SHORT COMMUNICATION

MRI enterography: what is the clinical impact of unsuspected extra-enteric findings?

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ABSTRACT. To define the incidence and nature of incidental extra-enteric findings on magnetic resonance enterography (MRE) following the introduction of a new clinical service, to assess the volume of additional tests generated and to gauge the potential of MRE to reduce the need for subsequent abdominal imaging. The imaging and patient records of 500 consecutive patients undergoing MRE at a single institution were reviewed. Note was made of patient demographics, any extra-enteric findings reported on the MRE, whether additional tests were recommended by the reporting radiologists to clarify or follow up extra-enteric findings and whether the patients underwent additional abdominal or pelvic imaging in the 4 months after the MRE. 64% of the cohort was male. The mean age was 45 years (range 11–80 years). Overall 190 (38%) underwent MRE for assessment of known Crohn's disease and 310 (62%) for other indications, such as abdominal pain and anaemia. 26 non-bowel-related extra-enteric abnormalities were noted on the MRE report in just 15 patients (3%), and a total of 6 additional tests were recommended by the reporting radiologist. 13 patients (2.6%) underwent some form of abdominal imaging within 4 months of the MRE. None of these additional investigations revealed any abnormality missed on the MRE. Extra-enteric findings are unlikely to have a significant impact on healthcare resources after the introduction of an MRE service.

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Although recent survey data confirm that barium fluoroscopy remains the most widely performed radiological examination to image the small bowel in UK practice [1], alternative techniques, notably MR enterography (MRE), are increasingly popular; around 38% of National Health Service hospitals currently offer MRE. This reflects a desire among clinicians and radiologists to limit exposure to ionising radiation in this group of patients, many of whom are young and will need repeated examinations over the course of their disease. There is also a perception that MRE is superior to fluoroscopy in terms of both diagnostic accuracy and the assessment of disease activity: a recently published European evidenced-based consensus relating to diagnosis and management of Crohn's disease recommended MRE over barium techniques [2].

There are clear cost and capacity issues when implementing an MRE service. Access to MRI scanners is limited and examination costs are probably greater than barium fluoroscopy. Furthermore, barium examinations do not interrogate extra-enteric organs—for CT colonography, unsuspected/incidental extracolonic pathology has been found to frequently precipitate unnecessary subsequent tests and costs [3–5]. To date, this has not been assessed for MRE within the National Health Service, although two reports have evaluated extra-enteric findings on MRE in German and Danish institutions [6, 7]. While the extraluminal assessment provided by MRE is perceived as advantageous, particularly with Crohn's disease when detection of complications such as abscesses has a positive impact on patient care, the implications of incidental extraluminal findings are unclear. While such findings may also be advantageous (for example, detection of gallstones in a patient with non-specific upper abdominal pain), they may also be problematic and precipitate time-consuming, expensive and potentially harmful subsequent investigations to clarify their nature. The purpose of this short communication is to define the incidence and nature of incidental extra-enteric findings on MRE following provision of a new clinical service, and to assess the volume of additional tests generated. The potential of MRE to reduce the need for subsequent

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cross-sectional abdominal imaging because of the extra-enteric assessment it affords was also assessed.

Methods

An ethics waiver for this retrospective analysis was given by the local ethics committee.

The hospital radiology information system (RIS) was searched by the study co-ordinator (abdominal radiologist with 5 years of gastrointestinal imaging experience) to retrieve 500 consecutive MRE studies performed between January and October 2010 at a single institution (secondary and tertiary care teaching hospital) with a busy inflammatory bowel disease practice (400–500 combined new and follow-up patients seen per year). The radiologists had introduced an MRE service in 2005 to replace barium fluoroscopy. The time period chosen for the search was deliberately some years after the introduction of the new service, to allow both radiologists and clinicians to become familiar with MRE, thereby better reflecting implementation of MRE as an established service.

In brief, the standard MRE protocol consists of 1000–1500 ml oral 2.5% mannitol/0.2% locust bean gum solution 45–60 min prior to MRI performed in the prone position (if tolerated). Applied sequences include axial and coronal half Fourier acquisition single-shot turbo spin echo (4 mm slice thickness) and true fast imaging with steady-state precision (6 mm slice thickness), coronal fat-saturated half Fourier acquisition single-shot turbo spin echo and coronal fat-saturated volume interpolated breath-hold examination images pre- and 70 s post-intravenous gadolinium. Anatomical coverage for the axial true fast imaging with steady-state precision (true-FISP) and half Fourier acquisition single shot turbo spin echo images is from the mid-stomach to the symphysis pubis, although the cranial extension of all coronal sequences includes the liver dome.

