

THE EFFECTS OF INTRAVENOUS ANALGESICS AND SEDATIVES IN A CANINE NOCICEPTIVE THERMAL ESCAPE MODEL. K Wegner,* KA Horais, NA Tozier, M Rathbun, Y Shtaerman, TL Yaksh. University of California-San Diego, La Jolla, CA.

Here we report the effect of analgesics and sedatives at clinically relevant doses on withdrawal latencies in a novel canine hind paw thermal escape model. Calibrated focused projection bulbs were utilized as a left and right paired thermal stimulus placed below a glass plate. Beagle dogs [mean 13.2 (9.3-17.1) kg, 18 (12-24) months old] were lightly restrained in a fabric sling with the anterior center of the metatarsal pad of the left and right hind paw positioned on the glass over each light. A cut-out time of 20 sec was set to prevent tissue damage. Each paw was tested independently and mean latencies calculated; population mean baseline withdrawal latency was 9.1 ± 0.78 sec (mean \pm SEM, n = 12 dogs, 8 males, 4 females; 50 trials). These results were shown to be repeatable between paws, within and between individual animals, and between test days. All drugs were given as intravenous boluses at doses deemed to have approximately comparable clinical effects. In a randomized cross-over design, morphine (M, 1.0 mg kg⁻¹), hydromorphone (H, 0.2 mg kg⁻¹), and fentanyl (F, 0.01 mg kg⁻¹) produced prominent time-dependent increases in withdrawal latency, butorphanol (Bt, 0.4 mg kg⁻¹) yielded a moderate latency increase, and buprenorphine (Bp, 0.01 mg kg⁻¹) displayed a modest, biphasic latency increase. The relative duration of action ranking based on the time withdrawal latency was > 50% of maximum was M = H (375 min) > Bt (230 min) > Bp (160 min) > F (75 min). Dexmedetomidine (D, 0.01 mg kg⁻¹) produced profound initial antinociception, modest duration of action (160 min), and marked sedation. In contrast, acepromazine (A, 0.1 mg kg⁻¹) produced moderate sedation lasting 180–240 min, but had no effect on withdrawal latency. H was examined over the dose range of 0.03 mg kg⁻¹ to 0.2 mg kg⁻¹ and a clear dose-dependent increase in withdrawal latency was shown. The duration of action over the dose range of H was 0.2 mg kg⁻¹ = 375 min, 0.1 mg kg⁻¹ = 330 min, 0.03 mg kg⁻¹ = 90 min. Taken together, these data indicate this nociceptive thermal escape model is sensitive, specific, and yields dose- and time-dependent paw withdrawal latency increases which are reflective of the clinical effects of the analgesics and sedatives examined.

USE OF A MEDETOMIDINE/MORPHINE COMBINATION FOR STANDING SEDATION DURING LAPAROSCOPY IN HORSES.

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Ideal standing sedation in horses should provide reliable restraint with minimal cardiorespiratory changes and adequate analgesia. This study assesses the efficacy of a medetomidine/morphine (ME/MO) combination for laparoscopy in mature horses.

Seven healthy adult horses (6.2 y.o. mean age; 450-560 kg; 4 males, 3 females), undergoing laparoscopy were instrumented for HR, ECG, RR, direct BP, CO using LiDCO, arterial blood gas analysis, and PCV determinations. ME ($5 \mu\text{g kg}^{-1}$ IV) was administered followed in 10 min by MO ($50 \mu\text{g kg}^{-1}$ IV) and 10 min later by a CRI of ME/MO ($5 \mu\text{g kg}^{-1} \text{h}^{-1}$ and $30 \mu\text{g kg}^{-1} \text{h}^{-1}$ respectively) at which time the surgery started. Measurements were recorded prior to and at 5 and 10 min after ME, 5 and 10 min after MO, and 5, 30, 60, 90, 120, and 150 min after ME/MO. Sedation and ataxia scores (0 = no effect, 3 = maximum effect) and a VAS (10 cm) for overall quality of sedation during surgery were obtained by 2 anesthesiologists and 2 surgeons. Additional sedation/analgesia during surgery consisted of administration of 300 μg of medetomidine. Data analysis included a two-factor (drugs and time)-factorial ANOVA for repeated measures. An ANOVA and Spearman correlation was used for comparison of VAS between investigators. Significance was considered to be $P < 0.05$.

Sedation was satisfactory with the ME bolus and increased after MO. The degree of ataxia decreased after MO as horses were less likely to lean, sway or cross their limbs. The infusion of ME/MO maintained a constant degree of sedation throughout the surgery although 5 of 7 horses required additional medetomidine to stop the horse from reacting to infiltration of local anesthetic in the surgical field. The amount of medetomidine administered throughout the procedure in those five horses varied between 300 and 1500 μg . VAS scores were similar between anesthesiologists and surgeons (7.8, 8.2, 8.3, 8.8 cm, individual mean values). HR was significantly lower at 10 min post-ME and at 5, 150 min post-ME/MO. RR was significantly lower at 10 min post-ME, 5 min post-MO and 30, 60 min post-ME/MO. SBP, DBP and MBP were significantly increased at 5 min post-ME. CO did not change significantly over time (47.9 and 79.4 $\text{mL kg}^{-1} \text{min}^{-1}$ minimum and maximum mean values). Arterial O_2 was significantly lower at 10 min post-ME and PCV decreased significantly post-MO.

In conclusion ME/MO is a reliable sedative combination for use in horses undergoing laparoscopy that results in stable cardiorespiratory function.

DOSE RANGE FINDING STUDY FOR MELOXICAM SUSPENSION IN CATS WITH A SODIUM URATE-INDUCED ARTHRITIS. G Carroll,*¹ R Narbe,² S Kerwin,¹ K Peterson,² L Taylor,¹ S Hartsfield.*¹ ¹Texas A&M University, College Station, TX; and ²Boehringer Ingelheim Vetmedica, Inc, St. Joseph, MO.

The objective of this study was to determine the lowest efficacious dose of meloxicam suspension for relieving pain in cats with sodium urate-induced arthritis. The study was a randomized, blinded, controlled, four-way crossover design in eight surgically neutered cats (4 males, 4 females). All cats received all treatments [one of three different doses of meloxicam (0.025, 0.05, and 0.075 mg kg⁻¹) or placebo orally once daily] for four days (Days -3 to Day 0) in each of the four study phases. On Day 0 of each phase the appropriate stifle was injected with 1 ml of 20 mg ml⁻¹ monosodium urate crystals, beginning with the right stifle in Phase I (left in Phase II). A minimum washout period of 21 days followed each phase. Analgesic efficacy was evaluated based on pressure mat data (total force, contact pressure, and contact area) and subjective parameters for pain assessment (analgesia score [AS], lameness [LS] score, and visual analogue score [VAS]). Pressure mat and subjective parameters were measured before and at 2, 4, 6, 8, 10, 12, 24, and 30 hours after sodium urate injection; subjective parameters were also measured at 1 hour after sodium urate injection. The primary parameter was the area under the time-response curve (AUC_{0→30h}) of the total force of the injected limb. The AUC_{0→30h} was calculated for each animal using the linear trapezoidal rule. Data were analyzed by analysis of variance as a crossover model with the factors 'treatment,' 'phase,' 'sequence,' and 'animal within sequence.' A sequential test procedure was applied (high dose *vs.* placebo, mid dose *vs.* placebo and low dose *vs.* placebo) in order to use the nominal level of $\alpha = 5\%$ for the single test without exceeding a global type I error of 5%. The test sequence stopped in case of a non-significant result. The lowest effective dose was the lowest dose significantly different from placebo.

