Quantitative assessment of global small bowel motility in Chronic Intestinal Pseudo-Obstruction and controls: A Preliminary Study

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Purpose

In this preliminary report, we present the initial results of a prospective investigation comparing MRI quantified global small bowel motility in healthy controls and patients with proven clinical and radiological Chronic Intestinal pseudo-obstruction (CIPO). Diagnosis is initially difficult and often delayed, many patients undergoing unnecessary surgical intervention prior to final diagnosis. MRI offers a potential non-invasive modality of diagnosis and monitoring, employing post-processing quantitation of global metrics describing small bowel motility[1].

Methods:

Subject selection: 11 healthy non-smoking volunteers (7 Male, mean age 33[22 to 48]) and 4 CIPO patients (2 Male, mean age 42[32 to 60]) were recruited. CIPO patients stopped any medications that influenced small bowel motility for one week prior to scan including opioids, antiemetics & anti-diarrhoeals.

Study overview: Participants underwent a single MRI motility scan before and immediately after an injection of 0.5mg IV neostigmine, a cholinomimetic with potent prokinetic action.

MR Protocol: The motility scan protocol used a 3D Balanced Turbo Field Echo (BTFE) motility sequence capturing one coronal volume through the abdomen and pelvis per second over a 20 second breath hold (2.5x2.5x10 in plane resolution, FA 20, TE=1.7ms, TR=3.5ms, 15cm thickness in 15 reconstructed slices)

Motility Analysis: Dynamic time-series data was registered using a modified 2D optic-flow technique for each slice through the abdominal volume[2]. The deformation fields generated by the registration process were used to provide a motility metric (artificial unit, AU) expressed as the standard deviation of pixel's Jacobian (a measure of local area change) and averaged across a user defined ROI.

ROI Placement: A radiologist, with 5 years experience reading MRE, placed regions of interest (ROIs) around the small bowel in each coronal slice over the 15-slice volume. The radiologist was blinded both to subject group and whether the scan was pre- or post-neostigmine.

Statistics: Data normality was assessed using Shapiro-Wilk testing. 1) Baseline motility was compared in CIPO patients and controls. 2) Percent change in motility between baseline and post-neostigmine was compared between groups. Difference in means were tested using Welch's T-test.
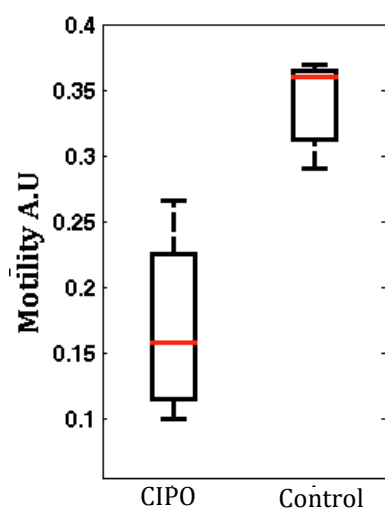
Figure 1. mean global motility difference in CIPO and control groups.

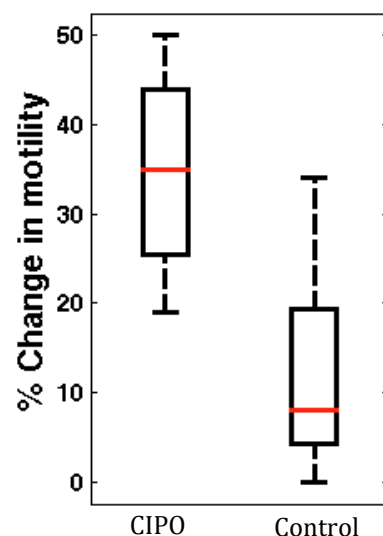Figure 2. % change in motility between CIPO and control groups

Results:

1) Mean baseline small bowel motility scores in CIPO patients was 0.17AU (range 0.1 to 0.26) and in controls 0.34AU (range 0.29 to 0.37) with a statistically significant difference of 0.17AU, P = 0.019 (CI 0.05 to 0.29) (figure 1).

2) The mean percent increase in small bowel motility scores in CIPO patients following noestigmine was 35% (95% CI from 19 to 50%) and in controls 13% (range 0 to 34) with a statistically significant difference in groups response to neostigmine of 22%, P = 0.03 (95% CI from 3 to 42%) (Figure 2).

Conclusion & Discussion:

This study demonstrated significant differences in both resting and cholinomimetic-induced global motility between CIPO patients and healthy controls. Despite marked bowel distension in the CIPO patients, motility appeared present but reduced compared to controls, and responded to provocation with neostigmine suggesting the bowel still exhibits the expected pro-kinetic effects following pharmacological stimulation. With just four patients this is a preliminary study, nevertheless initial results appear promising and support our ongoing investigation program.

References: 1) Menys et al. Global assessment … Radiol. 2013;269(2):443-50.) Odille et al. Quantitative assessment … MRM 2012;68(3):783-93,