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A comparison of cardiopulmonary and anesthetic effects of an induction dose of alfaxalone or propofol in dogs

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**Introduction:** The objective was to compare physiological parameters, arterial blood gas values, and induction and recovery quality after intravenous injection of alfaxalone or propofol in dogs.

**Methods:** Eight adult female dogs were randomly assigned to receive either alfaxalone 4 mg kg-1 or propofol 8 mg kg-1 to effect, intubated and allowed to breathe room air. Following a six-day washout the alternative drug was administered. Temperature, pulse rate, respiratory rate, direct blood pressure, and arterial blood gases were measured before induction, immediately post-intubation, and at 5 minute intervals until extubation. A single blinded investigator determined scores and adverse events. A paired 2-way t-test was used to evaluate normally distributed data and Wilcoxon matched pairs test for non-normally distributed data. Frequency of adverse events was evaluated with a Chi-square test.

**Results:** There were no significant differences in physiological parameters, arterial blood gas values, or time from intubation to extubation between alfaxalone and propofol (11 vs. 6 minutes; p=0.09). Alfaxalone resulted in a longer time to standing after extubation (12 vs. 5 minutes; p=0.0004). Induction, recovery, and ataxia scores were not different between groups; however, dogs receiving alfaxalone were more likely to have >1 adverse event than propofol (6/8 vs. 1/8; p=0.04) which included struggling, vocalization, tremor, and paddling.

**Conclusion:** Single boluses of alfaxalone or propofol had similar effects on cardiopulmonary physiology. Alfaxalone resulted in longer recovery times and more adverse events compared to propofol.

Comparison of the cardiovascular effects of acepromazine versus trazodone as pre-medications in dogs anesthetized for TPLO or TTA surgical procedures

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**Introduction:** Trazodone use in dogs for peri-operative anxiolysis is increasing. The anxiolytic effects of trazodone are due to serotonin 5-HT2A and alpha-adrenergic receptor antagonism. Little is known about the cardiovascular effects of trazodone in dogs under anesthesia. It was hypothesized that trazodone would cause less hypotension in patients under anesthesia in comparison to acepromazine.

**Methods:** Thirty healthy, client-owned dogs (2-11 yrs; 8.6-54.5 kg) scheduled for orthopedic surgery, were randomly assigned to two groups. One group (n = 15) received acepromazine (0.01-0.05 mg kg-1) with morphine (1 mg kg-1, IM) 30 minutes before induction. The other group (n = 15) received trazodone (5 mg kg-1 for patients > 10kg or 7 mg kg-1 for patients ≤ 10kg, PO) two hours prior to induction. Thirty minutes before induction, trazodone patients were administered morphine (1 mg kg-1, IM). Dogs were induced with propofol (4-6 mg kg-1, IV) to effect, maintained on isoflurane or sevoflurane in oxygen or oxygen/N2O (1:2). A bupivacaine (0.5 mg kg-1) and morphine (0.1 mg kg-1) epidural was administered before surgery. Patients were monitored continuously, parameters recorded every 5 minutes during anesthesia and included HR, RR, SpO2, ECG, blood pressure (direct and indirect) and anesthetic depth. A two-sample t test (p ≤ 0.05) was used to compare hemodynamic parameters (HR, SAP, MAP, DAP).

**Results:** No significant differences were found among the cardiovascular parameters evaluated between acepromazine and trazodone. One male dog that received trazodone experienced priapism but was treated successfully. No other adverse effects were reported.

**Conclusion:** Peri-operative, oral trazodone was cardiovascularly similar to acepromazine under general anesthesia. Trazodone appears to be safe for use pre-operatively in healthy dogs undergoing anesthesia.

Fentanyl decreases sevoflurane minimum alveolar concentration preventing motor movement (MACNM) in dogs without evidence of acute tolerance

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**Introduction:** The objectives of this study were to determine the effects of fentanyl on sevoflurane MACNM, and to evaluate if acute tolerance develops.

**Methods:** Baseline sevoflurane MACNM (MACNM-B) was determined using a noxious stimulus (50V, 50Hz for 10 msec) in six, mixed-breed, intact male dogs (2-3 years) on three occasions. Dogs were randomly assigned to fentanyl treatments (T) as a loading dose (Ld) and CRI: T1 - 7.5 µg kg-1 and 3.0 µg kg-1 hr-1; T2 - 15.0 µg kg-1 and 6.0 µg kg-1 hr-1; T3 - 30.0 µg kg-1and 12.0 µg kg-1 hr-1. The MACNM was defined as the lowest end-tidal sevoflurane preventing motor movement, and was determined in duplicate on each occasion. The first post-treatment MACNM (MACNM-I) determination was initiated 90 minutes after the start of the CRI, and a second MACNM (MACNM-II) determination was initiated three hours after MACNM-I was established. Plasma was collected for fentanyl analysis at the time of each MACNM determination. Data were analyzed using a mixed-model ANOVA.