The meloxicam doses of 0.075 and 0.05 mg kg⁻¹ day⁻¹ PO but not 0.025 mg kg⁻¹ day⁻¹ were significantly different from placebo for the primary parameter (AUC_{0→30h}). In conclusion, the lowest efficacious dose of meloxicam for relieving pain in cats with sodium urate-induced arthritis is 0.05 mg kg⁻¹ day⁻¹ PO. This is supported by a linear-linear spline model estimating a maximum effective dose of 0.045 mg kg⁻¹ day⁻¹ PO.

EFFECTS OF INTRAVENOUS TRAMADOL IN HORSES. JK Dhanjal,¹ DV Wilson,*¹ CG Hughes,² T Tobin,² NE Robinson.¹ ¹Michigan State University, East Lansing, MI; and ²University of Kentucky, Lexington, KY.

Tramadol is a potential analgesic in horses, with effects resulting from interactions between opiate, adrenergic and serotonin receptor systems. This study determined the optimal dose, serum concentrations and analgesic effects of IV tramadol. In a blinded, randomized dose-response study, 6 horses (mean age 21yrs and mean weight 565.8 kg) were treated every 20 min with the following successive doses of tramadol HCl: 0.1, 0.2, 0.4, 0.8, and 1.6 mg kg⁻¹ or with equivalent volumes of saline. Ten minutes after each dose heart rate, respiratory rate, step frequency, head height, and sweating, trembling, and head nodding scores were recorded. After the final dose, values were recorded every 20 min for 1 hour, hourly for 3 hours, and at 6 hours. Gut sounds also were scored. Blood was drawn for GC/MS measurement of serum tramadol before treatment, 20 min after each dose, and 80, 140, 200, and 380 min after the final dose. In a second study, hoof withdrawal and skin twitch reflex latencies (HWRL and STRL, respectively) to a thermal stimulus were determined 5 and 30 min and 1, 2, 4, and 6 hours after a bolus injection of 2.0 mg kg⁻¹ tramadol or vehicle. Data were analyzed using a 2-way RM ANOVA with $P < 0.05$ considered significant.

In comparison to saline, tramadol caused no significant change in heart rate, step frequency, or sweating score. Trembling and head nodding scores were dose-dependently increased by tramadol. Respiratory rate increased from 18.5 ± 4.6 (mean \pm sem) to 38.3 ± 7.1 and head height from 60.0 ± 3.1 cm to 67.6 ± 2.1 cm following the highest dose ($P = 0.01$). In all horses, there was a transient decrease in gut sounds after tramadol. Peak serum concentration of tramadol after a cumulative dose of 3.1 mg kg⁻¹ was 619.5 ± 60.2 ng ml⁻¹. The half-life was 114.3 ± 19.7 minutes. Baseline HWLR and STRL were 4.30 ± 0.34 and 2.66 ± 0.10 , respectively and were not significantly prolonged by tramadol. In the horse, IV tramadol at cumulative doses less than 3.1 mg kg⁻¹ produces minimal side effects and a bolus dose of 2.0 mg kg⁻¹ does not prolong the response to a thermal stimulus.

EFFECTS OF L-659,066, A PERIPHERAL ALPHA-2 ANTAGONIST, WITH OR WITHOUT GLYCOPYRROLATE, ON THE HEMODYNAMIC CHANGES INDUCED BY MEDETOMIDINE IN CONSCIOUS DOGS. SS Enouri, CL Kerr,* WN McDonell,* ML O'Sullivan, FJ Teixeira Neto. University of Guelph, Guelph, Ontario, Canada.

The objective of this study was to evaluate the effects of a peripheral alpha-2 antagonist (L-659,066; 0.2 mg kg⁻¹ IV) with or without an anticholinergic (glycopyrrolate, 5 µg kg⁻¹ IV), on the cardiopulmonary effects of medetomidine (10 µg kg⁻¹ IV) in dogs. Six healthy male (26.3 ± 1.8 kg, 29 ± 2.4 months) dogs were studied in a randomized crossover design. Dogs were instrumented under isoflurane anesthesia. At least 30 minute after termination of isoflurane administration, the dogs received either saline (S group), L-659,066 (L group) or L-659,066 with glycopyrrolate (L/G group) (pretreatment) followed in 10 minutes with medetomidine. Measurements and arterial and mixed venous blood gas samples were obtained prior to pretreatment (BL), 5 minutes following pretreatment and subsequently after medetomidine administration at intervals up to 60 minutes. Data were analyzed using an ANOVA for repeated measures with Dunnett's and Tukey's post-hoc tests ($P < 0.05$). Following pretreatment, HR and CI values were greater and SVR values were lower in the L and L/G groups and SI was lower in the L/G group than the BL levels. All dogs were heavily sedated following medetomidine administration. Following medetomidine administration, HR (S, 43 ± 16; L, 56 ± 13; L/G, 78 ± 26 beats min⁻¹) and CI (S, 56.1 ± 9.7; L, 94.3 ± 22.3; L/G, 111.3 ± 30.3 mL min⁻¹ kg⁻¹) values were lower while SVR values were greater than BL in all groups. Heart rate and CI values remained lower and SVR values higher than BL. Base excess values were lower and CVP values were greater in the S and L groups than the BL. Mean values of MABP were greater (S, 150 ± 10 mmHg) while SI were lower in the S and L/G groups compared to the BL. Values of MABP in the S group remained higher and SI in the S and L/G groups remained lower than BL. Values of PvO₂ were lower in the S group than BL values. Compared to the S group, HR, CI, and PvO₂ values were greater after pretreatment and HR, CI, and PvO₂ values were greater and SVR, MABP, and CVP values were lower in L and L/G groups after medetomidine administration. In the L/G group compared to the L group, after medetomidine administration HR values were greater at 5 minutes (L, 56 ± 13; L/G, 78 ± 26 beats min⁻¹), while MABP values were greater at 5 (L, 104 ± 8; L/G, 122 ± 13 mmHg) and 15 (L, 93 ± 4; LG, 106 ± 13 mmHg) minutes; SI values were lower at 5 minutes and CVP values were lower over the 60 minutes. In conclusion, L-659,066 prior to medetomidine prevented most of the cardiovascular changes induced by medetomidine in dogs without affecting medetomidine-induced sedation. Concurrent glycopyrrolate administration did not offer any advantages.

INCIDENCE AND PREVENTION OF GASTRIC ULCERS IN HORSES UNDERGOING GENERAL ANESTHESIA. C Scicluna. Clinique du Plessis, Chamant, France.

