

# A combination of small bowel imaging methods: conventional enteroclysis with complementary magnetic resonance enteroclysis

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## KEYWORDS

Enteroclysis; MR enteroclysis; Intestines; Diseases

**AIM:** The aim of this prospective study was to evaluate the overall findings of conventional enteroclysis (CE) with complementary magnetic resonance enteroclysis (MRE) in small bowel disease.

**METHODS:** The study included 32 patients referred from various clinical departments, with known or suspected small bowel disease and abnormalities on CE. Immediately after CE, true fast imaging with steady-state precession (true FISP), and unenhanced and gadolinium-enhanced T1-weighted fast low-angle shot (FLASH) sequences with fat saturation were obtained. Mucosal, mural and luminal changes of the small bowel were evaluated by each technique. In addition, bowel wall thickening, bowel wall enhancement and perienteric changes were assessed by MRE. The radiological findings obtained were evaluated together as a combination, and the role of MRE in the determination of the activity and complications of the small bowel disease was assessed. Radiological findings were correlated with clinical evaluation and follow-up in all cases, including endoscopy in 14 cases and surgery in 5 cases.

**RESULTS:** MRE provided important supplementary mural and extramural information, including degree of pathological wall thickness, mural enhancement pattern associated with disease activity, perivisceral collection, abscess formation, mesenteric fibrofatty proliferation, lymphadenopathy and increase in perienteric vascularity. Short strictures were not revealed on MRE; however, for patients with a history of abdominal malignancy, MRE helped characterize the level of any obstruction and the extent of the disease.

**CONCLUSION:** We recommend MRE for patients who have findings of advanced inflammatory bowel disease or neoplasm on CE examination. The combination of these two techniques can provide important information on the degree and extent of the disorder.

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## Introduction

In recent years, there have been important developments in endoscopic techniques of small bowel

examination. Despite the development of capsule endoscopy,<sup>1,2</sup> radiography is still important in the diagnosis of small bowel diseases. Although conventional small bowel follow-through is widely used, its diagnostic capability is limited. Conventional enteroclysis (CE), is the gold standard method for the evaluation of mucosal abnormalities, morphological changes in valvulae conniventes, luminal abnormalities, functional abnormalities,<sup>3</sup> the bowel wall and perienteric

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structures. Cross-sectional imaging can help to assess additional mural abnormalities and to determine extraluminal extension of disease.<sup>4,5</sup>

MRI has multiplanar imaging capacity, excellent soft-tissue contrast and lack of radiation exposure. Taking into account the improvement of the breath-hold and fast imaging sequences, MRI could become the optimal imaging method in the evaluation of small bowel diseases.<sup>6</sup>

In this prospective study, CE was immediately followed by MRE. The aim of the study was to assess the diagnostic value of this combination of tests in small bowel disease.

## Material and methods

From September 2002 to August 2003, 32 patients who had been referred with clinical evidence of known or suspected small bowel disease, and who had abnormal CE findings, were enrolled in the study. Informed consent was obtained from all the group; 16 were female and 16 were male, and subjects were aged between 14 and 62 years (mean age 34 years). Symptoms ranged from non-specific abdominal pain and distension to frequent vomiting, diarrhoea and weight loss.

CE was performed according to the standard technique described by Herlinger.<sup>7</sup> Using a 12F catheter (EZEM, Westbury, USA), transnasal intubation was carried out under fluoroscopy. The tip of the catheter was positioned distal to the ligament of Treitz, and 200 to 250 ml 70% barium suspension was infused with a pump at 75 to 175 ml/min, followed by 1500 to 2000 ml 0.5% methylcellulose at 200 to 250 ml/min.

Immediately after completion of CE, the participants were transferred to the MRI unit, and 20 mg hyoscinebutylbromide (Buscopan, Boehringer, Ingelheim, Germany) was administered intravenously (IV) to reduce small bowel peristalsis and prolong distension. Subjects were imaged in the prone position and a phased-array body coil was used. All examinations were performed on a 1.5 T MR machine (Magnetom, Siemens, Erlangen, Germany) (field of view 450×450 mm, matrix 220×226). Standard T1-weighted FLASH (TR: 1.42 ms, TE: 2.72 ms), true FISP (TR: 4.5 to 5 ms, TE: 1.6 to 3.8 ms) and gadolinium-enhanced (0.1 mmol/kg body weight) T1-weighted FLASH with fat saturation sequences were acquired using the breath-hold technique. MR images were obtained in axial and coronal planes with slice thickness 4 mm. The mean duration of MRE was less than 10 min.

Two experienced gastrointestinal radiologists (U.K. and G.O) independently evaluated and recorded CE and MRE examinations, respectively. Both radiologists were aware of the subject's clinical presentation, blood test results and past medical history. Finally, the combined CE and MRE findings were reassessed by both radiologists, and a final diagnosis was achieved by consensus.

On CE, mucosal abnormalities (ulcers, ulceronodular pattern, filling defects); morphological changes (fold thickening, adhesion, scalloping, intussusception); luminal abnormalities (stricture, dilatation); functional abnormalities; bowel wall and perienteric abnormalities (sinus tracts, fistula, mesenteric rigidity); were evaluated.

On MRE, mucosal, mural and luminal changes of the small bowel, location of abnormal bowel segments, evidence of extraluminal changes such as fistula, abscess, perienteric fatty proliferation, lymphadenopathy and intraperitoneal fluid, were assessed. A bowel segment was deemed to be abnormal if the wall thickness was greater than 3 mm or showed increased enhancement after IV administration of gadolinium. Abnormal enhancement was defined as increased signal intensity on gadolinium-enhanced T1-weighted FLASH sequence compared with adjacent loops. In addition, the pattern of enhancement was examined; diffuse enhancement was recorded when the bowel wall enhanced uniformly. A layered enhancement pattern was characterized by intense enhancement of the submucosa and serosa, with lesser enhancement of the muscular layer in between.<sup>8</sup>

Lymph node enlargement was defined as nodes with a short-axis diameter greater than 5 mm in the mesentery, or greater than 1 cm in the retroperitoneum. Any intraperitoneal fluid was deemed abnormal.

Bowel obstruction was diagnosed by both techniques if there was prestenotic dilatation and poststenotic normal or collapsed bowel lumen. Moderate prestenotic distension (<3 cm) with no distal collapsed bowel segment was considered low-grade partial obstruction; distension greater than 3 cm in the prestenotic segment, with a collapsed distal bowel segment, was considered high-grade obstruction.

Crohn's disease was staged by CE according to the degree and anatomical extent of the disease.<sup>9</sup> Stage 1 included early lesions, fold thickening, aphthous ulcerations and abnormality (granularity) of the villi. Stage 2 included intermediate lesions, nodular pattern, ulcerations (usually linear), mesenteric border rigidity with scalloping of the antimesenteric border and moderately thickened bowel wall. Stage 3 included advanced lesions,

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