MRI colonic stress test for differentiating different subtypes of constipation

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Introduction: Symptoms of chronic constipation are common but it can be difficult to distinguish slow transit constipation from irritable bowel syndrome with constipation (IBS-C), due to overlapping symptoms and lack of biomarkers. As treatments are rather different patients are often dissatisfied with their treatment leading to multiple consultations.

Aim: To assess whether a dynamic MRI test, assessing colonic response to distension by a laxative, could be used to differentiate patient groups.

Methods: 40 patients with chronic constipation (slow transit or irritable bowel syndrome: table 1) participated and results were compared with a healthy volunteer (HV) study[1]. Patients swallowed 5 MRI marker capsules 24 h before the study to assess their whole gut transit time, as previously described[2]. On the study day patients arrived fasted and underwent a baseline MRI scan before consuming 1 L of a macrogol based laxative. Patients then had hourly scans for 4 h using a 1.5T Philips Achieva scanner with a SENSE XL Torso coil. A Turbo Spin Echo single shot sequence (TR/TE = 8000/320 ms, FA = 90°, FOV = 400x362x168 mm^3, ACQ res = 1.56x2.90x7.0 mm^3) was used to acquire T2 weighted coronal images for measurement of small bowel water content as previously validated[3]. A Fast Field Echo sequence ($TR/TE_1/TE_2$ = 157/2.3/4.6 ms, FA = 80°, FOV = 450x362x168 mm^3, ACQ res = 2.01x2.87x7 mm^3) was used to acquire coronal dual echo images, used to measure colonic volumes. Balanced Turbo Field Echo sequence (TR/TE = 3/1.52 ms, FA = 70°, FOV = 330x228x15 mm^3, ACQ res = 1.5x1.5x15 mm^3) was used to acquire sagittal cross sectional, cine images of the ascending colon (AC) to assess colonic motility. A motility index was calculated as the duration of each contraction (in seconds) multiplied by the number of sections of the AC (proximal, mid or distal) involved, summed over all contractions in the two minute scanning interval. Patients completed symptom and stool frequency questionnaires on the study day. A MRI based colonic hypersensitivity index was calculated as the bloating score divided by AC volume, to normalize symptoms against actual physiological change.

Table 1. Parameters of colonic function in HVs and patients with chronic constipation

Parameter (Mean±SD)	HV	IBS-C	Slow Transit Constipation	P value***
N	11	17	23	
Whole Gut Transit Time (h)	30±25	69±33*	108±39*,**	<0.0001
Small Bowel Water Content (mL)	83±64	54±59	114±97**	0.06
Fasting AC volume (mL)	193±84	222±69	314±100*,**	0.0004
AC volume 2 h post laxative (mL)	357±153	386±168	597 ±170*,**	<0.0001
Motility index 2 h post laxative	80±48	63±46	28±35*,**	0.0018
Time to 1st bowel movement post laxative (min)	117±62	105±72	588±1034*,**	0.0004
Stool frequency on study day	8±3	8±3	4±4*,**	<0.0001
Hypersensitivity Index 2h post laxative	6±5	17±14*	12±7*	0.0094

*=p<0.05 compared to HV,**=p<0.05 compared to IBS (Mann Whitney U/ Unpaired T-test), *** 1-way ANOVA/Kruskall-Wallis

Results: (Table 1) Both patient groups had significantly greater whole gut transit time (prior to ingestion of laxative) than HVs (Figure 1). Patients with slow transit constipation had greater fasting small bowel water content and AC volumes and reduced motility index than HVs 2 h post laxative, findings not seen in Irritable Bowel Syndrome. Furthermore, slow transit constipation patients showed impaired response to the laxative with longer time to first bowel movement, reduced stool frequency on the day, greater distension of the AC (Figure 2) and reduced motility index compared with HVs and patients with Irritable Bowel Syndrome. The MRI based hypersensitivity index scored 2 h post laxative was higher in the Irritable Bowel Syndrome patients compared to those with Slow Transit Constipation and HVs.

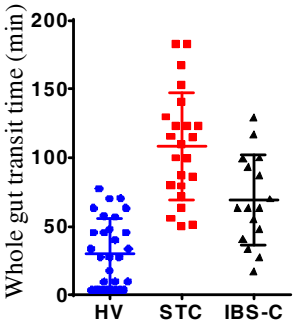

Figure 1. Comparing whole gut transit time in patients and HVs.

Discussion: The laxative challenge combined with MRI has the potential to provide a new non-invasive assessment of colonic function in patients with symptoms of chronic constipation. Our findings suggest the colon in irritable bowel syndrome is hypermotile and hypersensitive and quite different from the hypomotile colon seen in slow transit constipation, therefore likely to need rather different treatment. **References:** 1. Garsed K.C, et al. *Gastroenterology* 2012*;* 142:S814. 2. Chaddock G, et al. *Neurogastroenterol Motil* 2013 [In Press]. 3. Hoad C.L, et al. *Phys Med Biol* 2007; **52**: 6909-6922. **Acknowledgements:** Supported by the NIHR Biomedical Research Unit in GI and Liver diseases at the University of Nottingham.

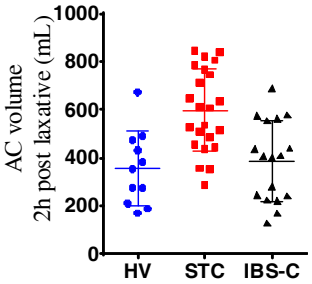

Figure 2. Comparing AC volumes, post laxative, in patients and HVs.