ORAL CONTRAST AGENTS FOR SMALL BOWEL MRI: COMPARISON OF DIFFERENT ADDITIVES TO OPTIMIZE BOWEL DISTENSION

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ABSTRACT:

The purpose of this study was to compare different osmotic carbohydrate solutions (2.5% mannitol, 2.5% / 2.0% / 1.5% sorbitol) for small bowel MR imaging regarding image quality and patient acceptance. 12 healthy volunteers underwent each four MR examination after ingesting 1500ml of the different contrast solutions. While best distension values were observed after both the administration of 2.5% mannitol and 2.0% sorbitol, the use of sorbitol led to less side-effects and should therefore be recommended for small bowel MR imaging.

INTRODUCTION:

The success of small bowel MRI is predicated upon adequate intestinal distension with a luminal contrast agent. The oral administration of a hydro solution containing mannitol has been proposed for small bowel imaging (1). However, the ingestion of mannitol can lead to severe diarrhea, which may limit patients acceptance. In addition, metabolism of mannitol can lead the formation of explosive gases like methane. This can cause harmful explosions with potentially lethal consequences (2). In opposite to mannitol, the metabolic products of sorbitol, a comparable carbohydrate, are not explosive. Hence, the purpose of this study was to assess whether mannitol can be substituted by sorbitol without a loss of image quality. Furthermore possible side-effects after the administration of these substances were to be assessed.

METHODS:

Twelve healthy volunteers (eight female and four male; age range 31 to 55 years) without any history of previous abdominal surgery, gastrointestinal diseases or gastrointestinal symptoms were examined on four separate days. They ingested in a randomised order 1500ml of a solution containing 2.5% mannitol, 2.5%, 2.0% or 1.5% sorbitol. The interval between two single examinations amounted to a minimum of 48 hours. MR examinations were performed on a 1.5 T system (Magnetom Sonata, Siemens Medical Systems, Erlangen, Germany) equipped with high-performance gradient systems. Coronal 2D images were collected in patients prone position using a fast T2-weighted steady state precession sequence (TrueFISP, TR/TE/flip 3.9/1.9/70°). Other imaging parameters were the following: field of view = 35cm, slice thickness = 7mm, matrix size = 144x256, acquisition time = 22 seconds. MR Imaging was performed under breath-hold conditions.

Small bowel distension was quantified on coronal 2D TrueFISP images by measuring 10 diameters of small bowel loops (each five diameters of the jejunum and five diameters of the ileum). In addition, patients acceptance for all solutions was documented. To this end, volunteers were questioned regarding the occurrence of side effects such as diarrhea, nausea, vomiting, abdominal spasms or flatulence 24 hours after each MR exam. A standardized questionnaire was used, which was based on a four-point scale (1 = no side-effects, 2 = mild side-effects, 3 = moderate side-effects, 4= severe side-effects). Mean small bowel distension values obtained for each exam were compared regarding the different contrast agents using a paired t-test. Qualitative results concerning the grade of distension as well as the grades of discomforts were compared using the Wilcoxon rank test for each pair separately. For all statistical analyses, a p value < 0.05 was considered to indicate a statistically significant difference.

RESULTS:

The quantitative comparison of all contrast agents revealed the highest small bowel distension for the 2.5% mannitol solution The administration of a 2.5% mannitol solution resulted in a mean small bowel diameter of 19.8mm, compared to 18.8mm for 2.0% sorbitol, 18.2mm for 2.5% sorbitol, and 17.9mm for 1.5% sorbitol (Fig. 1 a-d). The differences concerning bowel loop distension was statistically significant for the use of mannitol compared to both 2.5% and 1.5% sorbitol. However, the difference between the administration of 2.5% mannitol and 2.0% sorbitol failed to prove a statistically significant difference.

The highest degree of diarrhea was observed following the ingestion of the solution containing 2.5% mannitol (mean index-value 3.0). The ingestion of the 1.5% and 2% sorbitol solution led to the lowest degree of diarrhea (mean index-values of 1.3 and 1.6, respectively). Concerning flatulence, vomiting and abdominal spasms the ingestion of 2.0% sorbitol and 1.5% sorbitol revealed lower index-values than the other two contrast agents.

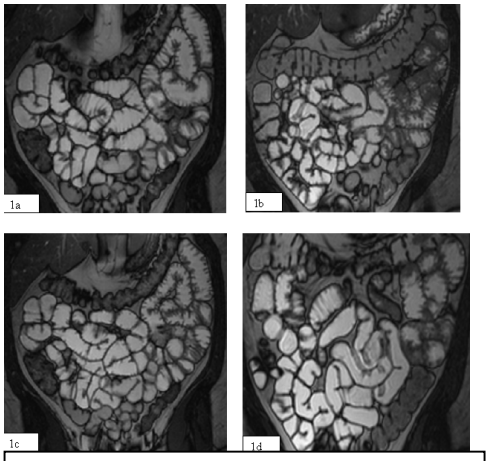

Fig 1. Coronal TrueFISP images after the ingestion of different contrast solutions: 2.5% mannitol (fig 1a), 2.5% sorbitol (fig 1b), 2.0% sorbitol (fig 1c) and 1.5% sorbitol (fig 1d).
The use of 2.5% mannitol and 2.0% resulted in the best small bowel distension, which was significantly higher than for 2.5% and 1.5% sorbitol solutions.

DISCUSSION:

Our data prove that 2.5% mannitol can be adequately substituted by 2.0% sorbitol for hydro MRI solutions. The use of 2.0% sorbitol solutions resulted in a bowel distension, which was only slightly lower compared to 2.5% mannitol. However, side effects were less intensive. Surprisingly, the administration of a 2.5% sorbitol solution led to a lower bowel distension than 2.0% sorbitol. This could be related to peristaltic deregulation, which may occur after the ingestion of high sorbitol concentrations. Thus, we recommend the use of 2% sorbitol solutions for optimal bowel distension combined with minimal side effects.

REFERENCES:

1. Lauenstein TC et al. Optimization of Oral Contrast Agents for MR Imaging of the Small Bowel. Radiology 2003;1:279-83.
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