Stress associated with surgery and anesthesia may contribute to observation of gastric ulcers during the postanesthetic period in horses. This prospective study evaluated the incidence, treatment, and prevention of gastric ulcers in horses undergoing general anesthesia.

Eighty-four horses (age, 3.5 ± 2.1 years, weight, 420.4 ± 49.5 kg) undergoing several elective surgical procedures were kept off of food for 20 hours prior to anesthesia. On the day before anesthesia, preoperative gastroscopy (baseline) was performed under sedation by a blinded assessor. Gastric ulcers were globally scored (0: no ulcers - 20: worst degree of ulceration) and horses randomly received one of four treatments (n = 21 per treatment group): control (placebo) or omeprazole administered orally at 1, 2 and 4 mg kg⁻¹ SID to groups OM1, OM2, and OM4, respectively. Treatment started after preoperative gastroscopy and continued for 2 days after anesthesia. Animals were premedicated with acepromazine and romifidine. Anesthesia was induced with ketamine and maintained with halothane in oxygen during controlled ventilation. A second gastroscopy was performed on day 2 after anesthesia. A Mann Whitney test compared scores and weight loss between groups. Pre and postoperative scores were compared by a Wilcoxon signed rank test ($P < 0.05$). Values are presented as median (range).

Age, weight, and anesthesia time did not differ between groups. Preoperative gastroscopy global scores were 5 (1-8), 5 (0-12), 7 (0-13), and 6 (0-9) in the control, OM1, OM2 and OM4 groups, respectively. Only 2 horses were “ulcer free” prior to surgery. Postoperatively, global scores were 5 (1-10), 5 (0-8), and 3 (0-8) in the OM1, OM2 and OM4 groups, respectively. These scores were significantly lower than values observed in the control group [7 (3-12)] at the same time. At the postoperative gastroscopy, global scores increased significantly from baseline in the control group, did not change in OM1 group and were reduced significantly in the OM2 and OM4 groups. All horses lost weight, but no group differences were observed.

Gastric ulcers are observed in most horses undergoing surgery. While anesthesia and surgery may worsen the extent of these ulcers, omeprazole (2-4 mg kg⁻¹) may reduce the extent of gastric ulcers during the immediate postoperative period.

CARDIOPULMONARY EFFECTS OF ANESTHETIC INDUCTION WITH KETAMINE/DIAZEPAM, THIOPIENTAL OR PROPOFOL IN DOGS SEDATED WITH A COMBINATION OF MEDETOMIDINE/HYDROMORPHONE. *SS Enouri, CL Kerr,* WN McDonell,* DH Dyson.** University of Guelph, Guelph, Ontario, Canada.

The purpose of this study was to evaluate the cardiopulmonary effects of anesthetic induction with ketamine-diazepam (KD), propofol (Pro) or thiopental (Thio) following sedation with medetomidine (Med, 10 $\mu\text{g kg}^{-1}$ IV) and hydromorphone (Hydro, 0.05 mg kg^{-1} IV) in dogs. Six healthy male (25.6 ± 2.5 kg, 24.6 ± 9.5 months) dogs were studied in a randomized crossover design. Instrumentation was performed under isoflurane anesthesia. At least 30 minutes after termination of isoflurane administration, the dogs were sedated with Med and Hydro, and 20 minutes later, anesthesia was induced with KD, Pro or Thio. Endotracheal intubation was the end-point for drug administration. Anesthesia was subsequently maintained using isoflurane in O_2 . Measurements and blood gas samples were obtained prior to sedation, 10 min following sedation, following induction before receiving O_2 , and after the start of isoflurane administration. Statistical analyses were performed using an ANOVA for repeated measures with Dunnett's, Tukey's, and Paired t-tests (post-hoc) ($P < 0.05$). Med and Hydro administration resulted in heavy sedation in all dogs. Following Med and Hydro administration, heart rate (KD, 42 ± 9 ; Pro, 40 ± 12 ; Thio, 39 ± 8 beats min^{-1}), cardiac index (CI) (KD, 63.8 ± 15 ; Pro, 60.7 ± 17 ; Thio, 61.3 ± 8 , $\text{mL min}^{-1} \text{kg}^{-1}$) and PaO_2 (KD, 80 ± 6 ; Pro, 78 ± 5 ; Thio, 76 ± 10 mmHg) values were significantly less than baseline values in all groups. Mean arterial blood pressure, central venous pressure, and PaCO_2 (KD, 44.8 ± 2.0 ; Pro, 42.9 ± 2.8 ; Thio, 44.6 ± 2.1 mmHg) values following sedation were significantly higher than baseline values in all groups. After induction of anesthesia, HR values were greater in KD (66 ± 19 beats min^{-1}) and Thio (56 ± 9 beats min^{-1}) groups compared to post-sedation values. PaCO_2 tension (KD, 51.5 ± 1.8 ; Pro, 48.2 ± 2.8 ; Thio, 49.8 ± 1.6 mmHg) was greater and stroke volume index was less after induction compared to post-sedation values in all groups. In the KD group after induction of anesthesia, PaO_2 tension (61 ± 4 mmHg) was significantly less while HR (66 ± 19 beats min^{-1}) and CI (75.8 ± 14 $\text{mL min}^{-1} \text{kg}^{-1}$) values were significantly greater compared to the Pro (PaO_2 , 76 ± 6 mmHg; HR, 45 ± 11 beats min^{-1} ; CI, 60.1 ± 9 $\text{mL min}^{-1} \text{kg}^{-1}$) and Thio (PaO_2 , 74 ± 7 mmHg; HR, 56 ± 9 beats min^{-1} ; CI, 62.6 ± 3 $\text{mL min}^{-1} \text{kg}^{-1}$) groups. Doses required for induction were ketamine (1.25 mg kg^{-1}) with diazepam (0.0625 mg kg^{-1}), propofol (1 mg kg^{-1}), and thiopental (2.5 mg kg^{-1}). In conclusion, Med and Hydro caused dramatic hemodynamic alterations. Induction with low doses of KD, Pro or Thio and maintenance of anesthesia with isoflurane resulted in minimal additional cardiovascular alterations, however O_2 supplementation is recommended following induction.

TRENDELENBURG POSITIONING EFFECTS ON REGIONAL CENTRAL NERVOUS SYSTEM BLOOD FLOW IN ANESTHETIZED HORSES. RJ Brosnan,* AE Vico, EP Steffey,* RA LeCouteur, IK Liu, B Vaughan. University of California-Davis, Davis, CA.

Head-down positioning in anesthetized horses causes intracranial hypertension. We hypothesized that increased intracranial pressure (ICP) during Trendelenburg positioning decreases cerebral and spinal cord blood flow.

Six horses aged 12 ± 3 years (mean \pm SEM) and weighing 471 ± 22 kg were mechanically ventilated with 1.57% end-tidal isoflurane in oxygen. We placed a subarachnoid catheter-tip ICP transducer through a craniotomy, and we placed a left ventricle cardiac catheter and multiple arterial catheters percutaneously. Each horse in right lateral recumbency was studied in both horizontal and Trendelenburg positions in alternating order. We injected intracardiac fluorescent microspheres and sampled arterial blood at constant calibrated rates for reference determinations and technique validation. After anesthetic overdose, CNS tissues were harvested, anatomically sectioned, digested, analyzed for fluorescence, and compared to reference samples for flow calculations. Inferential statistics utilized repeated measures ANOVA and Dunn-Sidak comparisons with $P < 0.05$.

