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RESEARCH PAPER

Effect of prolonged general anesthesia with sevoflurane and laparoscopic surgery on gastric and small bowel propulsive motility and pH in dogs

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Abstract

Objective To determine if general anesthesia with sevoflurane and laparoscopic surgery changed gastric and small bowel propulsive motility or pH in dogs.

Study design Prospective, controlled trial.

Animals Twelve, 19–24 months old, female, Treeing Walker Hound dogs, weighing 23–30 kg.

Methods Dogs were anesthetized for a median of 8.5 hours during another study to determine the minimum alveolar concentration of sevoflurane using a visceral stimulus. Gastric and small bowel motility were determined using a sensor capsule that measures pressure, pH and temperature. Gastric transit time and motility index were calculated. For 8/12 dogs, gastric motility, pH and transit time were measured. In 4/12 dogs, small bowel motility and pH were measured.

Results Anesthesia decreased gastric and small bowel motility but did not change luminal pH. Mean gastric contraction force decreased from median (range) 11 (8–20) to 3 (1–10) mmHg ($p < 0.01$) and gastric motility index decreased from 0.63 (0–1.58) to 0 (0–0.31; $p = 0.01$). Frequency of contractions did not change, 3.7 (1.6–4.4) *versus* 2.8 (0.1–5.1) contractions minute^{-1} ($p = 0.1$). Gastric motility returned to normal 12–15 hours following anesthesia. Gastric emptying was prolonged from 12 (5.3–16) to 49 (9.75–56.25) hours ($p < 0.01$). Mean small bowel contraction force decreased from 34 (24–37) to 3 (0.9–17) mmHg ($p < 0.02$) and motility index decreased from 3.75 (1–4.56) to 0 (0–1.53; $p = 0.02$). Frequency of contractions did not change, 0.5 (0.3–1.4) *versus* 1.4 (0.3–4.6) contractions minute^{-1} ($p = 0.11$). Small bowel motility returned within 2 hours after anesthesia. Laparoscopy did not result in changes to gastric or small bowel parameters beyond those produced by general anesthesia.

Conclusions and clinical relevance The force of gastric and small bowel contractions decreased during sevoflurane anesthesia for laparoscopy. Although gastric motility returned to normal within 12–15 hours the impairment of gastric emptying lasted 30–40 hours, predisposing dogs to postoperative ileus.

Keywords motility, post-operative ileus, smartpill, stomach, transit time.

Introduction

Postoperative gastrointestinal complications such as functional ileus, vomiting and constipation have been reported in humans, horses, rats, sheep and dogs (Tinckler 1965; Van der Gaag et al. 1981; Furuta et al. 2002; Behm & Stollman 2003; Trudel et al. 2003; Yanagida et al. 2004; Senior et al.

2006). In client owned dogs, the only report indicates that postoperative ileus (POI) occurred in 8% of 109 ovariohysterectomies evaluated. The dogs showed postoperative clinical signs and radiological features of ileus (Van der Gaag et al. 1981). An additional case report from a dog reports aerophagia with gastric dilation following anesthesia (Savas et al. 2001). It is the authors' experience that while post-operative gastrointestinal (GI) complications are infrequent, they appear to occur with some prevalence in geriatric or severely compromised dogs following abdominal surgery. Direct GI manipulation during surgery is considered one of the leading causes for post-operative GI dysfunction (Tinckler 1965; Graves et al. 1989; Behm & Stollman 2003; Yanagida et al. 2004; Senior et al. 2006). However, similar complications have been observed following anesthesia in the absence of abdominal surgery (Tinckler 1965; Little et al. 2001; Andersen et al. 2006; Senior et al. 2006; Maron & Fry 2008).

Studies in humans, horses and dogs have shown that general anesthesia alone can negatively impact GI motility and induce POI (Tinckler 1965; Schurizek et al. 1989; Lester et al. 1992; Durongphongtorn et al. 2006). The studies suggest that all of the inhaled and injectable anesthetics tested, except nitrous oxide, decreased GI motility (e.g. cyclopropane, ether, halothane, enflurane, isoflurane, xylazine, ketamine, diazepam, thiopental, guaifenesin, opioids). The anesthetics tested decreased the myoelectrical activity amplitude and prevented the normal inter-digestive migratory motor complexes from occurring throughout the GI tract. The outcome parameters measured showed a delay in time to first flatus, time to first solid bowel movement, time to start eating and time to hospital discharge (Behm & Stollman 2003).

In the present study we investigated whether general anesthesia and laparoscopic surgery decreased GI activity or changed GI luminal pH in dogs. Propulsive motility was measured as it represents movement of luminal contents through the GI tract. For example, administration of opioid drugs increases GI myoelectrical activity but decreases GI propulsive motility, delays gastric emptying and induces small and large bowel stasis (Bardon & Ruckebusch 1985; Roger et al. 1994; Wood & Galligan 2004; Boscan et al. 2006).

To measure propulsive motility, a commercially available wireless motility capsule (WMC) was employed (SmartPill® Corporation, NY, USA). The WMC is a minimally-invasive sensor that simultaneously measures intraluminal pressure, pH and temperature. This technique has been validated for the study of GI propulsive activity and transit time in humans (Kuo et al. 2007; Sarosiek & Majewski 2007; Parkman 2009; Rao et al. 2009) and dogs (Boillat et al. 2010a,b).

Material and methods

Twelve healthy adult female Treeing Walker Hound dogs, median (range) 21 (19–24) months, old, weighing 27.2 kg, (23–30) kg with body condition scores of 5–6/9 (Toll et al. 2010) were utilized for the study. The dogs were anesthetized as part of a separate study to test the minimum alveolar concentration (MAC) of sevoflurane during ovarian ligament stimulation (Boscan et al. 2011a,b). The study was approved by the University animal care and use committee (protocol 10-1935A).

Fourteen days prior the study, the dogs were acclimated and housed in individual runs to accustom them to the environment. The environment consisted of 12 hours light/dark cycle, environmental enrichment and playing time with people and other dogs 2–4 times per day, the room temperatures ranged between 20–22 °C. The dogs were fed twice daily with dry Purina EN[a] according to their resting energy requirements ($30 \times$ BW (kg) + 70 kcal day^{-1}; Toll et al. 2010). For the unanesthetized control data, on the study day, dogs were fasted overnight for 12 hours. In the morning, between 07:00–07:30 hours, the dogs were fed their respective calculated morning meal. Following their morning meal, the WMC was administered with 30 mL of water and thereafter the dogs were fed following their regular schedule. The dogs had water available at all times.

At least 7 days were allowed after the WMC exited the body before the dogs were anesthetized for the MAC determination and laparoscopic ovariectomy. The dogs were randomly assigned to either the gastric or the small bowel motility groups. For the dogs in the gastric motility group the WMC was administered between 07:00–07:30 hours on the same day as it was anesthetized. For the dogs in the small bowel motility group, the WMC was administered the day before anesthesia between 13:00 and 16:00 hours. For both groups, dogs were fasted for 12 hours before administration of the WMC. The WMC was administered with 30 mL of water immediately after their morning meal, mimicking the conditions used for the control study. After

