Minimal preparation MR colonography: initial patient evaluation

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Introduction: MR colonography strategies utilising oral contrast media and dietary restriction instead of cathartic cleansing have potential for polyp and tumour detection[1]. Such preparation strategies must modify the signal of faecal material to consistently differ from tumour, allowing discrimination. Previous work indicated the use of oral ferric ammonium citrate (FAC) with a high fat & low fibre diet (to shorten faecal T1 & T2 values)[2], gaseous insufflation[3], and comparison of several sequences suitable for breath-hold imaging. This MR colonographic technique is presently under evaluation by comparison with CT colonography and colonoscopy in patients at risk of colorectal tumours. This work presents the first 10 patient studies: the learning-curve and feasibility assessment for a larger trial.

Materials and Methods: Ten patients (4 male, 6 female; 35 - 86 years) conforming to UK guidelines for high-risk of colonic neoplasia each underwent MR, CT, and colonoscopy investigations. Patients rated the acceptability of preparation and examination strategies.

MR: For 3 days before MR colonography, patients followed a specific preparation strategy: FAC (Lexpec+Iron-M, Rosemont, 2.5ml qds) and high fat, low residue diet (shortens faecal T1 and T2 values (Figure 1)). Examinations were performed on a 1.5T MR system (GEHT Milwaukee) with 8 channel torso phased-array coil. Colonic distension was provided by air insufflation. Matched location coronal breath-hold images were obtained in both prone and supine positions (common parameters: 28 sections, 44cm FOV, slice/gap 6/0mm): 2D T2w SSFSE (TR/TEeff = 1100/80ms), 2D PDw SSFSE (TR/TEeff = 1500/38ms), 3D T1w FAME (TR/TE = 3.6/1ms, 20^o FA) and 3D T1w FGRE (TR/TE = 1.6/0.6ms, 10^o FA). Axial non-breath-hold T2w images (TR/TEeff = 1500/80ms, 36cm FOV) were also obtained.

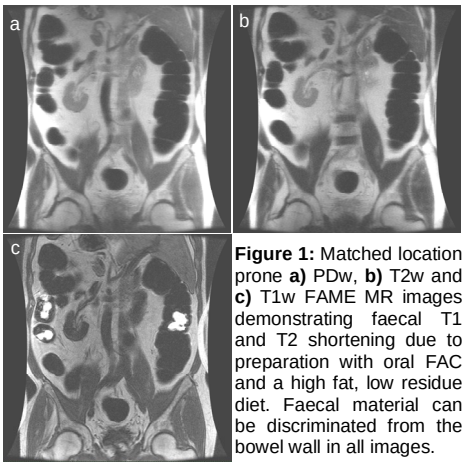

Figure 1: Matched location prone **a)** PDw, **b)** T2w and **c)** T1w FAME MR images demonstrating faecal T1 and T2 shortening due to preparation with oral FAC and a high fat, low residue diet. Faecal material can be discriminated from the bowel wall in all images.

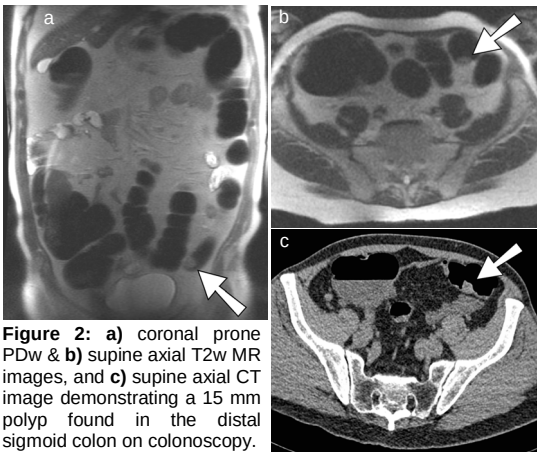

Figure 2: a) coronal prone PDw & **b)** supine axial T2w MR images, and **c)** supine axial CT image demonstrating a 15 mm polyp found in the distal sigmoid colon on colonoscopy.

CT & Colonoscopy: A fortnight after MR, patients underwent CT colonography followed by colonoscopy approximately 2 hours later. Oral fleet phospho-soda provided cathartic preparation, and colonic distension was achieved by air insufflation. CT examinations were performed on a Sensation 16 CT Scanner (Siemens, Forscheim) in both prone and supine positions (120 kV, 50 mAs).

Studies were assessed by anatomical colonic segment (6 segments: caecum, ascending, transverse, descending, sigmoid, and rectum). Examinations were supervised and analysed by qualified MR and CT radiologists with equivalent limited experience in colonography. Studies were reviewed by separate blinded pairs of observers in consensus for the presence of colonic polyps and technical adequacy (complete visualisation of colon for confident evaluation). The cause of any inadequacy was identified: luminal collapse, preparation failure, or poor coverage. A non-parametric Wilcoxon signed-rank test was used for comparisons.

Results: Four polyps were identified on colonoscopy: 3 of them >10mm diameter (Figure 2) and 1 >5mm, <10mm. CT and MR colonography correctly detected only 1 lesion: sensitivity = 33% for polyps >10mm (25% for >5mm). Technical inadequacy due to preparation failure or collapse occurred on 38% of segments on CT compared to 23% on MR and 10% on colonoscopy (Figure 3). MR and colonoscopy both provided significantly more adequate segments for review than CT ($P < 0.05$). On MR, 3 segments yielded false-positive results compared to 1 segment on CT. The specificity of MR for >10mm (and >5mm) lesions was 96% (94%); for CT 100% (98%). The preparation strategy for MR was considered significantly more acceptable than that for CT or colonography ($P < 0.012$); no significant exam preference was observed.

Conclusion: This work describes the initial feasibility study of a larger trial comparing minimal preparation MR colonography to CT and colonoscopy. Previous limited experience of MR or CT colonoscopy necessitated this initial phase to for technique optimisation and interpreter experience. Although the sensitivities of MR and CT were relatively low, lesions were only missed in the first 2 patients imaged. Technical adequacy was higher for MR than CT, but the fleet cathartic regime needed for colonoscopy can cause luminal fluid retention, impairing colonic visualisation. In future CT and colonoscopy may have to be performed after separate cleansing regimes to ensure optimal performance. Notably, despite small patient numbers, MR preparation was significantly preferred to conventional cathartic cleansing, suggesting the value of further optimisation of this strategy.

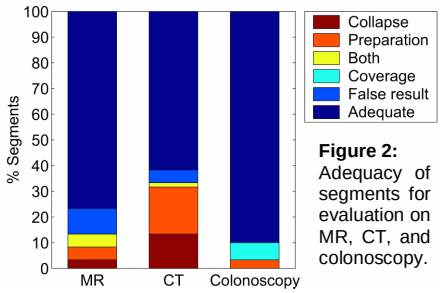

Figure 2: Adequacy of segments for evaluation on MR, CT, and colonoscopy.

References:

1. Lauenstein, TC, et al. Radiology, 2002. **223**(1): p. 248-254.
2. Jardine, VL et al. Proc.ISMRM'03: 341
3. Lomas, DJ, et al. Radiology, 2001. **219**(2): p. 558-562.

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