**Results:** The overall median MACNM-B for all groups was 2.55%. All treatments decreased (p<0.05) MACNM-B, and the decrease from baseline was 21.6%, 35.0% and 40.6% for T1, T2 and T3, respectively. Percentage change in T1 differed (p<0.05) from T2 and T3, however T2 did not differ from T3. MACNM-I was not significantly different from MACNM-II within treatments.

**Conclusion:** Fentanyl doses in the range of 3-12 μg kg-1 hr-1 (2.2 -12.5 ng mL-1) significantly decreased the sevoflurane MACNM. Tolerance to fentanyl did not occur under the study conditions.

Minimal infusion rate of alfaxalone for total intravenous anaesthesia (TIVA) after sedation with acepromazine or medetomidine in cats undergoing ovariohysterectomy

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**Introduction:** Pharmacokinetic studies in cats (Whittem et al. 2008) suggested an alfaxalone TIVA rate of 7-8 mg kg-1 hour-1.

**Methods:** Cats undergoing ovariohysterectomy were randomly assigned into two groups: together with butorphanol (0.2 mg kg-1 intramuscularly [IM]), group AA (*n=*14) received acepromazine (0.1 mg kg-1 IM), group MA (*n=*14) medetomidine (20 µg kg-1 IM). Thirty minutes later, anaesthesia was induced with alfaxalone to effect (0.2 mg kg-1 intravenously [IV] every 20 seconds), initially maintained with 8 mg kg-1 hour-1 alfaxalone IV and the rate adjusted (±0.5 mg kg-1 hour-1) every 5 minutes according to alteration >10% in heart rate (HR) and/or indirect systolic arterial pressure (SAP). Increased HR >10% with decreased SAP >10% and vice versa no rate change. Alfaxalone rate was increased if HR was >220 beats minute-1 with SAP >90 mmHg, palpebral reflex (PB) present or after additional alfaxalone bolus IV (movement/swallowing: 0.5 mg kg-1, respiratory rate (*f*r) >40 breaths minute-1: 0.25 mg kg-1). Alfaxalone rate was decreased if HR <70 beats minute-1 or apnea occurred. Meloxicam (0.2 mg kg-1 IV) was administered postoperatively. Data were analyzed using linear mixed models, chi square and  
t-tests with p≤0.05 for significance.

**Results:** Induction dose was significantly lower in group MA. Intraoperative bolus requirements and TIVA rates (group AA: 11.62 ± 1.37, group MA: 10.76 ± 0.96 mg kg-1 hour-1) did not differ between groups. In group MA, *f*r, end-tidal CO2 and SAP were significantly higher, HR lower and PR less observed. No cat became apnoeic.

**Conclusion:** Minimal alfaxalone TIVA rates after acepromazine or medetomidine in cats undergoing ovariohysterectomy were higher than in other studies.

The sedative and postoperative analgesic effects of methadone premedication compared to butorphanol and buprenorphine in cats undergoing neutering

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**Introduction:** Sedative and analgesic properties of methadone, butorphanol and buprenorphine with acepromazine were evaluated in cats undergoing neutering.

**Methods:** Twenty-four female and twenty-one male healthy cats were enrolled in this randomised, blinded, prospective study with ethical approval and owner consent. Cats received one of three opioids combined with acepromazine (0.05 mg kg-1) IM for premedication: Group1: buprenorphine (20 µg kg-1); group2: methadone (0.5 mg kg-1); group3 butorphanol (0.4 mg kg-1). Sedation was assessed 30 minutes after premedication using a visual analogue scale (VAS). Anaesthesia was induced with alfaxalone and maintained with isoflurane in oxygen. Surgical ovariohysterectomy or castration was performed. Pain was assessed using an interactive VAS score (IVAS) at 90 minutes, then hourly from 2 to 8 hours after premedication. Methadone (0.5mg kg-1 IM) and meloxicam (0.2 mg kg-1 SC) were provided six and eight hours after premedication respectively or together as rescue analgesia (IVAS above 50). Pain and sedation scores were analysed using Kruskal–Wallis test, with post hoc tests if appropriate, induction agent dose and rescue analgesia required with one-way ANOVA and Cochran’s Q test respectively(significance set at p<0.05).

**Results:** Sedation scores, induction agent dose, pain scores at all time points and rescue analgesia required were not statistically different between groups. No cats required rescue analgesia after the second dose of methadone. No adverse effects occurred peri-operatively.

**Conclusion:** Methadone combined with acepromazine provided comparable sedation and analgesia to both buprenorphine and butorphanol. Differences in analgesic efficacy between opioids might have been undetectable because of the surgical model and surgeon competency.

Effects of anesthetic drugs on spleen size analyzed by computerized tomography

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**Introduction:** This project studied the effects of commonly used anesthetics given as single drugs on spleen size.

