MRI of the small bowel: can sufficient bowel distension be achieved with small volumes of oral contrast?

S. Kinner[1], C. A. Kuehle[1], S. C. Ladd[1], J. Barkhausen[1], and T. C. Lauenstein[1,2]

[1]Department of Diagnostic and Interventional Radiology and Neuroradiology, University Hospital Essen, Essen, NRW, Germany, [2]Department of Radiology, Emory University Hospital, Atlanta, Georgia, United States

Introduction: Recent technological developments are the reason for an extended role of MR imaging in small bowel imaging. Advantages of MRI over CT and conventional enteroclysis include lack of ionizing radiation, better soft tissue contrast as well as the use of intravenous contrast agents with a more favourable safety profile. For diagnostic small bowel imaging sufficient luminal distension is mandatory [1]. However, patients with gastrointestinal symptoms are often unable to ingest a sufficient volume of currently applied oral contrast compounds. Aim of this study was to evaluate if small amounts of a contrast agent with high-osmolarity may result in sufficient bowel distension.

Materials and Methods: 6 healthy volunteers (4 female and 2 male; age range 30-49) without a history of previous gastrointestinal disease, gastrointestinal symptoms (such as acid regurgitation, nausea, early satiety) or abdominal surgery were studied. After a fasting period of at least 4 hours 150 ml, 300 ml or 450 ml of a commercially available oral contrast agent (Banana Smoothie, EZEM; USA) were ingested at three different occasions. While osmolarity of current oral contrast agents amounts to 120-150 mOsmol/l, the agent we tested in this trial had an osmolarity of 194 mOsmol/l. MRI examinations were performed in patients' prone position on a 1.5T MR System (Magnetom Symphony, Siemens, Erlangen, Germany). A set of 2 surface array coils was used for signal reception. Neither antispasmodic agents nor paramagnetic contrast compounds were intravenously administered. Coronal 2D images were collected under breath-hold conditions using a fast T2-weighted steady state precession sequence (TrueFISP, TR/TE/flip 4.6ms/2.0ms/70°; 500mm field of view, 4mm slice thickness with an intersection gap of 0.4mm, matrix size of 208x256, acquisition time of 19 seconds). Data acquisition was performed seven times: directly after ingestion of the contrast medium (t=0) and 5, 10, 15, 20, 30 and 45 minutes later. The small bowel was divided for data evaluation in four segments (duodenum, proximal jejunum, distal jejunum and ileum). Distension of the small bowel segments was quantified using a visual 5-grade ranking (5=very good distension, 1=collapsed bowel). Side effects and acceptance of the contrast agent was determined after every examination using a standardized questionnaire. Results were statistically compared using a Wilcoxon-Rank test. A P value < 0.05 was considered to indicate a statistically significant difference.

Results: Volunteers ingested the contrast agent within a time range of 4 minutes for 150 ml, 8 minutes for 300 ml and 11 minutes for 450 ml. Ingestion of 450 ml and 300 ml showed significant better distension than 150 ml. The all-over average distension value for 450 ml amounted to 3.4 (300 ml: 3.0, 150 ml: 2.3) and diagnostic bowel distension could be found throughout the small intestine. Even 45 minutes after ingestion of 450 ml the jejunum and ileum could be reliably analyzed. Immediate data acquisition within the first 15 minutes after ingestion showed significant higher distension of the duodenum and the proximal jejunum compared to later time points. The side effect rate for all contrast volumes was low. Primarily side effects like flatulence, eructation and diarrhoea were noticed. A linear relationship could be detected between volume and side effects as well as between volume and patients` acceptance.

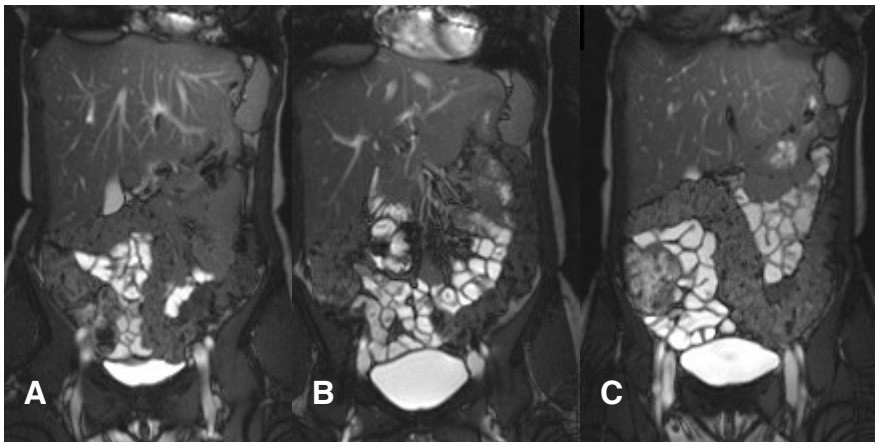

Fig.1: Influence of contrast volume on distension of the ileum. Expanding the dose from 150ml (A) to 300ml (B) or 450ml (C) led to an increasing distension of the ileum. In this example time point of every acquisition was 30min after ingestion of the contrast agent.

Discussion: Small bowel imaging with low doses of contrast leads to diagnostic distension values when a high-osmolarity substance is applied. This might be of great relevance especially for patients being unable to ingest larger amounts of oral contrast due to gastrointestinal symptoms. Data acquisition should be performed immediately after contrast ingestion to ensure a reliable depiction of proximal small bowel loops. The terminal ileum, however, can be adequately assessed even 45 minutes after contrast ingestion.

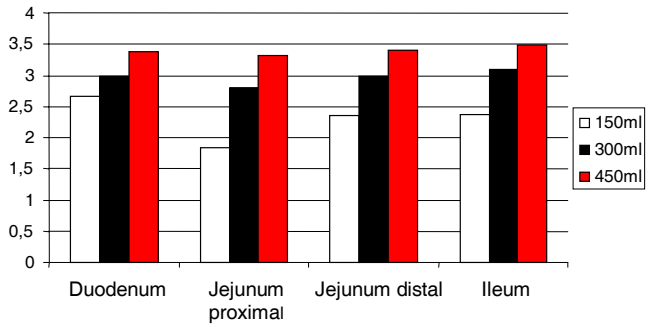

Fig.2: Average distension values for different volumes and bowel segments. Lowest distension was seen in the proximal jejunum, whereas the ileum showed best distension rates. Highest distension rates were found after the application of 450ml of oral contrast.

1. Lauenstein, Schneemann, Vogt et al., Optimization of oral contrast agents for MR imaging of the small bowel. Radiology. 2003;228:279-83.