We excluded one outlier horse because of unacceptable systemic hypotension. ICP in the remaining animals increased from 31 ± 2 to 55 ± 2 mmHg during Trendelenburg positioning, but cerebral perfusion pressure was unchanged. Blood flow to the cerebrum, cerebellum, and cranial brainstem sections ranged between 40 and 71 ml min⁻¹ 100 g⁻¹ head-down tilting significantly decreased flow to most sections by 16 to 20%. Flow reductions within the pons and medulla were smaller and not statistically significant. Spinal cord blood flow, although unaffected by position, was only 9 ml min⁻¹ 100 g⁻¹.

We conclude that increased heart-brain hydrostatic gradients during Trendelenburg positioning in anesthetized horses decrease cerebral blood flow, but to a lesser extent than they increase intracranial pressure.

A COMPARISON OF ANESTHETIC AND CARDIORESPIRATORY EFFECTS OF TILETAMINE-ZOLAZEPAM-BUTORPHANOL AND TILETAMINE-ZOLAZEPAM-BUTORPHANOL-MEDETOMIDINE WITH OR WITHOUT ATIPAMEZOLE IN CATS. JC Ko,^{*,1} LA Abbo,¹ AB Weil,^{*,1} BM Johnson,¹ ME Payton.² ¹Purdue University, West Lafayette, IN; and ²Oklahoma State University, Stillwater, OK.

The purpose of this study was to compare anesthetic and cardiorespiratory effects (SpO₂, EtCO₂, blood pressure, heart and respiratory rates) of two injectable anesthetic combinations in cats. Seven healthy, 2-year-old research cats weighing 6.2 ± 1.1 kg received intramuscular injections of tiletamine-zolazepam (8 mg kg⁻¹) and butorphanol (0.2 mg kg⁻¹) (TT) or tiletamine-zolazepam (3 mg kg⁻¹), butorphanol (0.15 mg kg⁻¹) and medetomidine (0.015 mg kg⁻¹) (TTD) in a randomized cross-over fashion with a 7-day washout between treatments. The same group of cats also received TTD with the identical dose and manner except that atipamezole (A, 0.075 mg kg⁻¹ IM) was given at 20 minutes to reverse medetomidine. Analgesic duration was assessed at 5 min intervals using an algometer on the paw. Induction and recovery were scored. Data were analyzed using ANOVA with repeated measures with significance of *P* < 0.05. Both combinations induced lateral recumbency within 5 min with endotracheal intubation duration of 70-80 min. Hypoxia with SpO₂ < 90% occurred at least once in all treatment groups between 5 -10 minutes after drug administration. Mild elevation of end-tidal CO₂ (high: 52 mmHg) was observed in the TT group. Mean BP ranged from 83-133 mmHg and heart rate ranged from 125-188 bpm in all treatment groups. Profound analgesia with high algometer pressure tolerance (kPa > 850) lasted for 65 min in TTD cats and 30 min in TT cats. Analgesia was shortened by A in the treated cats (tolerance < 850 kPa) after 35 min following TTD injection. Time from injection to walking ranged from 113-140 min in all groups, but recovery quality was lower in cats who received A. We concluded that both TT and TTD were suitable as injectable anesthetic combinations for induction and anesthesia for noxious stimulus.

INTRAVENOUS LIDOCAINE WITH SHORT-TERM XYLAZINE-KETAMINE ANESTHESIA FOR CASTRATION IN HORSES UNDER FIELD CONDITIONS. M Sinclair,* A Valverde.* University of Guelph, Ontario, Canada.

Horses frequently undergo field surgery with an injectable anesthetic regime and the ability to provide a safe reliable injectable anesthetic can be problematic. Under inhalation anesthesia, IV lidocaine has a MAC sparing effect and potential analgesic benefits. With field injectable regimes, IV lidocaine would potentially promote analgesia and reduce the need for additional injectable doses during surgery. The objectives of this study were to evaluate the use of IV lidocaine with a standard field anesthetic protocol for castration of 6 month-old colts to determine if lidocaine reduced the need for additional injectable anesthetic during surgery and if lidocaine impacted the overall recovery score and quality.

Thirty, client owned horses (~ 200 kg) undergoing routine field castration were used in the study. All horses received sedation with 2 mg kg⁻¹ of xylazine IM, followed by 2 mg kg⁻¹ of ketamine IV and 0.04 mg kg⁻¹ diazepam IV for induction. Horses were randomly assigned to either lidocaine (3 mg kg⁻¹ IV) (A) or saline (equal volume, IV) (B) immediately after induction. Anesthetic time to complete the surgery was prolonged by injections of xylazine/ketamine combined (0.17 mg kg⁻¹ and 0.33 mg kg⁻¹ respectively) if necessary. One investigator was blinded to the treatment used and was responsible for monitoring the horse to determine if additional injectable was required as well as for recovery scoring. Statistical analysis was performed using a one-way analysis of variance ($P < 0.05$) for continuous variables and Fishers exact chi-square for recovery score differences ($P < 0.05$). There were no statistically significant differences in the overall recovery score and quality, need for injectable anesthetic, or surgery time between A and B groups. There was a significantly longer time for the horses to stand after induction in group A [30.7 ± 11.15 min (mean ± SD)] vs group B (22.5 min ± 10.53 min) ($P < 0.04$).

Lidocaine given intravenously does not adversely affect recovery using injectable field regimes, but the overall recovery time is longer. Lidocaine does not appear to reduce the need for injectable anesthetic administration during surgery, however the analgesic benefits of the drug cannot be ruled out. Further investigation into the plasma concentrations achieved under injectable anesthesia and analgesia are necessary.

DEXMEDETOMIDINE CONSTANT RATE INFUSION FOR POST-OPERATIVE PAIN MANAGEMENT IN DOGS. C Valtolina,¹ J Robben,¹ J Uilenreef,¹ J Murrel,¹ B McKusick,² J Aspegren,² L Hellebrekers.¹ ¹University Utrecht, Utrecht, The Netherlands; and ²Orion Corporation, Turku, Finland.

Alpha-2 agonists have potent analgesic properties, but are not commonly used to provide post-operative analgesia in dogs. This study aimed to compare post-operative analgesia provided by a constant rate infusion (CRI) of dexmedetomidine (DEX) to that of a positive control [morphine (MOR)] in dogs after invasive surgery. In a blinded randomized clinical trial, 40 dogs requiring intensive post-operative pain management were studied. Immediately after surgery, a CRI of either DEX ($25 \mu\text{g m}^{-2} \text{h}^{-1}$) or MOR ($2500 \mu\text{g m}^{-2} \text{h}^{-1}$) preceded by a loading dose (DEX: $25 \mu\text{g m}^{-2}$ IV, MOR: $2500 \mu\text{g m}^{-2}$ IV) was administered for 24 h. Pain (measured using a CMPS), sedation and physiological variables were scored at regular intervals. Animals considered painful at any point received rescue analgesia and were reallocated to a post-rescue protocol; patients unresponsive to rescue analgesia were removed from the study. Data were analyzed with appropriate statistics, including ANOVA, two-sample t-tests or Chi-square test with $P < 0.05$ considered significant.