**Methods:** Five beagle dogs were used in this study in a crossover design. Spleen sizes were measured using volume values generated by computerized tomography. The dogs were scanned for baseline volume (saline group) and for drug effect ten minutes after IV injection of the assigned treatment. Sequential spleen areas obtained from 2-D slices of 2.5 mm thickness were highlighted for volume calculation using image processing software. Repeated Measurement Analysis of Variance (RM-ANOVA) was performed followed by Tukey post-test (p<0.005). Handling was limited by maintaining the dog in the crate during abdominal image acquisition and providing ten minutes for acclimation. Treatments were randomly provided, 7 days apart, and consisted of: saline, IV (S); acepromazine 0.03 mg kg-1, IV (A); thiopental 8 mg kg-1, IV (T); hydromorphone 0.1 mg kg-1, IV (H); and dexmedetomidine 0.005 mg kg-1, IV (D).

**Results:** Acepromazine and thiopental spleen volumes were similar (p=0.8710) and both were similar to saline (p=0.0154 and 0.0215, respectively). Hydromorphone was similar to dexmedetomidine (p=0.1442) and saline (p=0.0334), but hydromorphone differed from acepromazine (p=0.0001) and thiopental (p=0.0002). Dexmedetomidine was different from acepromazine (p=0.0029) and thiopental (p=0.0042), but similar to saline (p=0.4397).

**Conclusion:** We conclude that dexmedetomidine and hydromorphone have a tendency for the smallest spleen, and that acepromazine and thiopental have it for the largest spleen, volume. The lack of significance of acepromazine and thiopental compared to saline, both drugs known to cause splenomegaly, can be justified by the limited sample size.

Efficacy of psoas compartment femoral nerve block and parasacral sciatic nerve block in dogs presenting for pelvic limb amputation

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**Introduction:** Combination iliopsoas compartmental femoral nerve block and parasacral sciatic plexus block offers advantages including unilateral regional analgesia over epidural in dogs presenting for pelvic limb amputation. Analgesic efficacy of this combination has not been evaluated in clinical patients.

**Methods:** Eighteen patients were randomized to receive 2 mg kg-1 bupivacaine or an equivalent volume of saline for nerve blocks. This dose was divided 2/3 for iliopsoas, 1/3 for parasacral sciatic block. All dogs were premedicated with 0.5 mg kg-1 morphine and 0.02 mg kg-1 atropine SC, induced with propofol 10.0 ± 4.9 mg kg-1 and maintained with 1.25 ± 0.33% Isoflurane. Dogs were monitored with direct arterial blood pressure, ECG, end-tidal gases, respiratory rate and esophageal temperature. Intraoperative rescue analgesia of 2 μg kg-1 fentanyl was given by the blinded anesthetist in response to >10% change in any monitoring parameter. Pain scores were assessed postoperatively by blinded observers at 0, 30, 60 and 120 minutes, the morning after surgery, three and ten days later. Analysis included: Mann-Whitney for fentanyl boluses/pain scores and two-way ANOVA-repeated measures for vital parameters/airway gases.

**Results:** Intraoperative fentanyl boluses were significantly lower in the bupivacaine group (6±2.2 vs. 2.7±1.1, p <0.01) as well as postoperative pain scores at time 0 (1.4±2.2 vs. 3.5±3, p<0.05) and 30 min (1.5±1.8 vs. 3.1±2.2, p<0.05). No differences were found between groups for later time points for pain scoring, or between monitored parameters during anesthesia.

**Conclusion:** Combination nerve blocks provide significant intraoperative and early postoperative analgesia in dogs presenting for pelvic limb amputation.

Cardiovascular effects of dopamine and phenylepherine administration during isoflurane-induced hypotension in cats with hypertrophic cardiomyopathy

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**Introduction:** We determined the cardiopulmonary effects of increasing doses of dopamine and phenylephrine during isoflurane-induced hypotension in cats with naturally occurring hypertrophic cardiomyopathy (HCM).

**Methods:** Six adult cats with severe, naturally occurring HCM without outflow tract obstruction were anesthetized on two occasions. Cardiopulmonary data that included blood samples for cardiac troponin I (cTnI) concentrations were collected at various time points before and during anesthesia. Dopamine and phenylephrine were administered on different days, in random order at incrementally increasing doses; 2.5, 5, 10 µg kg-1 min-1 and 0.25, 0.5, 1 µg kg-1 min-1, respectively. Data were analyzed using repeated measures ANOVA with an appropriate post test when significance was detected. P < 0.05 was considered significant. Data are presented as mean±SD.

**Results:** Baseline mean arterial blood pressure for dopamine and phenylephrine groups was 53 ± 7.5 and 59 ± 15.6 mmHg, respectively. cTnI concentrations increased from baseline (0.2 ± 0.16 ng/ml ) during anesthesia and infusion of dopamine and phenylephrine but was not different between groups. Cardiac index was significantly increased in cats administered dopamine but not phenylephrine. Systemic vascular resistance index was significantly increased in cats administered phenylephrine compared to dopamine. Oxygen consumption remained unchanged in both groups. Systemic and pulmonary arterial blood pressure were increased following administration of both dopamine and phenylephrine. Acid base and blood lactate values did not change and were not different between groups. Clinically insignificant arrhythmias were observed in both groups.

