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RESEARCH PAPER

Comparison of isoflurane and propofol for maintenance of anesthesia in dogs with intracranial disease undergoing magnetic resonance imaging

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Abstract

Objective To compare isoflurane and propofol for maintenance of anesthesia and quality of recovery in client-owned dogs with intracranial disease undergoing magnetic resonance imaging (MRI).

Study design Prospective, randomized, clinical trial.

Animals Twenty-five client-owned dogs with intracranial pathology, 13 females and 12 males, ages 11 months to 13 years, weighing between 3.0 and 48.0 kg.

Methods Each dog was randomly assigned to receive propofol or isoflurane for maintenance of anesthesia. All dogs were not premedicated, were administered propofol intravenously to effect for induction, intubated and mechanically ventilated to maintain an end-tidal carbon dioxide tension 30–35 mmHg (4.0–4.7 kPa). Temperature and cardiac output were measured pre- and post-MRI. Scores for mentation, neurological status, ease of maintenance, and recovery were obtained pre- and post-anesthesia. Pulse oximetry, end-tidal gases, arterial blood pressure, heart rate (HR) and requirements for dopamine administration to maintain mean arterial pressure (MAP) >60 mmHg were recorded throughout anesthesia.

Results End-tidal isoflurane concentration was 0.73 ± 0.35% and propofol infusion rate was 292 ± 119 μg kg^{-1} $minute^{-1}$. Cardiac index was higher, while HR was lower, with propofol than isoflurane in dogs younger than 5 years, but not in older dogs. Dogs maintained with isoflurane were 14.7 times more likely to require dopamine than propofol dogs. Mentation and maintenance scores and temperature were not different. MAP and diastolic arterial pressure were higher in the propofol group. Recovery scores were better with propofol, although times to extubation were similar. Change in neurological score from pre- to post-anesthesia was not different between treatments.

Conclusions Dogs maintained with propofol during MRI had higher arterial pressures, decreased requirements for dopamine, and better recovery scores, compared to dogs maintained with isoflurane.

Clinical relevance Propofol anesthesia offered cardiovascular and recovery advantages over isoflurane during MRI in dogs with intracranial disease in this study.

Keywords anesthesia, brain, isoflurane, propofol.

Introduction

Magnetic resonance imaging (MRI) under general anesthesia is a major part of the diagnostic work-up for veterinary patients suspected of having intracra-

nial disease. Intracranial diseases in dogs may consist of inflammatory disease (encephalitis, meningoencephalitis), neoplasia, cerebrovascular accident, congenital anomaly or traumatic brain injury. Often a concurrent increase in intracranial pressure (ICP) is noted with these conditions and inappropriate anesthetic management and monitoring can cause even greater increases in ICP due to changes in cerebral hemodynamics, which can result in ischemic damage or fatal brain herniation (Bendo et al. 2006; Harvey et al. 2007).

Inhalation anesthetic agents impede many of the body's mechanisms that preserve cerebral perfusion pressure (CPP) and can increase ICP through direct vasodilation of cerebral vasculature (Sakabe & Matsumoto 2010). Inhalation anesthetics and opioids can cause significant respiratory depression and hypercapnia leading to cerebral vasodilation. Decreased mean arterial pressure (MAP), due to either decreased systemic vascular resistance or decreased cardiac output is also a common consequence of administration of anesthetic drugs (Goodchild & Serrao 1989; Ebert 2006). Cerebral autoregulatory mechanisms preserve a constant blood flow to the brain over a MAP of 50–150 mmHg (Bendo et al. 2006; Harvey et al. 2007; Green 2010). Outside this range, the body is unable to maintain constant CPP, and the brain is at risk for ischemic or hemorrhagic damage.

Total intravenous anesthesia (TIVA) with propofol, in contrast to inhalation anesthesia, has been recommended in human anesthesia based on laboratory and clinical data, to maintain cerebral perfusion and minimize changes in ICP in patients with intracranial disease (Van Hemelrijck et al. 1991; Kahveci et al. 2001; Petersen et al. 2003). The optimal anesthetic protocol for canine patients with intracranial disease has not been defined in the veterinary literature. Recent papers have primarily evaluated recovery quality (Lozano et al. 2009; Jimenez et al. 2012). A clinical study in dogs undergoing MRI comparing anesthetic recovery time and quality between sevoflurane, isoflurane, and desflurane, did not demonstrate a statistical difference between inhalation agents, although dogs tended to recover faster with desflurane (Lozano et al. 2009).

A literature search using the keywords dog, brain, MRI, propofol and isoflurane failed to reveal any study that compared TIVA with inhalation anesthesia in dogs with intracranial disease. The objectives of this study were to compare isoflurane and propofol administration in client-owned dogs with intracranial disease undergoing MRI by evaluating maintenance of anesthesia with respect to quality and cardiovascular function, and recovery from anesthesia by recording quality, time, and neurologic scoring. Our hypothesis was that an infusion of propofol would result in more desirable scores than isoflurane anesthesia in dogs with intracranial disease.

Materials and methods

Animals

All procedures were approved by the Animal Care Committee, University of Guelph, and followed the Canadian Council of Animal Care Guidelines. Thirty client-owned dogs (13 male, 17 female) admitted to the Ontario Veterinary College-Health Sciences Centre (OVC-HSC) with signs of intracranial disease requiring a diagnostic MRI (Signa 1.5 Tesla Excite II, Software Version 1.1 GE Healthcare, PA, USA) of the brain were used in the study. Informed owner consent was obtained prior to anesthesia in all cases. All dogs underwent physical and neurological examinations. Pre-anesthetic stabilization of the patient's neurological disease was conducted as dictated by the patient's clinical signs, and at times included the administration of steroids, opioid analgesics, or hyperosmolar agents. Dogs with significant cardiovascular disease or anemia were excluded from the study. Dogs were also excluded if MRI and cerebrospinal fluid (CSF) analysis were normal, and neurological exam did not strongly indicate the presence of an intracranial lesion.

Anesthesia and instrumentation

A catheter (Insyte-W; Becton Dickinson Infusion Therapy Systems, UT, USA) was inserted into a cephalic vein before anesthesia. No premedication was administered. Dogs were randomly assigned to one of two treatments for anesthetic maintenance (AM), propofol (Diprivan 1%; AstraZeneca, ON, Canada) or isoflurane (IsoFlo; Abbott Animal Health, IL, USA). Propofol was administered intravenously (IV) for induction of anesthesia in dogs of both groups. After endotracheal intubation the dogs were connected to a non-compatible MRI small animal anesthesia machine with rebreathing circuit (Universal F-Circuit; Dispomed, QC, Canada) using an oxygen flow of 1.5–2.5 L minute^{-1}. The anes-

