MR enterography performed as part of the investigation of non-specific abdominal symptoms

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Aims and objectives

The methods of imaging the small bowel continue to develop. Previously, small-bowel follow-through and barium enteroclysis had been used extensively to review abnormality of the small bowel (1) but more recently, CT or MR enteroclysis and MR enterography have been used as cross-sectional methods of demonstrating pathology, in particular Crohn's disease (Figure 1)(2-16). MRI seems to be developing as the preferred method of small bowel imaging, particularly in the paediatric population (17-22) as it does not require ionising radiation.

There is a growing role for MR enterography in the imaging for other conditions such as Peutz-Jeghers syndrome, inflammatory conditions such as vasculitis and treatment induced enteritis, infectious processes, coeliac disease, systemic sclerosis, bowel duplication and small bowel dilatation (23-28).

At our institution the preferred method of imaging of the small bowel is by MR enterography whereby a large volume of contrast is given orally prior to the examination. This has the advantage of being non-invasive, well tolerated (29), relatively quick when compared to enteroclysis, and lacks the use of ionising radiation.

A significant number of patients are imaged for the staging and diagnosis of Crohn's disease. However, a large number of other diagnoses are being detected during the investigation of non-specific abdominal symptoms by MR enterography. An audit was undertaken to review the utilisation of MR enterography in patients without an established diagnosis and presenting with non-specific abdominal complaints.
Images for this section:

**Fig. 1:** LAVA sagittal (a) and axial (b) sequences following gadolinium contrast from a 28 year old man with recurrent right iliac fossa pain and vomiting. Terminal ileum mural thickening with mucosal hyperenhancement (white arrows) and fat stranding of the subtending mesentery (red arrows) is demonstrated.

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Methods and materials

The Broadway Radiology Central MRI database was reviewed for 2011/12 and a list of the MR enterography examinations performed during this period was obtained. Examinations were then excluded if they were repeated examinations for follow up or performed as part of staging of known disease. The aim was to obtain only examinations performed as part of investigation of undifferentiated cases. The examination reports and case noted were then retrospectively reviewed to obtain patient demographic details and to review the period preceding the MR examination and the following twelve months.

All examinations were performed on a single 1.5T GE SignaHDxt scanner utilising a body surface coil with standard sequences: coronal and axial 2D FIESTA; and gadolinium contrast enhanced axial, coronal, and sagittal LAVA. Standard oral preparation was 1350ml Volumen with 1tsp Methylcellulose, given as a split dose 60 minutes and 20 minutes prior to the examination. An antispasmodic was routinely administered intravenously, usually 10mg Buscopan prior and a further 10mg Buscopan at the administration of gadolinium contrast (15ml Omniscan). Buscopan was substituted with Glucagon when Buscopan was contraindicated.
Results

Two-hundred and eighteen MR enterography studies were undertaken during 2011/12. 127 were excluded on the basis that they were staging examinations for an established diagnosis or repeated examinations. A total of 91 MR enterography examinations were reviewed however no clinical information could be obtained for 8 patients leaving 83; 54 of the patients were female and 29 were male. The median age was 31 years (5 - 98 years) (Figure 2). 78.3% of patients complained of abdominal pain and 45.8% diarrhoea. 41.0% complained of nausea with 24.1% vomiting. Much less frequent were the symptoms of constipation (7.2%); haematochezia (9.6%); anorexia (3.6%); and fatigue (3.6%). Clinical signs included abdominal tenderness (47%); peritonism (3.6%); and fever (8.4%). Physician documented anaemia was reported in 7.2% patients and a perianal fistula described in 3.6% patients.

Of those examined, 53 had undergone prior abdominal radiography, 30 prior chest radiography, 16 previous ultrasound of the abdomen or pelvis, and 16 previous CT examination.

Full MR examination was not tolerated by 3 patients; one refused oral contrast and two were unable to remain in the scanner for the required period. The remaining 80 patients tolerated the full examination; but this assumes that if no comment was made in the radiologist report then the procedure was fully tolerated. Oral preparation volume ranged from 400 ml - 1350 ml. The volume was not reported for 11 patients and 1 patient refused oral preparation. No patients required sedation.

The examination was deemed inadequate in 8 cases but the remaining 77 reported no inadequacy.

A radiologic diagnosis was obtained in 30 patients and 58 were reported as having no acute abnormality or an incidental abnormality not thought to be linked to the patients' presentation.

The MR diagnoses are detailed in Figure 3 and other diagnoses described are shown in Table 1.

Eight patients were diagnosed with radiologic Crohn's disease; their final diagnoses: 4 Crohn's disease, 1 an inflammatory bowel condition, 1 post infectious irritable bowel syndrome, 1 irritable bowel syndrome, and 1 an internal hernia.