**Conclusion:** Dopamine and phenylephrine produced dose-dependent increases in systemic and pulmonary blood pressure and oxygen delivery, only dopamine increased cardiac output. Hypotension, dopamine, and phenylephrine infusions caused significant increases in cTnI.

The anesthetic sparing effect of maropitant as a pre-anesthetic agent during canine ovariohysterectomy.

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**Introduction:** Previous work has shown that maropitant may have visceral analgesic properties (Boscan et al. 2011). The aim of this study was to determine the anesthesia sparing effect of maropitant during overio-hysterectomy in dogs.

**Methods:** In a prospective, randomized, double blinded study design, 40 female, healthy, dogs presented for routine spay were randomly divided into: control with 0.9% sterile physiologic saline SQ, morphine with 0.5 mgkg-1 SQ and maropitant with 1 mgkg-1 SQ. Drugs were administered as the pre-anesthetic agent. Anesthesia was induced with propofol and maintained with isoflurane. End-tidal isoflurane was measured and parameters such as heart rate, blood pressure, respiratory rate were recorded.

**Results:** The maropitant group required less isoflurane during ovarian ligation compared to control (1.41±0.25% vs 1.65±0.39%; p<0.01). The maropitant group was similar to morphine (1.53±0.37%). Similarly, the maropitant group required less isoflurane during skin closure compared to control (1.26±0.19% vs 1.52±0.26%; p<0.05). The morphine group required 1.45±0.22% isoflurane, which was not different to maropitant or control.

Of clinical relevance but not statistically different, the maropitant group maintained lower heart rate throughout surgery (103±20bpm) compared to morphine and control (120±21 and 115±23bpm respectively). The maropitant group also maintained more stable respiratory activity with only 35% of patients panting during surgical painful stimulation. In the control group 67% of the patients panted during painful stimulation. Similar to maropitant, 38% in the morphine group panted during painful surgical stimulation.

**Conclusion:** Maropitant is comparable to morphine for its anesthetic sparing properties during canine ovariohysterectomy.

The effect of nitrous oxide on sevoflurane MAC and MAC derivatives in dogs.

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**Introduction:** Nitrous oxide (N2O) is an anesthetic gas with many desirable properties; however, its potency in dogs is much less than in people. The objectives of this study were to investigate the effects of 70% N2O on the sevoflurane (SEVO) MAC, the MAC preventing motor movement (MACNM) and the MAC blocking autonomic responses (MACBAR) in dogs.

**Methods:** Anesthesia was induced in six, mixed-breed, intact male dogs (2-3 years) using SEVO delivered via a mask. Baseline SEVO MAC, MACNM and MACBAR were determined sequentially using a noxious stimulus (50 V, 50 Hz, 10 ms) delivered via two electrode needles inserted subcutaneously, over the mid-ulnar area. MACNM and MACBAR were defined as the minimum E´SEVO that prevented all motor movement, and an increase in pre-stimulation mean arterial pressure (MAP) or heart rate of ≥15%, in response to the noxious stimulus, respectively.

N2O (70%) was added to the breathing circuit and MAC, MACNM and MACBAR were re-determined. A mixed-model ANOVA was used to evaluate the effect of N2O on the percent change in baseline MAC and its derivatives.

**Results:** Median baseline values for SEVO MAC, MACNM and MACBAR were 1.75, 2.00 and 2.50%, respectively. N2O decreased (p<0.05) MAC, MACNM and MACBAR by 24.4%, 25.0% and 35.2%, respectively. The percent decrease among MAC and its derivatives did not differ significantly.

**Conclusion:** In the study reported here, 70% N2O significantly decreased SEVO MAC and its derivatives in dogs, and verified the clinical finding that it significantly reduces the E´SEVO needed to maintain surgical anesthesia.

Naltrexone does not affect isoflurane minimum alveolar concentration in cats

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**Introduction:** Opioid receptor antagonists have not been shown to affect anesthetic minimum alveolar concentration (MAC), but previous studies have only been conducted using species in which opioid receptor agonists potently decrease MAC. In this study, we test whether naltrexone, an opioid receptor antagonist, affects isoflurane MAC in the cat, a species that is relatively resistant to the general anesthetic effects of most opioids.

**Methods:** Six healthy adult cats were studied twice in a randomized crossover, placebo controlled, blinded experiment design. First, baseline isoflurane MAC was measured in duplicate using a tail clamp stimulus and a standard bracketing method. Then study drug (saline control or 0.6 mg kg-1 naltrexone) was administered IV every 40-60 min, and isoflurane MAC was re-measured in duplicate. Cats were studied with the second study drug using identical methods two weeks later. Data were analyzed using ANOVAs.

**Results:** Isoflurane MAC was 2.03 ± 0.12% and was unchanged from baseline following saline or naltrexone administration.

**Conclusion:** MAC is unaffected by opioid receptor antagonists, irrespective of the species sensitivity to MAC-sparing effects by opioid receptor agonists. Because MAC in cats is unaffected by at least some μ-opioid agonists and antagonists, spinal neurons that are directly modulated by μ-opioid receptors in this species cannot be the neuroanatomic sites responsible for immobility from inhaled anesthetics.

