Optimization of barium-based fecal tagging for MR colonography

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ABSTRACT:
Fecal tagging can obviate the need for bowel cleaning prior to MR colonography (MRC). Aim of this study was to optimize a barium-based fecal tagging model for MRC. 10 volunteers underwent MRC on 9 separate occasions using different tagging protocols. Amount, concentration and time range of the barium ingestion was varied. SI values of colonic feces were measured. Maximal reduction of the fecal material SI was achieved with the application of 210\% bariumsulfate at a dosage of 4x200ml in conjunction with the additives iron-oxide and lactulose.

INTRODUCTION:
MR colonography (MRC) has been proposed for colorectal cancer screening. One mayor limitation of this method concerning patient acceptance has been the need for bowel cleansing [1]. New techniques now offer the possibility to obviate bowel purgation by modifying the signal characteristics of stool: at this, patients have to ingest contrast agents prior to the MR examination (fecal tagging) [2]. One recent approach in conjunction with fecal tagging has been based on the oral application of bariumsulfate. Thus, signal of feces in T1w data sets can be decreased and stool becomes invisible due to similar signal characteristics as the water-consisting rectal enema. [3]. The administration of bariumsulfate should be optimized with regard to volume, concentration and timing. Furthermore, the effect of adding other signal reducing agents should be evaluated.

METHODS:
10 healthy subjects were studied. MRI was performed 9 different times on each volunteer. The imaging sessions were separated by a time lag of at least 8 days. In a randomized order the following parameters for fecal tagging were varied: ingestion of 100/200/300 ml of a barium-containing contrast agent (Micropaque\textsuperscript{®}; Guerbet, 1g Bariumsulfate/ml or Maxibar\textsuperscript{®}; EZEM, 2.1g Bariumsulfate/ml) with 4/6 main meals with/without an additional 200 ml two hours prior to the examination, with/without the ingestion of additive components (500mg iron-oxide/ 8g lactose). As an internal control, all subjects underwent MRC without fecal tagging. Imaging was performed on a 1.5T MR scanner (Magnetom Sonata, Siemens) using a T1-weighted 3D gradient-echo sequence (TR/TE/flip = 1.64/0.6/15). No spasmylocytic agent was administered. Neither intravenous nor rectal contrast media were applied. The signal intensity (SI) of the feces was measured in the ascending, transverse, descending and sigmoid colon. Average signal-to-noise ratios (SNR) and standard deviations as a parameter for the homogenization of stool’s signal intensity were calculated.

RESULTS:
Compared to controls without fecal tagging all tagging protocols led to a significant reduction in stool signal intensities (p<0.05). Mean SNR-values of the non-tagged stool amounted to 24.5. Maxibar proved superior to Micropaque. Ingestion of 100 ml was inferior to 200ml (p < 0.05). No benefit was associated with extending the barium ingestion from 4 to 6 meals or increasing the volume to 300ml per meal. Adding a fifth barium ingestion two hours prior to MRC did not further decrease fecal SI, while the ingestion of both lactose and iron-oxide did significantly lower stool SI (p<0.05). In addition, the administration of lactulose resulted in a better homogenization of stool’s signal with lowest standard deviation values. Optimal results were achieved with 200ml Maxibar applied for 4 meals and combined with both lactose and iron-oxide.

DISCUSSION:
Optimized Barium-based fecal tagging in conjunction with a dark-lumen MR colonography should be based on the ingestion of highly concentrated bariumsulfate in combination with lactulose and iron-oxide.

REFERENCES:

FIG 1: Mean SNR-values of 8 examination applying different tagging protocols and the internal control examination without fecal tagging.

FIG 2: Bright stool impresses in the examination without fecal tagging (A). While the application of 100\% barium leads to a moderate signal reduction of feces (B), best results were achieved using 210\% barium (C).