

Factors influencing small bowel water content: fibre intake, fasting and feeding

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Introduction

Small bowel water content depends on intestinal motility as well as the balance between absorption and secretion. Fasting motility is highly episodic with intermittent propulsive motor patterns migrating down the gut every 1-2 hours while the fed pattern facilitates absorption by constant small mixing movements which are less propulsive. We have recently developed a method of assessing small bowel water content (SBWC)¹. We usually require volunteers to fast overnight before MRI studies of gastrointestinal (GI) function the following morning to guarantee an empty stomach. However, we observed that the fasted small bowel often presents with an appreciable resting water content, although previous studies² have shown that subsequently the SBWC will drop following a rice pudding breakfast. Fibre in the diet can stimulate intestinal secretion hence we were interested in evaluating the effect of the evening meal on the next morning's fasted SBWC. We hypothesized that having a low fibre diet on the day prior to scanning would result in lower SBWC the following morning.

Method

Volunteer Selection: 10 healthy volunteers (5 F, 5 M), with no history of GI disease, formed the study group. The study was approved by the local Ethics Committee and all volunteers gave written informed consent.

Meal Descriptions: Evening meal: 220g microwaveable pasta pouch with 170g microwaveable tomato & basil pasta sauce pouch and 30g mild English cheddar, followed by 150g low fat raspberry yoghurt and 300ml still, bottled water, and either 30g Rice Krispies or 40g All-Bran with 125ml semi-skimmed milk. Total fibre content was 4.1g (Rice Krispies low fibre meal) or 14.7g (All-Bran high fibre meal). Both meals had approx. 800kcal. Volunteers consumed both meals, on separate study days in a randomised order. **Breakfast:** 213g creamed rice pudding with 34g seedless raspberry jam and 15g coarse wheat bran, with 100ml pure orange juice from concentrate; total calories=330kcal.

Study Protocol: Volunteers consumed the evening meal at 6pm and were asked to attend at 8am the following morning having fasted overnight and having abstained from alcohol for 24 hours, and from caffeine and exercise for 18 hours. Volunteers were scanned before breakfast (t=-45mins) to measure the fasting SBWC. At t=-15mins the volunteers consumed the rice pudding breakfast before being scanned at t=0 and 45mins to detect any change in SBWC due to consuming the meal. Images were acquired on a 3T Philips Achieva MRI Scanner using a SENSE Torso coil. Single shot coronal TSE (RARE) (TE=400ms, FOV=400mm, recon. matrix=512x512, SENSE=2) images were acquired during two breatholds.

Analysis: The SBWC was calculated for each volunteer at each time point by integrating the volume of all image pixels above a threshold, after exclusion of signal from regions other than bowel¹. The fasting SBWC was compared between the low and high fibre meals. The change in SBWC was also observed after consumption of the rice pudding breakfast.

Results

Figure 1 shows individual subject comparison between fasting SBWC after low and high fibre diets and it can be seen that there is a larger spread of volumes for the low fibre diet.

The median SBWC was lower after the high fibre diet than after the low fibre diet, however this difference did not reach statistical significance (p=0.093, Wilcoxon signed ranks test). Figure 2 shows the change in SBWC between fasting and consuming the rice pudding meal. There was a significant drop in the SBWC after consumption of the rice pudding meal, for every volunteer (p=0.003, Wilcoxon signed ranks test, with Bonferroni correction). The SBWC at t=45mins was also significantly lower still (p=0.003, Wilcoxon signed ranks test, with Bonferroni correction).

Conclusion

The SBWC dropped immediately after ingestion of rice pudding meal and is even lower at t=-45mins once gastric emptying had commenced. There was no significant effect of the fibre content of the previous night's meal. This is consistent with previous experiments using this rice pudding meal and may represent transfer from ileum to the colon together with enhanced absorption as the small intestine switches from the fasting to fed state².

References

1. C. L. Hoad *et al.* Phys. Med. Biol. in press, 2. L. Marciani *et al.* Proceedings 15th ISMRM, Berlin 2007, p. 894.

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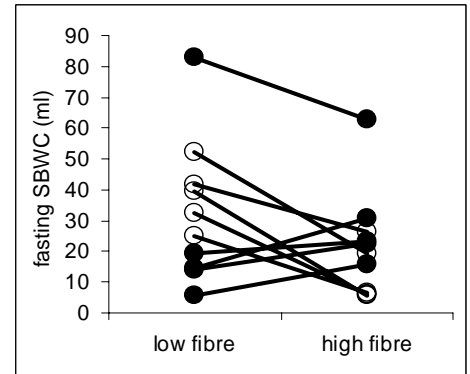


Figure 1: Individual comparisons of fasting SBWC after low and high fibre diet (filled circle=male, open circle=female)

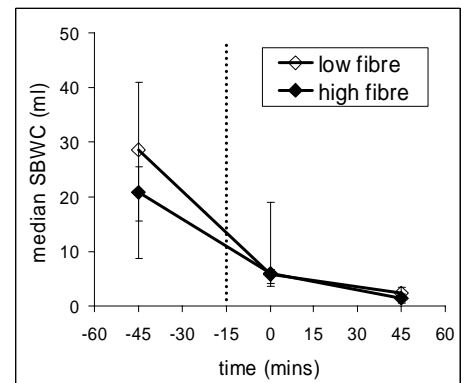


Figure 2: Median change in SBWC over time with interquartile range for low and high fibre diets. Rice pudding meal consumed at t = -15 mins