Effect of co-infusion of dexemedetomidine, morphine, lidocaine and ketamine on the minimal alveolar concentration of isoflurane in dogs.

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**Introduction:** Morphine (M), dexmedetomidine (D), ketamine (K), and lidocaine (L) are commonly used as anesthetic adjuncts to augment analgesia. Infusion of these alone and in combination (LK, MLK) has been shown to reduce minimal alveolar concentration (MAC) of isoflurane (ISO). The aim of this study was to assess MACISO-reduction of a co-infusion of DMLK.

**Methods:** Baseline MACISO was determined in six healthy dogs (10-12 m old, 6.5-21.2 kg). On three subsequent separate occasions each dog was anesthetized with ISO and given, in random order, 1 of 3 treatments: D (0.5 µgkg-1hr-1); MLK (morphine 0.2 mgkg-1hr-1 + lidocaine 3 mgkg-1hr-1 + ketamine 0.6 mgkg-1hr-1); and DMLK (combined D+MLK infusions). Dogs were mechanically ventilated to eucapnea and core body temperature was maintained between 37.5-38°C. After 2 hours of infusion, MACISO was determined using buccal mucosal electrical stimulus. Heart rate (HR), mean arterial pressure (MAP), and cardiac index (CI) were recorded at MACISO. The primary investigator was blinded to the treatment. ANOVA was used to analyze data. Significance was set at p<0.05.

**Results:** Baseline MACISO was 1.3±0.15%. D, MLK, and DMLK significantly lowered MACISO by 30±7%, 55±12%, and 90±10%, respectively, and differed among groups. HR at MACISO was significantly lower compared to ISO alone in all groups. MAP at MACISO was significantly lower compared to ISO alone in the DMLK group, as was CI in the D and DMLK groups.

**Conclusion:** Infusions of D, MLK, and DMLK reduced MACISO in healthy dogs. Changes in HR, MAP, and CI were well tolerated.

Modeling of the effect of dexmedetomidine on cardiac index on its own disposition

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**Introduction:** Dexmedetomidine is likely to influence its own disposition due to its cardiovascular effects. We have previously reported the pharmacokinetics of dexmedetomidine, using a generic 2-compartment model, and its effect on cardiac index, in isoflurane-anesthetized cats. The aim of this study was to model the pharmacokinetics of dexmedetomidine in isoflurane-anesthetized cats, including an effect of dexmedetomidine on its clearance, directly proportional to its effect on cardiac index.

**Methods:** Retrospective analysis of pharmacokinetic data previously obtained in 5 cats was performed. Briefly, dexmedetomidine was injected intravenously in isoflurane-anesthetized cats as a short infusion of 10 µgkg-1 over 5 minutes (2 µgkg-1min~~-1~~). Blood samples were obtained at various times during and after the infusion. Plasma dexmedetomidine concentration was measured using liquid chromatography/mass spectrometry. A 2-compartment pharmacokinetic model, including an effect of plasma dexmedetomidine concentration on clearance, directly proportional to its effect on cardiac index, was fitted to concentration-time data. Parameters estimated by the model were V1 (volume of the central compartment), V2 (volume of the peripheral compartment), Cl (clearance), and Cld (distribution clearance).

**Results:** Weighted mean±SEM (range) V1 and V2, and harmonic mean±pseudo-SD (range) Cl and Cld were 405±47 (354-610) and 1450±285 (1146-2480) mLkg-1 and 9.6±6.2 (5.4-30.9) and 32.0±18.2 (18.3-52.5) mLmin-1kg-1, respectively.

**Conclusion:** The clearance estimated by this model, when plasma dexmedetomidine concentration is 0, is higher than estimated by the generic 2-compartment model previously reported. This model suggests that a value of clearance can be calculated for each plasma dexmedetomidine concentration; this may increase the accuracy of infusion regimens targeting specific concentrations.

Use of naltrexone to antagonize high doses of remifentanil in cats: a dose-finding study

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**Introduction:** Naltrexone is an opioid antagonist with a relatively long duration of action. The aim of this study was to find a dose of naltrexone that antagonizes high doses of remifentanil in cats.

**Methods:** Six adult healthy cats were used. In a first phase, remifentanil (200 µg kg-1 followed by 60 µg kg-1 min-1) was administered intravenously to 2 cats. Naltrexone (100 µg kg-1) was then administered intravenously every minute until the increase in locomotor activity induced by remifentanil had been reversed. In a second phase, 6 cats were used. Baseline thermal threshold was determined, naltrexone (600 µg kg-1) was administered intravenously, and 30 minutes later, thermal threshold determination was repeated. Remifentanil (same dose as above) was administered intravenously and thermal threshold determination repeated at 60, 120, 180, and/or 240 minutes after naltrexone administration. If an increase in thermal threshold was found, naltrexone administration was repeated at decreasing intervals in the next experiment. Experiments were repeated until a naltrexone dosing interval was found that prevented increases in thermal threshold for 4 hours in all 6 cats.