Forty dogs were enrolled [age, 6 ± 3.3 years (mean \pm SD) and weight 27.3 ± 14.3 kg]. Twenty dogs (9 DEX and 11 MOR) completed the study without rescue analgesia. Eleven DEX and 8 MOR dogs were reallocated to the post-rescue protocol, 7 of these dogs were removed from the study. In the first 12 h there were no significant differences in pain scores between groups, while DEX dogs were less ($P = 0.009$) painful during the last 12 h CMPS scores (mean \pm SD) for DEX and MOR respectively were T16, 0.8 ± 0.6 , 2.1 ± 1.1 ; T20, 1.0 ± 1.2 , 1.8 ± 1.1 ; and T24, 0.6 ± 0.5 , 1.7 ± 0.9 . DEX caused more sedation initially, but overall sedation score was not significantly different between groups. DEX CRI was equally effective as MOR CRI for providing post-operative analgesia and no adverse reactions resulted from either protocol

AN INVESTIGATION OF BEHAVIOR OF HORSES UNDERGOING GENERAL ANESTHESIA AND EXPLORATORY LAPAROTOMY. M Sinclair,* ST Millman. University of Guelph, Ontario, Canada.

Behavior is increasingly used as a means of assessing animal comfort and/or pain in veterinary patients. Recumbent posture is needed for REM sleep in horses and may be a useful indicator of positive well-being and comfort post-operatively. The purpose of this study was to explore the behavior of horses prior to and following general anesthesia for exploratory laparotomy to determine if behavioral indicators pre-operatively can predict the overall outcome of the horse in the post-operative recovery phase and to compare behavioral responses to standard anesthetic recovery scoring and cortisol levels. Six healthy research horses (mean age 5.5 years; mean weight 437 kg) were used in this study. Horses were housed in box stalls and underwent the same standard general anesthetic protocol with exploratory laparotomy. A 5-point subjective score (1, strong 1-2 attempts; and 5, fracture or arrest) was used to assess anesthetic recovery (AR). To avoid observer effects on behavior, cameras were mounted in each stall and horses were recorded using 24-hour time lapse video, 48 hours prior to surgery until 24 hours after the first bout of recumbent rest. Instantaneous 5-minute scan sampling was used to quantify proportion of time spent performing the following behaviors: eating, drinking, oral exploration of stall (O), cribbing, pawing, lying laterally recumbent (LR), lying sternal (LS), standing, and locomotion. Latency to display LR post-surgery was also determined and was defined as a positive outcome. Blood was collected twice daily, and assayed for plasma cortisol. Spearman ranked correlations determined associations of behavior pre- and post-surgery, cortisol SR, and LR. Effects of surgery on diversity of behavior was assessed using Shannon diversity index scores.

Behavioral responses varied. Anesthetic recovery scores ranged from 1.0 to 2.5 and latency to perform LR ranged from 0.6 to 9.2 days post-surgery. Horses with better AR scores displayed more LR post-surgery ($P < 0.05$). Behavior was predictive of recovery, since horses that displayed more O ($P < 0.10$) and LR ($P < 0.05$) pre-surgery, had shorter latency to LR after surgery. Interestingly, horses with higher cortisol pre-surgery tended to have better AR scores ($P < 0.10$) and had shortest latency to LR ($P < 0.05$). Diversity score was significantly reduced after surgery ($P < 0.05$), and horses with higher diversity scores pre-surgery had shorter latency to LR. Horses with poor AR ($P < 0.05$) and long latency to LR ($P < 0.05$) spent more time eating post-surgery.

Our results indicate that behavior prior to anesthesia and surgery may predict responses during AR and surgical recovery. Further research is warranted to help define the relationship of LR as an indicator of pain control and its association with horses' active or passive coping styles with stress.

BUCCAL ABSORPTION OF 3 FORMULATIONS OF BUPRENORPHINE IN THE DOG – A PILOT STUDY. KR Mama,*¹ P Mich,¹ T Raske,¹ SD Stanley.² ¹Colorado State University, Fort Collins, CO; and ²University of California-Davis, Davis, CA.

The pharmacokinetics and analgesic actions of buccally administered buprenorphine have been well evaluated in cats, but similar information is not readily available in dogs. Prior to evaluating the analgesic and sedative actions of oral buprenorphine in the dog, we assessed the oral (buccal) absorption of 3 formulations of buprenorphine and compared plasma drug concentrations with that obtained after IV administration of the same dose (20 µg kg⁻¹). Mouth pH was measured prior to drug administration in all dogs.

Six female Walker hounds [4 ± 1.9 years (mean ± SD), 21.7 ± 3.9 kg] were studied twice and randomly assigned to receive 2 of 4 buprenorphine treatments; 3 dogs per treatment group. Buccal treatments included injectable buprenorphine, injectable buprenorphine in methylcellulose gel, and reconstituted buprenorphine powder. The fourth group received injectable buprenorphine IV. Plasma was collected from a pre-placed jugular catheter at 30 minute intervals for 3 hours following drug administration and 60 minute intervals thereafter for an additional 3 hours. Plasma was stored at -20°C until analysis by liquid chromatography-mass spectrometry. The limit of quantification was 0.05 ng ml⁻¹.

Data were not statistically analyzed due to the limited power given small group size. However, the data strongly suggest that the injectable formulation of buprenorphine is the formulation best absorbed from the buccal mucosa. An average peak concentration of 16.8 ng ml⁻¹ was seen 30 minutes post drug administration in dogs receiving injectable drug on the buccal mucosa. This compared with 2.32 and 0.45 ng ml⁻¹ in groups receiving methylcellulose and reconstituted powder respectively. The peak was not sampled in the IV group where plasma concentrations had presumably decreased to 1.44 ± 1.01 ng ml⁻¹ by 30 minutes. The drug was detected in all groups through the 6 hour sampling period, but had decreased to close to the limit of quantification in the dogs receiving reconstituted powder. Oral pH was 8.3 ± 0.5 units.

The most common side effect noted in this group of dogs was excessive salivation. This did not appear to be related to oral administration as it occurred in the oral and IV dogs, between 1 and 3 hours after drug administration. Quieting was noted in all dogs in the group administered injectable buprenorphine buccally and in one dog in the IV group. These results suggest that the injectable formulation of buprenorphine is absorbed from the buccal mucosa and has a clinical effect in dogs and should be selected when evaluating the actions of this drug administered buccally.

ANESTHETIC PROPERTIES OF CARBON DIOXIDE IN THE RAT. RJ Brosnan,*¹ EI Eger II,*² MJ Laster,² JM Sonner.² ¹University of California-Davis, Davis, CA; and ²University of California-San Francisco, San Francisco, CA.

