Small bowel MRI: impact of contrast volume, contrast formula and timing of data acquisition on bowel distension

C. A. Kuehle[1], W. Ajaj[1], S. Massing[1], S. C. Ladd[1], J. Barkhausen[1], T. C. Lauenstein[1]

[1]Institute of Diagnostic and Interventional Radiology, University Hospital of Essen, Essen, NRW, Germany

Introduction:

The prevalence of inflammatory small bowel diseases (IBD) varies within different geographic areas with highest rates of 445 per 100000 for Crohn's disease (CD) and ulcerative colitis (UC) in the western world (1). The peak age of onset is between 15 and 30 years (1). Although IBD is a common disease, the clinical diagnosis is often hampered by nonspecific symptoms. Thus, the accurate diagnosis is most frequently obtained by small bowel (SB) imaging using x-ray, ultrasound or magnetic resonance imaging. Whereas small bowel imaging has been dominated by x-ray techniques for decades, recently MRI enteroclysis has emerged an attractive alternative. Bowel distension, a prerequisite for good image quality is frequently achieved by administration of fluids via a naso-duodenal tube. However, this procedure is perceived as traumatizing by many patients and the placement of the tube usually requires fluoroscopy (2). Therefore, we propose a non-invasive distension method for small bowel MRI. This study aimed to optimize the volume of different oral contrast solutions and the timing of administration and image acquisition.

Methods:

Six healthy volunteers without any history of gastrointestinal disease were included in this study. Each subject underwent MRI of the small bowel on 16 separate days after a fasting period of four hours. We compared 4 different oral contrast agents containing: (A) 0.2% locus bean gum combined with 2.5% mannitol, (B) 2.0% sorbitol, (C) 1.4% sorbitol and (D) tap water. Prior to each examination the volunteers were asked to continuously ingest an amount of either 450ml, 900ml, 1350ml or 1800ml of oral contrast. Directly following the ingestion of the first 100ml of contrast, the volunteers received 100mg erythromycin intravenously (Abbott Pharmaceutics, Wiesbaden, Germany) to increase gastric emptying. The examinations were performed in a randomized order regarding type and volume of the oral contrast compounds. All MRI examinations were performed on a 1.5 T MR System (Magnetom Sonata, Siemens Medical Systems, Erlangen, Germany) in patients' prone position. Neither spasmolytic agents nor paramagnetic contrast compounds were applied intravenously. Coronal 2D images were collected using a TrueFISP sequence (TR/TE/flip 3.9/1.9/70°). Data acquisition was performed after 5, 10, 15, 20, 30 and 45minutes post ingestion. For data analysis, the small bowel was divided into 5 segments: duodenum, jejunum (proximal and distal) and ileum (proximal and distal). The distension of the small bowel was quantified using a visual 5-point scale. 24 hours after each MR exam, volunteers answered a standardized questionnaire regarding the occurrence of side effects such as diarrhoea and abdominal cramps.

Results:

Contrast agents A, B and C provided a significantly higher distension compared to water (fig.1, table1). However, there was no significant difference between the 3 substances. Distension grades differed between the 5 small bowel segments depending on the time point of data acquisition and/or contrast volume. The best distension of the duodenum and the proximal jejunum was achieved 5 to 10minutes after the ingestion of 900ml (mean score 3.0 – 3.9), which was not improved by higher volumes. 1350ml of contrast resulted in the best distension of the distal jejunum and ileum (mean score 3.9 – 4.7). This was not improved by increasing the volume to 1800ml. Duodenal distension significantly decreased 15minutes following end of ingestion, whereas distension of the jejunum and ileum remained unchanged over 45minutes. As for patients' acceptance, there was no significant difference between contrast A, B or C regarding volumes 450-1350ml. However, consumption of 1800ml led to a significant higher rate of side effects compared to lower volumes ((A) diarrhoea; (B) and (C) abdominal cramps).

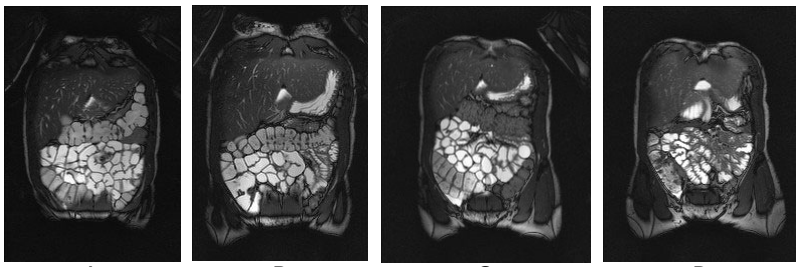

Fig.1: MRI of the small bowel after the administration of 1350ml of oral contrast agents. (A) 0.2% locus bean gum combined with 2.5% mannitol, (B) 2.0% sorbitol, (C) 1.4% sorbitol and (D) tap water

Discussion:

The presented data indicate that optimal timing regarding contrast consumption and data acquisition is essential to ensure high luminal distension. Duodenal MRI can be performed using 900ml of contrast, but imaging should be performed early after ingestion. For MRI of the jejunum and ileum larger volumes are preferable, which allow scanning for about 45minutes after ingestion.

References:

1. Loftus EV Jr. Clinical epidemiology of inflammatory bowel disease: Incidence, prevalence, and environmental influences. Gastroenterology. 2004 May 126(6):1504-17.

2. Schunk K. Small bowel magnetic resonance imaging for inflammatory bowel disease. Top Magn Reson Imaging. 2002 Dec;13(6):409-25.

Ileum, 1350ml

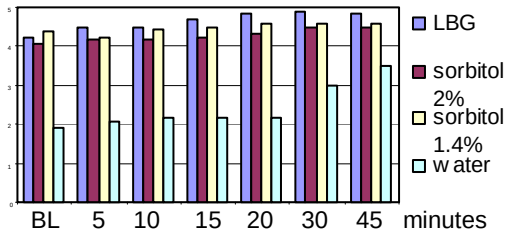

Table 1:
Mean values of bowel distension for all 4 contrast agents within 45 minutes following the end of ingestion.