**Results:** In the first phase, both cats became severely dysphoric following remifentanil administration. A cumulative naltrexone dose of 300 µg kg-1 was necessary to restore normal behavior in both cats. In the second phase, hourly administration of naltrexone prevented increases in thermal threshold associated with hourly administration of remifentanil for 4 hours. Less frequent administration did not prevent increases in thermal threshold consistently.

**Conclusion:** Hourly naltrexone administration antagonizes the behavioral and antinociceptive effects of a high dose of remifentanil in cats.

Pharmacokinetics of fentanyl, alfentanil and sufentanil in isoflurane-anesthetized cats

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**Introduction:** The aim of this study was to compare the pharmacokinetics of fentanyl, alfentanil and sufentanil in isoflurane-anesthetized cats.

**Methods:** Six adult, healthy, cats were used. Anesthesia was induced and maintained with isoflurane in oxygen. Catheters were placed in a jugular vein for blood sampling and in a medial saphenous vein for drug and fluid administration. Ventilation was controlled. Body temperature was maintained between 38 and 39°C. After instrumentation, end-tidal isoflurane concentration was set at 2%, and adjusted as required due to spontaneous movement. Fentanyl (10 µg kg-1), alfentanil (100 µg kg-1), or sufentanil (1 µg kg-1) was administered intravenously as a bolus, on separate days. Blood samples were collected immediately before, and at various times up to 8 hours following drug administration. Drug plasma concentration was measured using liquid chromatography/mass spectrometry. Compartment models were fitted to concentration-time data.

**Results:** A 3-compartment model best fitted the concentration-time data for all drugs, except for 1 cat in the sufentanil group. Median (range) volume of the central compartment (mL kg-1), volume of distribution at steady-state (mL kg-1), clearance (mL min-1 kg-1), and terminal half-life (min) were 234 (91-345), 2542 (1789-2830), 17 (15-30), and 151 (115-211) for fentanyl; 84 (70-142), 924 (679-1829), 12 (9-16), and 144 (118-501) for alfentanil; and 57 (43-102), 793 (671-944), 17 (13-24), and 52 (46-74) for sufentanil.

**Conclusion:** Clearance was similar for the fentanyl and sufentanil, but lower for alfentanil, and volume of distribution was largest for fentanyl, intermediate for alfentanil, and smallest for sufentanil, resulting in similar terminal half-lives for fentanyl and alfentanil, longer than for sufentanil.

Perioperative mortality in dogs undergoing anesthesia and cervical spinal surgery

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**Introduction:** Anesthesia and surgery for cervical spinal disease has been reported to have high mortality. We hypothesized that current perioperative mortality for cervical surgery is less than the 8% previously reported and similar to that for thoracolumbar surgery.

**Methods:** Data were collected sequentially on 52 dogs presented for anesthesia and surgery for cervical spinal cord disease. Simultaneously, data were collected for all thoracolumbar spinal surgery. Data included signalment, drugs, surgical approach, disease process, arrhythmias, and outcome. Mortality between groups was compared with a Fisher's Exact Test.

**Results:** Surgical procedures included; thoracolumbar intervertebral disc decompression (TLDD) (n=111), ventral cervical intervertebral disc decompression (CDD) (n=40), atlanto-axial stabilization (8), dorsal laminectomy (4), thoracolumbar vertebral fracture stabilization (1), thoracolumbar neoplasia removal (1).

Four dogs that underwent a cervical approach did not survive to discharge (4/52; 7.6%). Two dogs (2/8; 25%) undergoing atlanto-axial stabilization died (1 arrested, 1 euthanized). Two dogs (2/38; 5.2%) undergoing CDD were euthanized due to aspiration pneumonia. All dogs undergoing TLDD surgery survived until discharge. Overall mortality in dogs undergoing cervical spinal surgery was greater compared with dogs undergoing thoracolumbar spinal surgery (p=0.009). Overall mortality in dogs undergoing CDD was not significantly different compared with dogs undergoing TLDD (p=0.07), and there were no spontaneous deaths in these groups.

**Conclusion:** Overall perioperative mortality was greater in dogs undergoing cervical surgery compared to thoracolumbar surgery. However, spontaneous death rates (1/52; 1.9%) were lower than previous reports. Mortality in dogs undergoing cervical and thoracolumbar disk surgery appeared similar, although dogs undergoing CDD should be monitored for aspiration pneumonia.

Intracranial pressure and cardiopulmonary variables during isoflurane or sevoflurane anesthesia in beagle dogs

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**Introduction:** This study compared the effects of isoflurane (ISO) or sevoflurane (SEVO) on ICP and cardiopulmonary variables in dogs.

**Methods:** Six healthy male Beagle dogs between 9 and 13 months of age were studied in a prospective, randomized, crossover design. Individual minimal alveolar concentration (MAC) values were pre-determined. Anesthetics and MAC-multiples within each anesthetic (1.0, 1.5 and 2.0 MAC) were studied in randomized order with a 1-hour washout period between anesthetics. Dogs were mechanically ventilated to maintain PETCO2 between 35-45 mmHg. Heart rate, cardiac output, systolic (SAP), mean (MAP) and diastolic arterial pressure (DAP), ICP (using a fiberoptic transducer), end-tidal CO2 and anesthetic concentrations (using an infrared gas analyzer) and arterial blood gases were measured. Cerebral perfusion pressure (CPP) and systemic vascular resistance (SVR) were calculated. Data were analyzed using repeated measures ANOVA and *post-hoc* comparisons with Fisher’s LSD (p < 0.05).