Carbon dioxide decreases halothane MAC in dogs only when PaCO₂ exceeds 95 mmHg. The present study sought to confirm these findings for several potent inhaled anesthetics in rats.

Groups of 8 adult Sprague-Dawley rats were anesthetized in individual plexiglass cylinders with halothane, isoflurane, or desflurane delivered in oxygen. MAC was determined using a standard tail clamp technique for each agent alone, and then with increasing concentrations of inspired CO₂ ≤ 63.2%. A fourth group was given CO₂ alone to determine the MAC of CO₂.

MAC for halothane, isoflurane, and desflurane were (mean ± SEM) 1.14 ± 0.04, 1.42 ± 0.04, and 7.21 ± 0.22 %, respectively. Increasing inspired CO₂ concentrations produced identically linear dose-dependent decreases in MAC for each potent inhaled anesthetic as described by the equation: %MAC = -1.9 × F_ICO₂ + 1.0, where %MAC is the percent decrease in ED₅₀ for the volatile agent and F_ICO₂ is the fraction inspired carbon dioxide. The MAC of CO₂ was approximately 50% of one atmosphere. With elimination of CO₂, the MAC of isoflurane and desflurane returned to the original MAC. Given alone, CO₂ proved lethal.

Unlike dogs, no threshold for the CO₂-MAC response arose with halothane, isoflurane, or desflurane in rats. The ED₅₀ for CO₂ is also approximately 50% greater in rats than reported in dogs.

EFFECTS OF BUPRENORPHINE ON ISOFLURANE MINIMUM ALVEOLAR CONCENTRATION IN DOGS. P. Queiroz-Castro, CM Egger,* BW Rohrbach, T Doherty.* University of Tennessee, Knoxville, TN.

This study evaluated the effects of buprenorphine (BUP) on isoflurane minimal alveolar concentration (ISO_{MAC}) in dogs. It was hypothesized that BUP would decrease ISO_{MAC} in a dose-dependent manner. Six healthy dogs (2-3 years; 2 males and 4 females; 7.4–11 kg) were studied in a randomized crossover design. Each dog was studied on 3 occasions with 7 days washout. Anesthesia was mask induced with isoflurane (ISO). Dogs were intubated and ventilated to maintain normocapnia. Baseline MAC (MAC_B) was determined starting 45 minutes after induction with the end-tidal ISO held constant for 20 minutes. The noxious stimulus (50 V, 5 Hz, 10 ms), which consisted of 2 single stimuli followed by 2 continuous stimuli of 5 seconds duration, was delivered via two needles inserted subcutaneously near the elbow. If purposeful movement occurred, ET_{ISO} was increased by 0.1 vol%, otherwise, it was decreased by 0.1 vol% and the stimulus was re-applied following a 20-minute equilibration. MAC was defined as the mean value of the ET_{ISO} values bracketing the dog's response and lack of response to the stimulus.

After MAC_B determination dogs received one of the following treatments IV: BUPI (0.01 mg kg⁻¹), BUPII (0.05 mg kg⁻¹) or BUPIII (0.1 mg kg⁻¹), and post-treatment MAC (MAC_T) was determined. Two MAC_T values were determined: MAC_{T1} was determined starting 45 minutes after BUP administration and MAC_{T2} at 4 hours after BUP administration. MAC values were determined in duplicate and the mean values were used for statistical analysis. A mixed-model ANOVA and Tukey test were used with $P < 0.05$ considered significant.

BUPII and BUPIII significantly reduced MAC_{T1} by 36% and 27%, respectively compared to MAC_B . MAC_{T2} was not significantly reduced by any treatment.

In conclusion, buprenorphine at 0.05 and 0.1 mg kg⁻¹ significantly reduced ISO_{MAC} . Buprenorphine ISO_{MAC} reducing effects were not significantly evident after 4 hours.

CLINICAL APPLICATION OF DORSOLUMBAR EPIDURAL ANESTHESIA IN A BOVINE REFERRAL CENTER. M Hiraoka,¹ W Miki,¹ WG Son,² I Lee.² ¹Hokkaido NOSAI, Hokkaido, Japan; and ²Seoul National University, Seoul, Korea.

This study describes the clinical use of dorsolumbar epidural anesthesia with a fixed volume of anesthetic in a bovine referral center for one year. Among 274 Holstein cattle scheduled for flank surgery in a standing position, 234 cattle (85%) received a mixed anesthetic (5 ml) consisting of 0.5 ml of 2% xylazine hydrochloride, 3 ml of 2% lidocaine hydrochloride and 1.5 ml saline by modified dorsolumbar epidural anesthesia through the first and second lumbar (L1-L2) or the last thoracic and the first (T13-L1) lumbar intervertebral space. Entrance of an epidural needle (16 gauge, 120 mm) into the epidural space was confirmed by hanging-drop technique with saline and the needle was advanced about 10 mm in order to penetrate epidural fat. Infiltration anesthesia was performed in 40 cattle (15%) when the epidural needle could not be inserted into the epidural space in order to perform the flank surgery. Depth of entrance into the epidural space and injection were 8.5 ± 0.8 cm and 9.3 ± 0.7 cm, respectively. One hundred ninety three of the animals underwent omentopexy for left displacement of abomasum, 57 underwent omentopexy for right displacement of abomasum, 18 underwent cesarean section and 6 underwent surgical correction of intestinal volvulus. The surgeries began about 12 min after the administration of the anesthetic and lasted for about 36 min. Epidural anesthesia induced enough analgesia in 90% of cattle. Nine cattle showed ataxia and two of them became recumbent. The modified method using a fixed volume of anesthetic was successfully used in a bovine referral center. In addition to welfare of cattle with painless surgery, this modified method will allow veterinarians to save time and effort, thus lowering the cost of each surgery.

COMPARISON OF TWO ANESTHETIC PROTOCOLS FOR FELINE BLOOD DONATION. M Killos, L Graham,* E Olmstead, J Lee. University of Minnesota, Saint Paul, MN.

Volunteer feline blood donors are commonly anesthetized for blood donation. Injectable protocols afford wide safety margin and predictable levels of sedation. However, recoveries are long and prolonged blood collection may require redosing. Inhalants provide faster recoveries but may cause profound hypotension.

This prospective, blinded, randomized crossover study compares an injectable and an inhalant protocol. Twenty client-owned, healthy domestic short hair cats aged 4.5 ± 1.2 years, and weighing 5.7 ± 0.8 kg were evaluated twice, with at least six weeks between donations. One donation used an intramuscular injection (KMB) of ketamine 5 mg kg^{-1} midazolam 0.2 mg kg^{-1} and butorphanol 0.3 mg kg^{-1} . The other donation episode used sevoflurane (SEV) in oxygen via mask. Blood (60 ml) was collected from the jugular vein, over five minutes minimum. Blood pressure, SpO₂, and heart and respiratory rates were monitored once per minute.

