of gadolinium-based contrast material.

Negative contrast enteral agents have low signal intensity on T2-weighted images. These agents constitute solutions with superparamagnetic iron oxides (SPIOs), including nanoparticles of maghemite in bentonite matrix, and ultrasmall SPIOs (USPIOs).[7] On T2-weighted images, the inflammation in the bowel wall is much more pronounced because negative contrast agents reduce the signal intensity of the bowel lumen.

However, the low signal intensity of intraluminal contrast on T2-weighted images and the associated susceptibility effects may reduce the conspicuity of the normal small-bowel wall and of low–signal-intensity lesions, such as carcinoid tumors, as well as of intraluminal abnormalities.

For suspected small-bowel neoplasms it is recommended to use biphasic agents, such as water, Volumen, sorbitol, and polyethylene glycol (PEG), which produce low signal intensity on T1-weighted images and high signal intensity on T2-weighted images. These agents provide conspicuous distinction between the bowel wall and the lumen, both on T2-weighted images (eg, by enabling the detection of mural ulcers, which could otherwise be missed, being darkened if a negative—hypointense—contrast agent is used) and on T1-weighted postgadolinium images (eg, by increasing the conspicuity of hyperenhancing masses).

On T1-weighted images, the contrast between the bowel lumen and masses after intravenous administration of contrast material is increased. The high contrast between the lumen and the dark bowel wall on T2-weighted images improves the detection of endoluminal abnormalities and more effectively highlights transmural ulcers.[8,9]

The role of gadolinium chelates for the detection of small-bowel tumors has yet to be clearly defined. The accuracy of a nonenhanced MR protocol designed for detection of small-intestinal neoplasms was recently found to be similar to that of a protocol that included contrast enhancement.[2,10]

Gadolinium-enhanced fat-saturated T1-weighted pulse sequences help to characterize small-bowel tumors because of their enhancement pattern, and to stage neoplasms by evaluating the presence of liver and mesenteric metastasis.[9,11,12] Moreover, the use of gadolinium-enhanced T1-weighted sequences allows the characterization of malignant versus benign strictures in small-bowel obstruction.[13]

Contrast-enhanced sequences help to differentiate inflammatory from noninflammatory diseases, thereby increasing diagnostic accuracy. Dynamic contrast-enhanced MR imaging of the small bowel may be useful in evaluating and identifying bowel-wall inflammation in patients with celiac disease.

The use of gadolinium is highly discouraged in pregnant patients and in patients with renal failure, as it increases the risk of developing nephrogenic systemic fibrosis.

MR Techniques: Enterography and Enteroclysis

The first step in the evaluation of the small intestine is to achieve a good distension of the small bowels. This distension is critical because collapsed bowel loops may hide lesions or mimic disease by mistakenly suggesting that the collapsed segments are actually an abnormality-related thickened bowel wall.[14]

At present there are 2 basic methods to obtain distension of the small bowel, namely MR enteroclysis and MR enterography; the first is obtained by infusion of the contrast material through a nasojejunal tube, the second by oral administration of contrast material.[15,16]