Imaging and clinical records for the 500 patients were accessed by the study co-ordinator, and note made of the following: age and sex of the patient, small bowel findings (if any) by MRE, documentation of any extra-enteric findings, whether additional tests were recommended by the reporting radiologists to clarify or follow up extra-enteric findings, whether the patients underwent additional abdominal or pelvic imaging in the 4 months after MRE and, if so, the clinical indications for these tests and the findings. Extra-enteric findings were defined as findings unrelated to any pathological processes affecting the small bowel. In particular inflammatory bowel disease-related findings such as abscess or lymphadenopthy were not considered extra-enteric findings for the purposes of the study. In those patients in whom additional findings were identified on subsequent abdominal investigations, the MRE was reviewed by the study co-ordinator to see if these findings had been visible on the MRE in retrospect.

Results

Of the 500 patients, 64% were male. The mean age was 45 years (range 11–80 years). Overall 190 (38%) underwent MRE for assessment of known Crohn's disease and 310 (62%) for other indications, such as abdominal pain, anaemia and abnormal bowel habit. In those without known Crohn's disease, clinicians had requested MRE to exclude a small bowel cause for such symptoms, such as bowel mass, inflammatory bowel disease or other cause of enteropathy. Of those patients with Crohn's disease, 105 (55%) had ileal disease, 8 (4%) had jejunal disease and 4 (2%) had diffuse small bowel involvement. In those patients without known Crohn's disease, a diagnosis of inflammatory bowel disease was made in 47 (15%) following MRE. The most significant non-inflammatory bowel disease small bowel findings included small bowel lymphoma ($n=1$), coeliac disease ($n=2$), malrotation ($n=1$) and radiation enteritis ($n=5$). No other subsequent new small bowel-related diagnosis was made in this cohort over the 4-month period of study follow-up.

A total of 26 unsuspected incidental extra-enteric abnormalities were noted on the MRE report in just 15 patients (3%; Table 1). Of these 15, 10 had known Crohn's disease and 5 did not. Six additional tests in six patients were recommended by the radiologist reporting the MRE to further investigate an extra-enteric finding (four ultrasound, one MRI and one CT), of which five were done (Table 1). Three of the additional tests were to investigate complex adnexal cysts; in two cases these had resolved by the time subsequent ultrasound was performed. A CT was recommended to further characterise an abnormal rounded low-signal lesion around the common bile duct. The CT confirmed the finding to be a duodenal diverticulum.

A total of 13 patients (2.6%) underwent some form of abdominal imaging within 4 months of the MRE (Table 2). None of these additional investigations revealed any abnormality missed on the MRE.

Discussion

Although barium fluoroscopy remains the ''workhorse'' of small bowel imaging in the UK, alternatives such as CT and particularly MRE are currently disseminating into daily practice. Advocates of MRE point to the avoidance of ionising radiation and its ability to assess transmural disease. The impact of its ability to scrutinise the extra-enteric organs has not been previously described, to our knowledge.

Reassuringly, we found that an additional test to investigate an incidental finding was suggested by the radiologist reporting the MRE in only 6 of 500 consecutive patients (1.2%). Our findings are probably representative of patients referred for MRE. Although the oldest patient was 80 years old, most were much younger, with a mean age of 45 years, and almost 40% had known Crohn's disease. The incidence of extra-enteric findings is reduced in younger patients. In this regard, parallels can be made with the CT colonographic (CTC) literature. In a cohort of 10 286 patients undergoing CTC with a mean age of 59.8 years, Pickhardt et al [4] reported an incidence of extracolonic malignancy of just 0.35%. Conversely, in a symptomatic patient cohort aged older than 70 years and undergoing CTC, Tolan et al [5] reported extracolonic cancers in 6%.

Table 1. Reported extra-enteric findings in 500 consecutive MR enterography (MRE) examinations

Extra-enteric finding (total number)	Additional investigation suggested in MRE report	Finding of additional investigation
Liver cyst ($n=1$)	Nil	
Gallstones ($n=4$)	Nil	
Renal cysts ($n=4$)	Nil	
Atrophic kidney ($n=1$)	Nil	
Fibroid uterus ($n=1$)	Nil	
Dilated common bile duct ($n=2$)	MRCP ($n=1$)	Dilated common bile duct; no cause identified
Liver haemangioma ($n=1$)	Ultrasound	Not done
Chronic liver disease ($n=1$)	Nil	
Renal pelvicalyceal dilation ($n=1$)	Nil	
Adnexal cyst ($n=5$)	Ultrasound ($n=3$)	1 complex cyst, 2 normal
Peritoneal cysts ($n=1$)	Nil	
Benign buttock soft-tissue nodule ($n=1$)	Nil	
Pre-sacral collection ($n=1$)	Nil	
Extramedullary haemoparesis ($n=1$)	Nil	
Non-enhancing low signal adjacent to common bile duct ($n=1$)	CT pancreas	Periampullary duodenal diverticulum

MRCP, MR pancreatocholangiography.

The very low incidence of extraenteric findings in our cohort probably also reflects a low suspicion of non-enteric pathology on the part of referring clinicians. It seems likely that physicians would request other tests such as CT when their suspicion of significant pathology beyond the small bowel is high.