All cats experienced decreased blood pressure during donation (mean 14% decline from baseline). Eight KMB cats required blood pressure support (6-12 mL LRS or hetastarch IV bolus) for Doppler readings $<70\text{mmHg}$, while sixteen SEV cats required similar support. All cats improved after intervention. The most severe hypotension noted was in a KMB cat. Incidence of hypotension was not statistically significantly different between protocols. Six KMB cats experienced post-procedure hyperthermia (rectal temp $103.4\text{-}108^\circ \text{F}$, $39.7\text{-}42.2^\circ \text{C}$) requiring intervention. Owner surveys indicated significantly faster return to normal behavior at home with SEV (mean 3.9 hours) than with KMB (mean 12.7 hours).

Both anesthetic protocols had significant rates of hypotension during feline blood donation, and should be used only with appropriate monitoring and support. KMB may cause transient but serious hyperthermia. SEV allows faster return to normal behavior at home.

IMMOBILIZATION WITH A COMBINATION OF KETAMINE HYDROCHLORIDE AND MEDETOMIDINE IN WILD JAPANESE MONKEYS (*MACACA FUSCATA FUSCATA*). T Miyabe, M Morimoto, J Suzuki, Y Muroyama, T Suzumura, F Kanchi, H Tanaka, S Hayakawa, Y Hamada. Kyoto University, Inuyama City, Aichi, Japan.

Eighty-three free-ranging Japanese monkeys (*Macaca fuscata fuscata*) on Koshima Island were captured (45 females and 38 males) and seventy-five monkeys were immobilized with a combination of ketamine hydrochloride and medetomidine (MK). Eight monkeys less than one year of age were handled without immobilization. The mean age of the monkeys was eight years (0-22 years) and the mean body weight was 5.6 kg (0.8-10.7 kg). A 1:2 volume of ketamine (50 mg ml⁻¹) and medetomidine (1 mg ml⁻¹) was prepared and administered according to the estimated body weight (0.15 mL kg⁻¹). Mean \pm SD dosages of ketamine used were 2.5 ± 0.6 mg kg⁻¹ and that of medetomidine was 99 ± 22 μ g kg⁻¹. Mean induction time was 6.6 ± 6.1 min. Time for anesthetic induction was defined as the time to lateral recumbency. Six monkeys did not attain lateral recumbency after the first injection because of under estimation of body weight and additional dosages of the combination were administered. After induction, the animals were weighed, measured and blood withdrawal was performed, then radiographs of the limbs were taken. Atipamezole was administered 18.2 ± 7.9 min after MK injection after all procedures were completed. Animals were kept in burlap (jute) bags or net cages (1m x 1m x 1m) until totally recovered and released 87.9 ± 23.5 min after MK injection. Immobilization and muscle relaxation were good for the procedures. No additional dosages were required after induction to complete the procedures. The combination of medetomidine (~ 100 μ g kg⁻¹) and ketamine (~ 2.5 mg kg⁻¹) appeared to be suitable for field immobilization of Japanese monkeys.

EFFECT OF LIDOCAINE AND KETAMINE ON THE MINIMUM ALVEOLAR CONCENTRATION OF SEVOFLURANE IN DOGS.

JD Wilson, T Doherty,* C Egger,* A Fidler, S Cox, B Rohrbach. University of Tennessee, Knoxville, TN.

Quantification of MAC reduction is a method for comparing anesthetic properties of drugs and can be used experimentally to test and develop clinically useful multi-modal anesthetic combinations. The purpose of this study was to evaluate the effects of intravenous lidocaine (L), ketamine (K), and the combination (LK) on the minimum alveolar concentration (MAC) of sevoflurane (SEV) in dogs. Six, healthy, 3-4 year old Beagles, 2 males, 4 females, weighing 10 ± 2 kg were used. Anesthesia was induced with SEV in 100% oxygen delivered by face mask. Dogs were intubated and mechanically ventilated to maintain normocapnia. Baseline minimum alveolar concentration of sevoflurane (MAC_B) was determined in duplicate for each dog as the end-tidal SEV concentration midway between that which prevented or allowed purposeful movement in response to an electrical stimulus. Treatment was initiated following MAC_B determination. Each dog was allocated according to a Latin square design to receive one of the following treatments administered intravenously as a loading dose (LD) followed by a constant rate infusion (CRI): lidocaine (LD 2 mg kg^{-1} CRI $50 \text{ } \mu\text{g kg}^{-1} \text{ min}^{-1}$), lidocaine (2 mg kg^{-1} $100 \text{ } \mu\text{g kg}^{-1} \text{ min}^{-1}$), lidocaine (2 mg kg^{-1} $200 \text{ } \mu\text{g kg}^{-1} \text{ min}^{-1}$), ketamine (3 mg kg^{-1} $50 \text{ } \mu\text{g kg}^{-1} \text{ min}^{-1}$), ketamine (3 mg kg^{-1} $100 \text{ } \mu\text{g kg}^{-1} \text{ min}^{-1}$), or lidocaine (2 mg kg^{-1} $100 \text{ } \mu\text{g kg}^{-1} \text{ min}^{-1}$) + ketamine (3 mg kg^{-1} $100 \text{ } \mu\text{g kg}^{-1} \text{ min}^{-1}$) in combination. Post-treatment MAC (MAC_T) was determined in duplicate 30 minutes after initiation of treatment. A mixed model ANOVA was used to evaluate percent change between groups. A *P* value ≤ 0.05 was used to denote statistical significance. Least squares mean \pm SEM MAC_B of all groups was $1.9 \pm 0.2\%$. Lidocaine infusions of 50, 100, and $200 \text{ } \mu\text{g kg}^{-1} \text{ min}^{-1}$ significantly reduced MAC_B by 22.6%, 29.0% and 39.6%, respectively. Ketamine infusions of 50 and $100 \text{ } \mu\text{g kg}^{-1} \text{ min}^{-1}$ significantly reduced MAC_B by 40.0% and 44.7%, respectively. The combination of K and L significantly reduced MAC_B by 62.8%. Lidocaine and K, used at the doses studied, will allow a clinically important reduction in the concentration of SEV required to maintain general anesthesia in dogs.

BISPECTRAL INDEX (BIS) SCORES DO NOT CORRELATE WITH SEDATION SCORES IN RHESUS MACAQUES AFTER KETAMINE ADMINISTRATION. LS Barter,* LL Brignolo, JF Antognini. University of California-Davis, Davis, CA.

Non-human primates often undergo anesthesia for research purposes with techniques that include neuromuscular blockade. Electroencephalographic (EEG) monitoring may improve assessment of anesthetic depth in those animals. The bispectral index (BIS) monitor processes the EEG to derive a dimensionless number between 0 (coma) and 100 (awake). The correlation between BIS scores and level of anesthetic induced hypnosis has not been investigated in non-human primates and may be complicated by use of dissociative anesthetics. The aim of this study was to evaluate the correlation between BIS scores and level of hypnosis in primates following ketamine administration. EEGs were recorded from 20 adult rhesus macaques (8.5 ± 4.2 yrs, 8.7 ± 1.7 kg) anesthetized with intramuscular ketamine (10 ± 3 mg kg⁻¹) for routine husbandry procedures. Beginning 25 ± 4 min from the time of ketamine administration, sedation score (SS, from 0 = deep hypnosis to 5 = awake) and BIS score (0 to 100) was assessed every 5 minutes until the animal became ambulatory. Fifty-two recordings were obtained with an average BIS score of 83 ± 20 (range 31 to 98) and sedation score 3 ± 1 (range 1 to 5). No correlation was found between sedation and BIS scores ($r^2 = 0.06$). Some ambulatory animals ($SS > 4$) had BIS scores in 60s. Conversely some anesthetized animals ($SS < 1$) had BIS scores in the 90s. In this study BIS scores did not correlate to depth of hypnosis in rhesus macaques anesthetized with ketamine. Further evaluation is required to determine if depth of hypnosis in primates can be monitored during non-dissociative maintenance techniques, particularly following ketamine-based induction protocols.

