Small bowel MRI: Comparison of water and polyethylene glycol as oral contrast media

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Introduction
Diagnostic quality small bowel imaging using heavily T2 weighted RARE based MR has recently been demonstrated with both oral and jejunal delivery of intra-luminal contrast medium. Although nasojejunal tube delivery allows a more controlled examination with good distension of the small bowel it is invasive and unpopular with patients. Oral delivery avoids the discomfort and inconvenience of intubation but, as in X-ray small bowel series, can be limited by the ability of the contrast medium to both distend and reach all of the small bowel during the examination. Recent work showed that oral water can be used as a simple and safe intra luminal contrast media but in some cases is completely absorbed before it reaches the terminal ileum[1].

In order to try and overcome this limitation this work investigates using a commercial polyethylene glycol (PEG) based agent (Kleenprep®, Helsinn-Birex Pharmaceuticals Ltd, Ireland) and compares its performance with water for MRI of the small bowel in volunteers. PEG is not absorbed in the intestine[2] and works as a bowel cleansing agent by retaining fluid within the lumen. Pilot studies demonstrated that it has a comparable T2 value to water.

Methods
Twenty five volunteers (age range 21-55 years, 12M:10F) with no past history of bowel disease were recruited for the study and informed consent obtained. Each volunteer underwent two MR examinations 1 week apart, on the first occasion drinking mineral water and on the second occasion the PEG preparation. Three volunteers failed to attend the second examination.

Pre-contrast coronal and axial localiser images, 100mm projection images (TE effective 620ms) and 10mm thick (gap 5mm) slice coronal images (TE effective 65ms) were obtained.

Volunteers were asked to drink up to 2 litres of the contrast medium and then imaged at 10 minute intervals for the next two hours. The 10mm thick coronal projection images (TE effective 620ms, acquisition time 1 second) and 10mm thick slices (TE effective 65ms, acquisition time 15 seconds) were repeated to observe the lumen of the whole small bowel as well as the individual segments of the small bowel with adjacent soft tissues.

The following common parameters were used: single shot half-Fourier RARE (SSFSE), torso phased array coil, TR infinite, matrix 256x192, FOV 34x40cm, NEX 0.5, receiver bandwidth 62.5 kHz. Each set of images (projection thick slab and coronal thick slices) were evaluated by consensus by two radiologists, blinded to the volunteer details and the type of oral contrast medium used. The following features were evaluated and statistically analysed: (i) did contrast medium reach the terminal ileum? (ii) transit time (in minutes) from the ingestion to arrival at the terminal ileum, (iii) demonstration of small bowel segments using a subjective five point grading scale.

Results
(i) In 21/22 (95%) of the volunteers, the PEG preparation reached the terminal ileum compared with only 14/22 (63%) with water. This was a statistically significant (McNemar Chi, p<0.05) difference.

(ii) The mean small bowel arrival times for water and the PEG preparation were 50.6 +/- 48 minutes and 37.7 +/- 22 minutes respectively, a difference which did not reach statistical significance (Student’s paired t-test, p=0.28).

(iii) Using the Wilcoxon signed rank test there was no significant difference in demonstrating the stomach (p=0.1), duodenum (I/II) (p=0.37), duodenum (II/IV) (p=0.71) but the PEG preparation was significantly better than water in demonstrating the jejunum (p=0.007), ileum (p=0.005), and terminal ileum (p=0.002).

Discussion
PEG preparations are routinely used and licenced as bowel cleansing agents and they could be deployed rapidly as a oral contrast media for abdominal and bowel MRI. As they are not absorbed the risk of systemic side effects is reduced and they have proved to be safe for human use. Potential disadvantages are their taste and mild cathartic effect.

In this study a PEG preparation has been shown to be significantly better than water at reaching the terminal ileum, demonstrating the jejunum and ileum and for the overall visualisation of the small bowel. These results suggest that oral PEG preparations may be of value to delineate the bowel in routine abdominal MRI.

Further work in patients with small bowel disease is required to refine the technique and evaluate the diagnostic performance of PEG based MR examinations of the small bowel in comparison with existing investigations such as X-ray contrast studies and scintigraphy.

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References

Fig. 1: Projection images of the small bowel with water (A) and PEG (B) in patients achieving high scores on the grading. 10mm thick images of examinations using PEG with high scores for the terminal (C, arrow) and 2nd part of the duodenum (D, arrow).