Motility of the small bowel: comparison of spasmolysis with hyoscine versus glucagon

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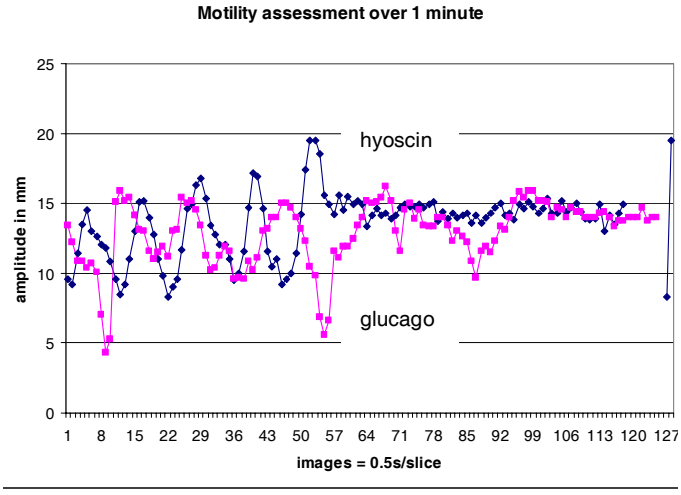
Introduction: Peristalsis of the small bowel leads to movement artefacts which impede the diagnostic quality of various radiological examinations. Mainly two paralyzing agents, hyoscine-butylbromide (Buscopan® Boehringer Ingelheim) or glucagon (GlucaGen Novo Nordisk®) are used to overcome this drawback and are injected intravenously shortly before performing abdominal imaging studies. Little has been reported about their local effect and pharmacological efficiency. Previously we have shown that MR with a high temporal resolution of 0.25s / image allows the visualization, quantification and characterization of small bowel motility [1]. Continous monitoring may be hampered by respiratory movement and displacement of bowel loops. The goal of the present study is to characterize intraindividually Buscopan® versus glucagon spasmolysis regarding small bowel motility based on MRI over a time period of 60 minutes.

Materials und Methods: Ten healthy volunteers, non-smokers (5f/5m; average age 32y; BMI 22 (19-29) prepared with a standardized 3 hours protocol (20ml oral Gd-DOTA/Dotarem® Guerbet; 40-60g Metamucil® / Ispaghula fibres) were imaged twice on a 1.5-T unit (Achieva, Philips Medical Systems, Best, The Netherlands) using a 4-channel SENSE body surface coil (array). Written informed consent was obtained from all volunteers and the study had been approved by our hospital ethical review board. Gastrointestinal motion was recorded for over 60 minutes on a stationary dynamic mode using a 2D T1-w gradient-echo sequence with the following parameters (TR/TE/FA = 4.0/1.1/25°; FOV=40cm; matrix 256x256; slice thickness 10mm, temporal resolution 540ms/slice). Data acquisition was performed in apnea, in prone position over 20s, followed by a break of 40s to allow respiration. After recording normal motility, either 40mg hyoscine (Buscopan®) or 1mg glucagon was administered intravenously. Analysis of motility was performed under blinded conditions on coronal cine-dynamics for the following parameters: time delay to spasmolytic effect, efficiency of spasmolysis, time delay and location of reappearing normal motility.

Results: Glucagon administration resulted in a complete arrest of small bowel movement in all cases, while slight shivering or slow spasms were still observed in 5/10 hyoscine studies. Both paralytic agents lead to an instantaneous and almost complete arrest shortly after injection, with 28.1s for Buscopan and 34.4 s for glucagon with no significant difference. Therefore imaging studies after these two agents may start early after injection. The first reappearing peristaltic motion was already observed after 369 ± 208s for Buscopan and 484 ± 218s for glucagon. Normalization of peristalsis was reached visually after 24.6 min for hyoscine and after 33.4 min for glucagon. Qualitatively, both spasmolytic agents presented a gradual reappearance of motility. Initial movements started in the proximal small bowel after iv Buscopan whereas motility reappeared in the distal ileum after iv glucagon. Normalization of peristalsis is significantly more variable with hyoscine (p=0.0025) compared to glucagon.

Tab 1: Means of 10 healthy subjects when comparing intraindividually hyoscine versus glucagon spasmolysis with MRI over 60 minutes:

Spasmolytic agent	T (onset)	T (reappearance)	Loc (reappearance)	T(normalization)
Hyoscine butyl bromide (Buscopan® ; iv 40mg)	28.1 s ± 8.9	6 min 9s ± 3 min 28s	Proximal	24.6 min ± 11
Glucagon (iv 1mg)	34 s ± 11.2	9 min 9 s ± 3 min 38 s	Distal – terminal ileum	33.4 min ± 5.1
p-values	**0.3**	**0.28**	**0.007**	**0.003**



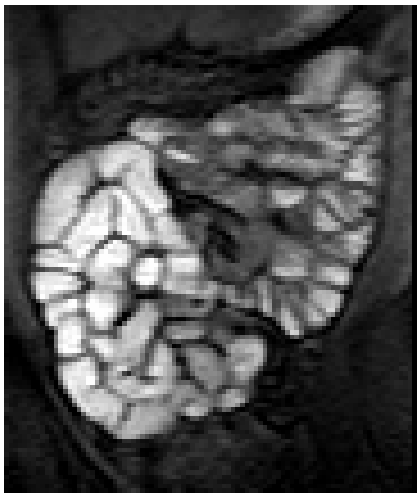


Figure 1A: Typical onset of effect for glucagon and buscopan for one volunteer – intravenous injection at time point t=0. Initially normal peristalsis is followed by complete arrest after 28s for hyoscine and 32s for glucagon. **B:** Cor. 2D T1-w small bowel image acquired within 0.5s demonstrating the well distended lumen and dark bowel wall after standardized preparation with oral Gd-DOTA and ispaghula fibres.

Conclusions: MRI allows monitoring of small bowel motility and pharmacological spasmolysis over time periods of even 60 minutes. Both hyoscine (40mg IV) and glucagon (1mg IV) induce a rapid instantaneous onset of spasmolysis, but with a more pronounced and reliable efficiency in the case of glucagon. Phases of complete arrest ideally suited for abdominal imaging without motion artifacts are found to be rather short and are within a range of 6 to 8 minutes. Reappearance of normal motility starts proximally in the case of hyoscine, whereas movements start from the terminal ileum after IV glucagon.

[1] Froehlich JM et al., JMRI 2005; 21(4): 370-5.