MR-Assessment of Postoperative Small Bowel Motility

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Purpose:

Postoperative gastro-intestinal paralysis is a significant problem after abdominal surgery. Discomfort ranges from abdominal cramps to nausea and vomiting. It leads to delayed hospital discharge and has a considerable impact on health care costs. Clinically, the postoperative assessment is based on auscultation, occurrence of flatulence and defecation, as well as qualification and quantification of reflux from the naso-gastric tube. However, these symptoms are non-specific indicators for intestinal dismotility. Currently there are only invasive techniques available to quantify small bowel motility such as manometry and measurement of the intestinal transit time by radio-opaque markers.

The aim of the study was to test the use of Magnetic Resonance Imaging (MRI) as a non-invasive and rapid method to visualize and quantify small bowel motility of patients after major abdominal surgery.

2. Material and Methods:

30 patients (15m, 15f; mean age: 62years ±13, mean weight: 70 kg±12; mean size: 168cm±8) were included 3 to 5 days (mean 4.0 days ±1.0) after colorectal surgery (CRS). The study was performed in accordance with the ethical committee and all patients gave written informed consent. Surgery was performed under general anesthesia. Neither bowel preparation nor additional drugs were used before or during the study. Imaging was done on a 1.5T Gyroscan
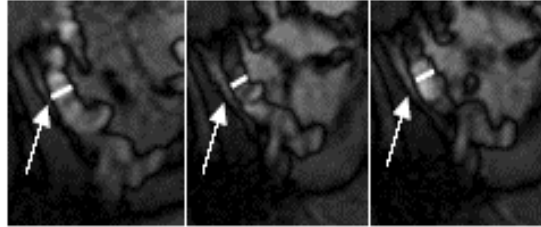
Fig 1: Repetitive acquisiton of coronal 2D balanced TFE data set of the same slice with 0.25 sec acquisition time. Crossectional measurement of the bowel diameters.

Intera (Philips Medical, Best, The Netherlands). The patient was placed feet first and supine using a sense phased array body coil with 4 dedicated coils. After the survey scan a coronal 3D TFE sequence with the following parameter was applied in apnoea for 17sec: TR 4.4, TE 1.3, flip angle 20°, FOV 420mm, rectangular FOV 95%, matrix 512 x 512, SENSE-factor 2, 80 slices, slice thickness 1.5mm. From this sequence three different images were selected for their display of either proximal, middle or distal segments of the small bowel. At these positions dynamic sequential coronal 2D balanced TFE sequences (TR/TE 2.7/1.3ms, Flip 45°, slice 10mm, matrix 192X512, FOV 500mm, SENSE factor = 2) with a slice repetition time of 0.25 sec were acquired during apnoea (17sec per dynamic scan).

On the dynamic images a small bowel segment was selected. A line was placed perpendicular to the long axis of the lumen and copied to all the other images of the series. The luminal diameter was measured along this line on each of the dynamic images (Fig. 1). The mean bowel diameter, the amplitude and the contraction frequency were calculated for all patients and plotted over time.

Different motility patterns were identified based on diameter, amplitude and frequency.
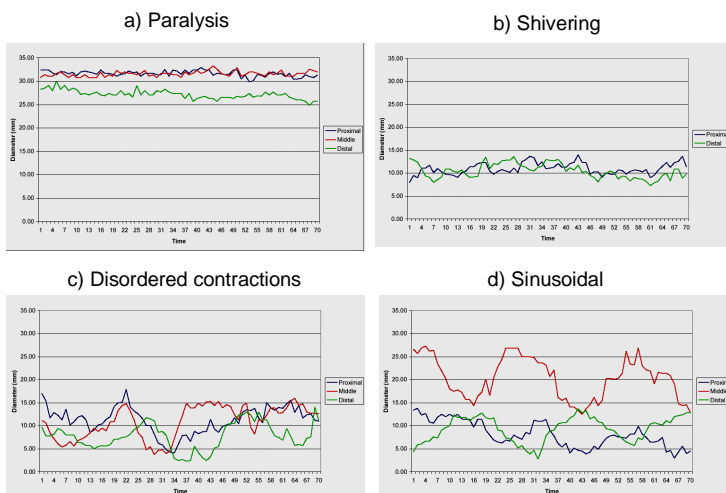
Fig 2: Small bowel motility pattern of patients 3 to 5 days after colorectal resection surgery. Measurements of cross sectional diameter of small bowel loops and plotted over time.

Display of four main motility pattern:

a) Paralysis: large diameter of the small bowel without any motility

b) Shivering: low amplitude and high frequency

c) Disordered contraction: Higher amplitudes without coordinated movement pattern

d) Sinusoidal motion corresponding to normal small bowel function

3. Results:

Imaging after CRS was well tolerated by all 30 patients. In all cases image quality was sufficient to measure the cross-sectional diameters (Fig 2), amplitudes and frequencies of the proximal jejunum, mid jejunum and distal ileum. The average diameter of the small bowel loops was 15.9 ± 2.5 mm with a wide range from max 38.3 to a minimum diameter of 1mm. The mean amplitude of the small bowel motility measurements was 10 ± 4.7 mm ranging from 22.7 to 2 mm.

Four main motility patterns were identified based on the plots (Fig. 2):

- paralysis: dilated diameter, low amplitude, low frequency: n=20.5 % of cases
- shivering: small diameter, low amplitude, high frequency: n=18%
- uncoordinated contractions: inconstant diameter, inconsistent amplitudes, low or high frequencies: n= 41%
- sinusoidal wave pattern: regular changing of diameter, constant amplitude, constant frequency: n=20.5%

4. Conclusions:

MRI provides a well tolerated non-invasive method for a qualitative and quantitative assessment of small bowel motility in patients after CRS. It does not require any bowel preparation such as intestinal cleansing, filling or contrast administration. Four motility patterns were observed (paralysis, shivering, uncoordinated contractions and sinusoidal wave patterns). The method has potential for the monitoring of pharmacological therapy, hydration management and nutrition on bowel motility after CRS.