

Effects of Isoflurane and Edrophonium on Small Bowel Motility Monitored with Real-Time Interactive MRI

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INTRODUCTION: Real-time interactive MRI (RTIMRI) provides a mean for prolonged, noninvasive monitoring of small bowel peristalsis [1]. We previously applied this technique to evaluate the effects of glucagon and metoclopramide on peristalsis in human [2]. We present the results on the gastrointestinal effects of two other classes of drugs: gaseous anesthetic isoflurane and cholinesterase inhibitor edrophonium.

METHODS AND MATERIALS: Two Yorkshire female piglets (40 kg each) were fasted for 12 hours. Anesthesia was induced with Telazol at 5 mg/kg intramuscularly. Telazol is a centrally acting, dissociative anesthetic similar to ketamine. The animals were intubated, and orogastric tubes passed into the stomach. Light anesthesia was maintained with inhaled isoflurane. Four mg of ferric ammonium citrate (FAC) dissolved in 2 liter of water was infused into the stomach. A paramagnetic agent, FAC acts as a positive bowel contrast medium. The animals were put in right lateral decubital position for at least 30 minutes, allowing passage of contrast medium into the small bowel.

The animals were placed in prone position within the MR scanner. The contrast filled small bowel in the right abdomen was monitored continuously with RTIMRI at a scan rate of 2.5 frames per second, interpolated to 10 frames per second. The concentration of gaseous isoflurane delivered was decremented in steps starting from 5% by volume until spontaneous muscular movement occurs. Two-minute video clip was recorded at each decrement. At light sedation, 0.1 mg/kg of edrophonium was injected intravenously and the motility response recorded. Motility was evaluated in real-time by two observers in a consensus manner.

RESULTS: Small bowel peristalsis correlates inversely with the rate of isoflurane delivered. At deep sedation, there is a generalized paralysis of the small bowel. Peristalsis increases gradually at first with a reduction of anesthetic. Significant small bowel peristalsis is observed near the anesthetic level of spontaneous muscular movement.

At light sedation, edrophonium elicits a generalized increase in small bowel peristalsis. This effect has a rapid onset within one minute. It lasts for several minutes, most intense in the first two minutes. This

stimulatory effect is blunted by increased sedation.

DISCUSSION: Edrophonium is a fast acting, indirect-cholinomimetic agent that blocks the acetylcholinesterase degradation of endogenous acetylcholine, thereby enhancing parasympathetic stimulation of the gut. This stimulatory effect is well known and it is demonstrated in this experiment.

In contrast, little is known about the effects of gaseous anesthetics on gastrointestinal motility. Our results showed that small bowel motility is sensitive to and inhibited by isoflurane in a graded manner. Furthermore, the inhibitory effect of isoflurane is not completely reversible by edrophonium, suggesting a decrease in the release of endogenous acetylcholine at the nerve endplate or a direct inhibitory effect on the smooth muscle itself. This finding has important implications on gastrointestinal-motility studies using gas-anesthetized animal models.

Real-time interactive MRI proves to be an effective tool in the visualization and assessment of small bowel motility. This technique provides a direct, noninvasive mean to evaluate *in vivo* the effects of various pharmacological agents and their interactions.

REFERENCES:

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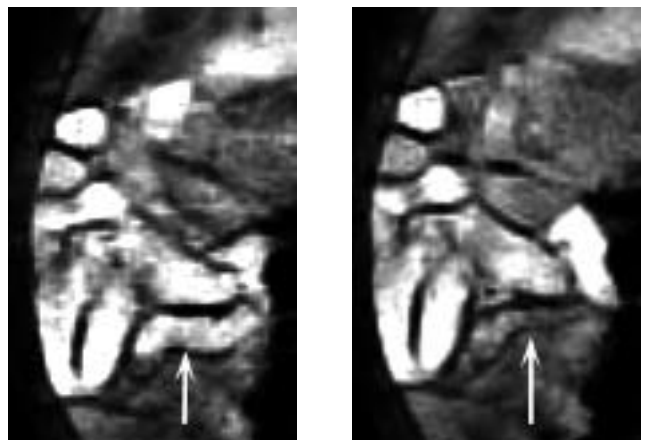


Figure 1: Small bowel of a pig enhanced by FAC. Arrows point to contracting bowel loop after edrophonium as administered.