Two patients were diagnosed with appendicitis on MR examination, 1 was confirmed at surgery and 1 was given a presumed diagnosis of mesenteric adenitis following appendicectomy and pathological analysis showing a normal appendix.
The remaining 15 patient diagnoses are shown in table 1. An appropriate diagnosis was made for 13 of these patients. One patient diagnosed with constipation was later shown to have Crohn's disease and one with pelvic inflammatory disease was later discovered to have endometriosis.

Fifty-eight patients had no acute abnormality on MR examination, the final diagnoses on follow up included 33 nonspecific abdominal pain, 6 irritable bowel syndrome, 4 gastroenteritis, 2 duodenitis / gastritis, 2 delayed colonic transit, 2 Crohn's disease, 1 adhesions, 1 ovarian cyst rupture, 1 cholecystolithiasis, 1 endometriosis, and 1 delayed gastric emptying.
Fig. 2: Patients examined using MR enterography by age

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Table 1: List of other diagnoses discovered during MR enterography

- Bowel Ischaemia - possible volvulus
- Constipation
- Gallstones
- Lymphadenopathy of uncertain cause
- Small bowel tumour
- Diverticular disease
- Perianal fistula
- Possible delayed gastric emptying
- Recurrent intussusception
- Pelvis mass
- Pelvic inflammatory disease
Fig. 3: Radiologist diagnosis based on MR enterography findings

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Conclusion

During the years 2011-12 two hundred and eighteen MR enterography examinations were undertaken at Central MRI, Palmerston North. We have presented 83 undifferentiated cases undergoing MR enterography over a two year period with a reasonable follow up period to determine whether the diagnosis arrived at as a result of imaging was accurate. This has shown that a radiologic diagnosis was provided for 30 patients and of these 22 (73.3%) were subsequently shown to be correct. 53 examinations were reported as normal and of these 47 (88.7%) had no subsequent abnormality discovered. These figures roughly translate to the positive and negative predictive value of MR enterography at our institution. However, this relies upon the 12 month clinical follow up and assumes that patients that have been discharged go on to have no further problems and that they are not investigated elsewhere. Longer term follow up may also discover a subsequent diagnosis. The sensitivity and specificity of MR enterography cannot be accurately assessed. A spectrum of diagnoses can be made using this technique and what constitutes a positive or negative test is not clear, nor is an available gold standard against which to compare the variety of diagnoses. We have shown that the examination is well tolerated (96.4%) and an adequate examination was performed for 92.8% of the patients. No comment was made about the adequacy of the examination in 73 (88.0%) of the reports. A clinician's assessment of the reliability of the examination may be aided by a comment upon the examinations' adequacy. Large segments of small bowel that are contracted during the entire examination or where inadequate volumes of oral preparation (not reported in 13%) can lead to limited assessment of the small bowel. A comment upon this within the report may give the resultant radiologist's diagnosis a level of confidence upon which the clinicians may decide to perform further tests to confirm or dispute the diagnosis. The median age of the patients examined was 31 years and this likely reflects an appreciation of the absence of ionising radiation in this examination technique. 16 patients had undergone previous CT imaging. Interestingly, 5 had no abnormality described on this examination and on MR enterography no subsequent pathology was demonstrated. There are a number of limitations of this audit. It is retrospective and relies solely upon clinical follow up to determine patient diagnosis. Eight patients could not be followed due to absence of clinical records or follow up. The clinical notes, imaging reports, and determination of whether the diagnosis on MR enterography correlated with the final diagnosis was made by a single observer (DH). The follow up period does not allow for late diagnosis which may reduce the negative predictive value of the examination. No gold standard could be used for this heterogeneous group of patients against which to compare the index test.

Summary

At our institution, MR enterography is a well-tolerated examination (96.4%) with a reasonable positive predictive value (73.3%) and good negative predictive value (88.7%)
when investigating patients with undifferentiated abdominal symptoms. Its current use appears appropriate and it could be considered earlier in patient investigation and especially in younger patients where the use of ionising radiation may be detrimental. A small number (5 patients) had undergone CT imaging which demonstrated no abnormality and MR enterography provided no additional diagnostic information.

**Recommendations**

- Encourage MR enterography early in the investigation of younger patients with undifferentiated non-specific abdominal symptoms.
- Carefully consider the need for repeat imaging by MR enterography when recent CT imaging has shown no abnormality.
- Include sequences, oral preparation, intravenous medication, and contrast details within the report and specifically comment upon the diagnostic adequacy of the examination.
- Be aware of extra-small bowel pathologies that may be shown by the examination.


