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RESEARCH PAPER

Assessment of cardiac troponin I and C-reactive protein concentrations associated with anesthetic protocols using sevoflurane or a combination of fentanyl, midazolam, and sevoflurane in dogs

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Abstract

Objective To report serum cardiac troponin I (cTnI) and C-reactive protein (CRP) concentrations in dogs anesthetized for elective surgery using two anesthetic protocols.

Study design Prospective, randomized clinical study.

Animals Twenty client-owned dogs presenting for elective ovariohysterectomy or castration.

Methods The dogs were randomized into two groups. All dogs were premedicated with glycopyrrolate (0.011 mg kg^{-1}) and hydromorphone (0.1 mg kg^{-1}) IM approximately 30 minutes prior to induction of anesthesia. Anesthesia in dogs in group 1 was induced with propofol (6 mg kg^{-1}) IV to effect and in dogs in group 2 with diazepam (0.2 mg kg^{-1}) IV followed by etomidate (2 mg kg^{-1}) IV to effect. For maintenance of anesthesia, group 1 received sevoflurane (adjustable vaporizer setting 0.5–4%) and group 2 received a combination of fentanyl (0.8 μg kg^{-1} $minute^{-1}$) and midazolam (8.0 μg kg^{-1} $minute^{-1}$) IV plus sevoflurane (adjustable vaporizer setting 0.5–4%) to maintain anesthesia. Serum cTnI and CRP concentrations were measured at baseline and 6, 18, and 24 hours post-anesthetic induction. Biochemical analysis was performed at baseline. Lactate was obtained at baseline and 6 hours post-anesthetic induction. Heart rate and mean arterial blood pressure were measured intra-operatively.

Results Baseline serum cTnI and CRP concentrations were comparable between groups. A significant difference in serum cTnI or CRP concentrations was not detected post-operatively between groups at any time point. Serum CRP concentrations were significantly increased post-anesthetic induction in both groups, which was attributed to surgical trauma.

Conclusions and clinical relevance There was no significant difference in serum cTnI and CRP concentrations between anesthetic protocols. Further investigation in a larger number of dogs is necessary to confirm the current findings.

Keywords anesthesia, biomarker, canine.

Introduction

The goal of balanced anesthesia is to utilize lower doses of a combination of anesthetic agents to maximize their effects while minimizing hemodynamic compromise and adverse affects. Myocardial injury can occur during anesthesia and surgery as a result of myocardial ischemia (Zaugg et al. 2004). According to the theory of myocardial preconditioning, exposing the myocardium to nonfatal periods of ischemia may be protective against later ischemic insults (Murry et al. 1986; Ovize et al. 1992). Several anesthetic agents have been documented to imitate the effects of myocardial preconditioning and thus diminish the effects of ischemia. The inhalant anesthetic agents, isoflurane and sevoflurane, confer myocardial protection by increasing the rate of myocardial recovery and function following reperfusion (Warltier et al. 1988; Schlack et al. 1998; Toller et al. 1999). Injectable anesthetic agents, including fentanyl and propofol, have myocardial protective benefits that are less pronounced than those of inhalant anesthetic agents (Malagon et al. 2005; Cromheecke et al. 2006). Although the exact mechanism of myocardial protection varies between causes of myocardial ischemia and anesthetic agent, the effects have been observed in many species including rabbits, rats, dogs and humans (Murry et al. 1986; Shizukuda et al. 1992; Cason et al. 1997; Schultz et al. 1997; Cromheecke et al. 2006).

Cardiac troponins are sensitive and specific markers for myocardial damage (Babuin & Jaffe 2005). Cardiac troponin I (cTnI) is an intracellular contractile protein specific to the myocardial cell and is the biomarker of choice for the identification of myocardial damage (Babuin & Jaffe 2005; Schober 2005). Pelander et al. reported that 49% (44/89) of apparently healthy dogs had serum cTnI concentrations below the detection limit while 48% (43/89) had concentrations between 0.2 and 0.5 μg L^{-1} (Pelander et al. 2002). In humans and in dogs, cardiac troponin concentrations correlate well with myocardial infarct size (Mair et al. 1995; Ricchiuti et al. 1998). Cardiac troponin I increases are related to an early cytosolic release associated with cellular damage often followed by a persistent increase that is related to structural damage. In dogs, cTnI concentrations are increased 4–6 hours following coronary artery occlusion and peak at approximately 12–24 hours after such an insult (Burgener et al. 2006). Elevations in cardiac troponin I concentrations have been documented in dogs with cardiac disease, infectious diseases (i.e. *Babesia*, *Leptospira*, *Trypanosoma cruzi*), and pyometra and have been shown to correlate with survival in dogs with gastric dilatation volvulus (Lobetti et al. 2002; Schober et al. 2002; Oyama & Sisson 2004; Barr et al. 2005; Spratt et al. 2005; Hagman et al. 2007; Mastrorilli et al. 2007; Pelander et al. 2008).

C-reactive protein (CRP) is an acute phase protein and nonspecific indicator of inflammation produced by the liver in response to infection, necrosis, trauma, malignancy, immune mediated disease, and other inflammatory diseases (Pepys & Hirschfield 2003). Measurable increases in serum CRP concentrations occur in humans with cardiovascular disease, but also with many other diseases (Osman et al. 2006). Although type of anesthesia and surgery performed influence the stress response, there are few reports with mixed results regarding the influence of anesthesia on serum CRP concentrations in humans (Brix-Christensen et al. 1998; Buyukkocak et al. 2005, 2006). In a study with children undergoing routine surgery, post-operative elevations in serum CRP concentrations occurred with four different anesthetic protocols, but were attributed to surgical inflammation (Buyukkocak et al. 2005).

Although there has been research evaluating various anesthetic agents and their effects on serum cTnI and CRP concentrations in humans, to the authors' knowledge there have not been similar studies published in dogs. The purpose of this study is to report serum cTnI and CRP concentrations in dogs anesthetized for elective ovariohysterectomy and castration using two anesthetic protocols.

Materials and methods

Twenty client-owned dogs presenting to the Texas A&M University Veterinary Teaching Hospital for routine elective surgical procedures were prospectively enrolled in the study after informed consent was obtained from the owner (Table 1). This study was reviewed and approved by the Clinical Research Review Committee of the University. Dogs were healthy, not receiving any medications with the exception of parasite prevention. None of the dogs had historical or physical examination findings suggestive of heart disease and none had been placed previously under general anesthesia. Anesthesia protocols were selected to represent two forms of balanced anesthesia that are routinely used