**Results:** Mean ± SD ICP within each anesthetic and for SEVO (16.7 ± 5.0, 19.3 ± 7.2, 18.8 ± 5.9) compared to ISO (18.7 ± 4.3, 20.2 ± 4.9, 17.8 ± 7.1) at 1.0, 1.5 and 2.0 MAC, respectively, were not significantly different. Compared to equipotent concentrations of ISO, the following variables were significantly increased during SEVO: CPP, SAP, MAP, DAP and SVR at both 1.5 & 2.0 MAC and [HCO3-] at 1.5 MAC.

**Conclusion:** In these healthy, normocapnic dogs, ICP did not appear to increase in a dose-dependent manner with either anesthetic. CPP for ISO at 2.0 MAC was below the reported range for normal conscious dogs.

Hemodynamic effects of anesthetic induction with propofol, a combination of ketamine-propofol or ketamine-diazepam in dogs

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**Introduction:** Hemodynamic effects of propofol, ketamine-propofol, and ketamine-diazepam were evaluated.

**Methods:** Ten healthy beagles were randomly allocated to two out of three groups with one week interval. Isoflurane anesthesia was induced for instrumentation. After full recovery, the arterial catheter was connected to a calibrated LiDCO*plus* monitor for continuous HR, SAP, MAP, DAP, cardiac output (CO), stroke volume (SV), and systemic vascular resistance (SVR) recording. Oxygen content (CaO2) and delivery (DO2) were calculated. Fifteen minutes after acepromazine and oxymorphone administration, propofol 4 mg kg-1 (GP) (*n*=6*)*, mixture of ketamine 2 mg kg-1 and propofol 2 mg kg-1 (GKP) (*n*=7) or ketamine 5 mg kg-1 and diazepam 0.2 mg kg-1 (GKV) (*n*=6) were given over 60 seconds. Data including arterial blood-gases were collected before premedication (T0), before induction (T1), immediately after (T2) and 5 minutes later (T3). Mixed-model ANOVA and ANCOVA were used for analysis (p≤0.05).

**Results:** At T3, HR was higher in GKV than GP (p=0.0005) and GKP (p=0.0393). The MAP and DAP were higher in GKV than GP (p<0.0001 and 0.0003) and GKP (p=0.0101 and 0.0223) at T2 and T3. The GP had a lower CO than GKV at T3 and a lower SVR at T2. The SVR decreased after induction in GP and GKP; in GKV was lower by T3. The CaO2 decreased after induction in all groups but increased by T3 in GP and GKP. The GKV showed higher DO2 than GP at T3.

**Conclusion:** Ketamine-diazepam provided hemodynamic stimulation. Ketamine-propofol provided similar stability as propofol.

Cardiovascular effects of orotracheal intubation following anesthetic induction with propofol, ketamine-propofol, or ketamine-diazepam in premedicated dogs

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**Introduction:** Objectives were to describe and compare the hemodynamic response to orotracheal intubation following induction of anesthesia with propofol, propofol-ketamine, and ketamine-diazepam in premedicated dogs.

**Methods:** Ten healthy beagles were anesthetized twice with one-week interval and randomly allocated to two out of three groups. After instrumentation, the arterial catheter was connected to a calibrated LidCO*plus* monitor for continuous HR, SAP, MAP, DAP, cardiac index (CI), stroke volume index (SVI), and systemic vascular resistance (SVR) recording. Fifteen minutes after acepromazine and oxymorphone administration, propofol 4 mg kg-1 (GP) (*n*=6*)*, mixture of ketamine 2 mg kg-1 and propofol 2 mg kg-1 (GKP) (*n*=7) or ketamine 5 mg kg-1 and diazepam 0.2 mg kg-1 (GKV) (*n*=6) were given. Five minutes after anesthetic induction, dogs were orotracheally intubated. Data were collected prior and at intubation (T0), at 30, 60, 90, 120, 150, and 180 seconds thereafter. Mixed-model repeated measures ANCOVA were used for analysis (p≤0.05). Effect of baseline differences was eliminated.

**Results:** No changes in HR over time and between groups were observed. Overall, SAP, MAP, and DAP significantly decreased over time, with no differences between groups. On GKP, a significant increase in MAP and DAP was observed between baseline and T0, and in MAP between T0 and T30. Although not significant, a slight initial increase in SAP, MAP and DAP, and a slow decrease in CI, SVI, and SVR was observed over time in all groups.

**Conclusion:** In dogs, intubation following propofol, ketamine-propofol, or ketamine-diazepam does not trigger cardiovascular stimulation. Hemodynamic variables are depressed over time.