A total of 13 patients underwent additional abdominal imaging within 4 months of MRE, although no additional findings were diagnosed. Indeed, it could be argued that many of these tests were superfluous given the prior normal MRE. For example, several ultrasound examinations were requested to exclude structural renal abnormalities such as hydronephrosis and pelvi-ureteric junction obstruction; such diagnoses can be excluded easily using current MRE protocols. It should be noted, however, that MRE protocols are tailored to the small bowel and are therefore not optimised to fully assess the extra-enteric organs. For example, whether current protocols are sufficient to exclude hepatocellular carcinoma (with a single 70 s post-contrast coronal acquisition) is debatable, and additional tests are still probably indicated in such scenarios. Similarly, MRI has low sensitivity for renal calculi if this is of clinical concern.

Two similar studies to our own have reported the incidence of extra-enteric findings in those undergoing MRE. Herfarth et al [6] reviewed the extra-enteric findings in a cohort of 1006 patients, of whom 710 had proven or suspected inflammatory bowel disease (IBD), 182 had non-specific abdominal symptoms and 144 had suspected small bowel tumour. The first two groups are comparable with the present study. The authors reported a much higher incidence of extra-enteric findings—59.6% of patients had at least one finding beyond the bowel. However, the vast majority were of no clinical significance and were most commonly simple cysts, either ovarian (15.5% of IBD patients) or renal (22% of patients with non-specific symptoms). The lower incidence in the current study almost certainly reflects the difference in reporting styles between the radiologists—in general, radiologists at our institution do not report the presence of simple cysts if they are unequivocally benign and small. The most common finding in the IBD groups

Table 2. Nature, indications and findings of additional abdominal imaging performed within 4 months of MR enterography (MRE)

Imaging investigation	Stated clinical indication	Interval from MRE	Original MRE finding	Additional investigation finding
Renal ultrasound	?Hydronephrosis	1 day	Renal cysts	Renal cysts
Renal ultrasound	Renal impairment	2 days	Renal cysts	Renal cysts
GB ultrasound	?Gallstones	2 weeks	Nil	Normal
Pelvic ultrasound	?Inguinal hernia	2 weeks	Nil	No hernia
MRCP	?Sclerosing cholangitis	1 week	Nil	Normal
Renal ultrasound	?Pelvi-ureteric junction obstruction	1 month	Nil	Normal
Liver ultrasound	HCC surveillance	2 months	Nil	Normal
Liver ultrasound	HCC surveillance	2 months	Nil	Normal
Abdominal ultrasound	Upper abdominal pain ?cause	1 month	Nil	Normal
Liver ultrasound	Abnormal liver function	1 month	Nil	Normal
Abdominal ultrasound	Abdominal pain	2 months	Nil	Normal
Liver ultrasound	?Cirrhosis	3 months	Chronic liver disease	Cirrhosis
Renal, bladder ultrasound	Right loin pain	4 months	Nil	Normal

GB, gallbladder; HCC, hepatocellular carnicoma; MRCP, MR pancreatocholangiography.
? indicates the clinical query.

classified as of moderate importance was ''non-suspicious lymphadenopathy''—a common ''normal'' occurrence in IBD patients, and again not counted as an extra-enteric finding in the current study unless the radiologist was concerned that it was not simply related to IBD. The next most common finding of moderate significance was gallstones (at just 3.3%, similar to the present study), followed by ''degenerative bone disease'' (something not routinely reported by radiologists on MRE at our institution, unless very severe). Finally, although findings of major clinical significance were reported in around 10% of IBD patients and 15% of patients with non-specific symptoms, the vast majority (70%) were abscesses—again, something not defined as an extra-enteric finding in the current study. Overall, excluding lymphadenopathy and degenerative bone disease, the combined incidence of moderate or major extra-enteric findings in the study by Herfarth et al was around 7% in the IBD group and 20% in the group with non-specific symptoms. The figure for the IBD group is thus comparable with the current study; the higher figure for the patients with non-specific symptoms probably represents a difference between patient cohorts.

In a cohort of 283 patients with known or suspected Crohn's disease, Jensen et al [7] reported a 20% incidence of unknown and unexpected extra-enteric findings, although only 6% had important or incompletely characterised findings. Again, the most common finding was simple cysts (accounting for 67% of patients with extra-enteric findings). Only 3.2% of patients had further intervention to work up extra-enteric findings. Allowing for our general ''under-reporting'' of benign incidental cysts, the findings of Jensen et al are therefore not too dissimilar to those of the current study.

Because the literature increasingly supports implementation of MRE as a superior and safer alternative to barium fluoroscopy, radiological departments must assess how they will cope with increasing demand on scarce MRI resources. This short communication provides some reassurance that extra-enteric findings are unlikely to impact significantly on healthcare resources if MRE is introduced.

Conflict of interest

The views expressed in this publication are those of the authors and not necessarily those of the Department of Health.

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