SEQUENTIAL FAST 3D MRI FOLLOWING ORAL INGESTION OF GD-DOTA - A NEW MEANS TO ASSESS INTESTINAL TRANSIT TIME

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Background:

Determination of intestinal transit times permits differentiation of various motility disorders of the gut. To date two techniques are in clinical use: conventional radiography following ingestion of radioopaque markers on three consecutive days [1] and sequential scintigraphy following ingestion of radionuclides.

Conventional radiography in conjunction with ingested markers is inexpensive and easy to perform. It does however expose patients to ionizing radiation limiting the number of possible follow-up examinations. Furthermore, the projectional nature of the radiograph can inhibit accurate localization of the markers in the small or large bowel, thereby causing considerable error.

Compared to conventional radiography, the radionuclide technique is cumbersome. Based on its long half life, In^{111} contained in about 20 ml of fluid is generally employed as the tracer. To offset difficulties regarding spatial localization due to the poor imaging characteristics inherent to In^{111}, scintigraphy is performed at short time intervals. Up to 15 images are collected over a 48 hour period making the technique costly. Furthermore, the ingested fluids may influence intestinal motility revealing a falsely shortened transit time.

Purpose:

To determine the feasibility of using a conventional paramagnetic contrast agent in conjunction with fast 3D MRI as a means for determining intestinal transit times.

Methods:

Three healthy male volunteers, without history of gastrointestinal symptoms or gastrointestinal surgery were studied. Informed consent was obtained from each subject in accordance with regulations set forth by the institutional review board. Gd-DOTA (Guerbet, Paris, France) was chosen as the contrast agent. The substance is a highly stable nontoxic aqueous phase marker, which has been documented to remain stable even in a highly acidic environment, is not absorbed in the intestines, and has no measurable influence on bowel motion [2, 3]. Furthermore the agent has been shown to provide excellent contrast for gastric emptying studies [4].

4 ml of 0,5 M Gd-DOTA were orally ingested as a single dose, following an overnight fast There was no preceding bowel cleansing. During the study the volunteers were allowed to eat without any restriction.

MR imaging was performed on a 1.5T system (Signa, EchoSpeed, GEMS, Milwaukee, WI), using the torso phased array coil for signal reception. Coronal 3D efgre data sets of the abdomen were collected with the following parameters: TR 5.1 ms, TE 1.2 ms, flip angle 45°, slice thickness 2.2 mm. Combined with a 38 x 32 cm FOV, a 256 x 192 matrix resulted an in plane resolution of 1.2 x 1.8 x 2.2mm, which was further improved by zero interpolation in all three planes. Each image set consisted of 84 sections and was collected breathheld over 28 seconds. Imaging was performed before, as well as 1 hour following the oral contrast ingestion and subsequently at 12 hour intervals up to 96 hours, or until the signal of the contrast bolus had disappeared.

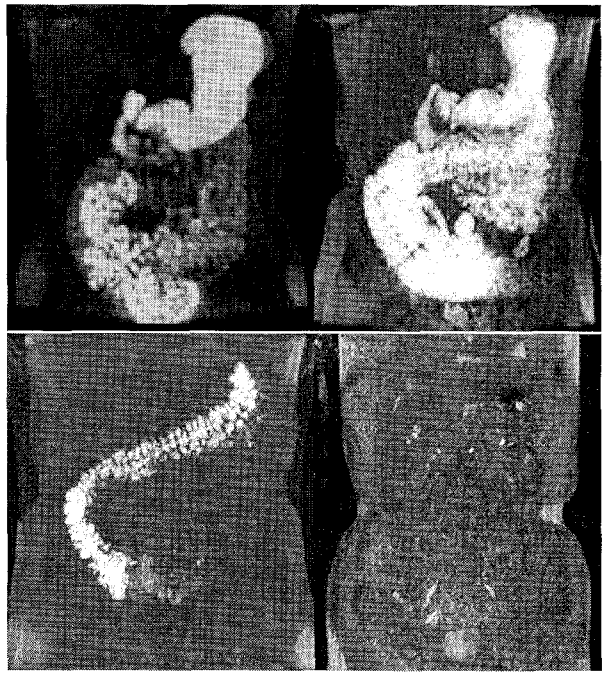

Fig 1: MIP projections of 3D data sets collected at 1 (a), 12 (b), 24 (c) and 36 hours following oral ingestion of 4 ml Gd-DOTA. The contrast bolus can be followed as it expands in the small bowel at 1 hour before it becomes visible in the transverse colon at 12 and 24 hours. In this volunteer contrast was no longer present in the colon at 96 hours.

Results:

All three volunteers tolerated the oral ingestion of Gd-DOTA well. Each imaging session lasted less than 5 minutes, including patient placement and removal from the MR table.

The ingested contrast material was well visible on the collected 3D data sets. Contrast transit through the stomach, small bowel and colon was easily followed. Furthermore, the bolus prolongation during the small bowel phase and subsequent colonic concentration could be monitored.

Conclusion:

Depiction of intestinal transit is possible with sequential 3D MRI following oral ingestion of Gd-DOTA. The technique is safe, quick and permits easy localization of the contrast within the gut. The ability to depict bolus concentration and contraction is of undetermined clinical significance.

References:

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