Efficacy of maropitant in preventing vomiting in dogs premedicated with hydromorphone

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**Introduction:** Objective: To investigate the efficacy of maropitant (CereniaTM) in preventing vomiting in dogs receiving hydromorphone as an anesthetic analgesic premedication.

**Methods:** Eighteen dogs ASA I/II admitted for elective orthopedic surgical procedures. The dogs were a mixed population of males and females, purebreds and mixed breeds, 1.0 – 10.2 years of age, weighing 3 – 49.5 kg.

Dogs were randomly selected to receive one of two treatments administered by subcutaneous injection. Group A received 1.0 mgkg-1 of maropitant, Group B received 0.1 mlkg-1 of saline one hour prior to anesthesia premedication. Dogs were premedicated with 0.1 mgkg-1 of hydromorphone intra-muscularly. A blinded observer documented the presence of vomiting, retching and/or nausea and salivation for 30 minutes after premedication.

The primary variable used for analysis of efficacy was whether the dog experienced one or more vomiting episode. A two-tailed Fisher exact test was performed between the treatment and control group. The Fisher exact test was repeated with inclusion of retching and nausea in addition to vomiting. Statistical significance was assessed at P ≤ 0.05.

**Results:** All dogs in the saline group vomited (6/9), retched (1/9) or displayed signs of nausea, salivation and lip-licking (5/9). None (0/9) of the dogs in Group A vomited, retched or displayed signs of nausea, salivation or lip-licking. Group A had significantly fewer incidences of vomiting (P=0.0090), vomiting and retching (P= 0.0023) and vomiting, retching and nausea (P < 0.0001) when compared to saline.

**Conclusion:** Maropitant was effective in preventing vomiting, retching and nausea associated with hydromorphone administration in dogs.

Thermal and mechanical nociception after tramadol with and without naloxone in dogs

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**Introduction:** In dogs mu-receptor related anti-nociception by tramadol is questionable as their production of the active metabolite O-desmethyltramadol is limited.

**Methods:** Six healthy, adult Beagle dogs (15.5 ± 0.5 kg, 4 female/2 male-castrated) were studied in a randomized, blinded, crossover design with 1 week wash out periods. All dogs were treated with 1 mg kg-1 tramadol (T1), 4 mg kg-1 tramadol (T4), 1 mg kg-1 tramadol followed by 0.1 mg kg-1 naloxone (T1N), 4 mg kg-1 tramadol followed by naloxone (T4N) or saline (C) intravenously. Thermal (TT) and mechanical thresholds (MT) were assessed in duplicate and random order via skin flick in response to contact heat and leg withdrawal in response to pin pressure. Thresholds were determined at 30 and 15 minutes prior to, and at 15, 30, 45, 60 minutes, 120, 180, 240, 300 360, 420, 480, 540, 600, 660, 720 and 1440 minutes after treatment. In group T1N and T4N naloxone was injected 30 minutes after tramadol. Data were analyzed by repeated measures ANOVA followed by paired t-tests with correction for multiple comparisons. Alpha was 5%.

**Results:** Tramadol induced mild to moderate salivation but no sedation. In group C, no significant changes in TT (44.05 ± 0.55°C) and MT (8.13 ± 0.66 N) occurred over time. There were no statistically significant differences in TT between treatment groups and over time. The MT increased significantly above control values between 30 and 240 minutes in T1 and T4. Additional naloxone had no significant effect on TT and MT.

**Conclusion:** Antinociceptive effects of tramadol in dogs are minimal.

The effects of intravenous fluid warming on prevention of hypothermia in anesthetized dogs

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**Introduction:** Hypothermia is a common complication of anesthesia in dogs. In people, intravenous fluids are sometimes warmed in attempt to minimize hypothermia, especially when large volumes of cold fluids are used. Administration of warmed IV fluids to dogs for minimizing hypothermia during routine anesthesia has not been reported. This study evaluated the effects of using an IV fluid warming system for healthy dogs undergoing ovariohysterectomies. The Hotline® warmer uses special tubing that circulates warm (42°C) fluid along the length of the IV fluid line, reportedly eliminating cool down.

**Methods:** 27 dogs entered the study and were randomly assigned to receive IV fluids that were warmed by Hotline® device (n=13) or at room temperature (n=14). Rectal and distal esophageal temperatures were recorded, together with other parameters. Descriptive and parametric statistics were used to compare differences between groups and to characterize the effects of fluid warming on the incidence and severity of hypothermia in these dogs. Results were significant if P<0.05.

**Results:** There were no differences between groups in terms of signalment, body weight, ambient room temperature, rate of IV fluid administration, duration of surgery, or incidence of hypothermia (defined as esophageal temperature < 36°C). There were significant differences between group means for the lowest esophageal temperature (35.43°C vs. 36.06°C, P=0.049) and the time to reach 35.5°C (when other warming techniques were initiated) (56 minutes vs. 96 minutes, P=0.029).

**Conclusion:** Warming IV fluids appears to affect heat loss in anesthetized dogs. Further studies are warranted to assess it use in combination with other warming techniques.