THE EFFECT OF HYPOTHYROIDISM ON ISOFLURANE REQUIREMENT IN DOGS. SH Berry,* DL Panciera. VA-MD Regional College of Veterinary Medicine, Blacksburg, VA.

There is an empirical impression that hypothyroid dogs require less anesthetic than dogs with normal thyroid function. However, there are no controlled studies that demonstrate this in the dog using modern inhaled anesthetics. The purpose of this study was to determine the anesthetic requirements of dogs with experimentally induced hypothyroidism. Eighteen healthy, adult dogs were studied. Hypothyroidism was induced in nine dogs by intravenous administration of 1 mCi kg⁻¹ of ¹³¹Iodine. The remaining nine dogs served as controls. Dogs were studied after hypothyroidism was confirmed and 9-12 months after the induction of hypothyroidism. Anesthesia was induced with isoflurane in oxygen via a face mask. The trachea was intubated, and anesthesia was maintained using isoflurane in oxygen using semiclosed rebreathing circle system. The minimum alveolar concentration (MAC) was determined in triplicate using a tail clamp technique. The mean values for the groups were compared using a 2 sample t-test with $P < 0.05$ considered significant. The mean MAC of isoflurane in the hypothyroid dogs was 0.9802%. The mean MAC of isoflurane in the control dogs was 1.1081%. The mean MAC of isoflurane in hypothyroid dogs was not significantly different from the mean MAC of isoflurane in the control dogs ($P = 0.3553$). We conclude that the dosage of isoflurane does not need to be reduced in hypothyroid dogs.

WHAT IS THE MORTALITY RATE OF ANESTHETIZED BIRDS? DR Yaakov, KL Rosenthal, FJ Golder,* FS Shofer. University of Pennsylvania, Philadelphia, PA.

The anesthetic mortality rate in pet birds is unknown. This retrospective study was undertaken to: 1) evaluate the avian anesthetic mortality rate at the Matthew J Ryan Veterinary Hospital, The University of Pennsylvania (MJR-VHUP) and, 2) to identify factors associated with anesthetic mortality.

Records of 564 anesthetic episodes in 310 pet birds at MJR-VHUP during the years 2000-2005 were examined. The parameters examined included signalment, weight, presenting complaint, reason for anesthesia, if and which pre-medications were used, duration of the anesthetic episode, number of previous anesthetic episodes, ASA status, use of face mask or endotracheal tube, use of IPPV, and type of monitoring equipment used. An anesthetic episode was defined from the time of anesthetic induction until recovery from anesthesia (*i.e.* the bird is able to stand on it's own). Anesthetic death was defined as any death that occurred during the anesthetic episode, or when an individual did not recover from the anesthetic period. Birds that died due to surgical complications during the anesthetic episode were not considered anesthetic deaths. The definition of the mortality rate was the number of anesthetic episodes that resulted in an anesthetic death out of the total number of anesthetic episodes. To identify factors associated with anesthetic episodes resulting in death, Student's t or Wilcoxon rank sum test was used for continuous data and chi square test or Fisher's exact test was used for categorical data. A probability of $P < 0.05$ was considered statistically significant.

The number of anesthetic episodes resulting in anesthetic death was 21 (mortality rate = 3.7%). Anesthetic episodes in birds weighing under 100 grams were found to have a higher risk of death (8.5% for birds <100 grams vs 2.6% for birds >100 grams respectively, $P = 0.04$). Mortality rate was higher in individuals assigned a preanesthetic ASA status greater than 3 (ASA>3 in 56% of anesthetic episodes that resulted in anesthetic death vs ASA>3 in 5% of anesthetic episodes that survived. $P < 0.0001$). Duration of episode, intubation, IPPV, and the number of anesthetic episodes were not found to significantly affect anesthetic mortality rate.

EFFECTS OF TRAMADOL ON SEVOFLURANE MAC IN DOGS. MR Seddighi, CM Egger,* BW Rohrbach, T Doherty.* University of Tennessee, Knoxville, TN.

This study evaluated the effects of continuous rate infusion of tramadol on sevoflurane MAC (SevoMAC) in dogs. It was hypothesized that tramadol would reduce SevoMAC in a dose-dependent manner.

Six healthy, adult dogs [2-3 years old, 24.2 ± 2.6 kg (mean \pm SD)] were used in a randomized crossover design. Each dog was studied on 2 occasions, with a 7-day washout. Anesthesia was induced using sevoflurane delivered via a mask. Baseline SevoMAC (MAC_B) was determined starting 45 minutes after tracheal intubation. A noxious stimulus (50V, 50Hz, 10 msec) was applied subcutaneously to the ulnar region. If purposeful movement (gross movement of the head or extremities) occurred, end-tidal sevoflurane was increased by 0.1 vol%, otherwise, it was decreased by 0.1 vol% and the stimulus was re-applied after a 20-minute equilibration. After MAC_B determination, dogs randomly received either a 1.5 mg kg^{-1} (T1) or a 3 mg kg^{-1} (T2) tramadol loading dose (LD), followed by a continuous rate infusion (CRI) of $1.3 \text{ mg kg}^{-1} \text{ hour}^{-1}$ or $2.6 \text{ mg kg}^{-1} \text{ hour}^{-1}$ respectively and MAC was re-determined 45 minutes after starting each CRI (MAC_T). Data were analyzed using a mixed model ANOVA to determine the effect of treatment on percentage change in SevoMAC ($P < 0.05$). MAC values are expressed as mean \pm SEM.

The MAC_B values were $1.80 \pm 0.12\%$ and $1.75 \pm 0.07\%$ for T1 and T2, respectively and were not significantly different. There was no effect of weight, week, or time-to-MAC determination on either MAC_B or MAC_T . SevoMAC values were reduced ($P < 0.05$) by T1 and T2 ($29\% \pm 4$ and $33\% \pm 4$, respectively); however, there was no significant difference in MAC reduction between T1 and T2.

In conclusion, tramadol at the doses studied reduced the SevoMAC by approximately 30%.

CHANGES IN ANESTHETIC MONITORING PARAMETERS OBSERVED IN ACUTE GASTROINTESTINAL PERFORATION DURING FELINE GASTRODUODENOSCOPY (6 CASES, 1995-2006). LF Graham.* University of Minnesota, Saint Paul, MN.

Gastrointestinal (GI) perforation is an uncommon complication associated with gastroduodenoscopy in cats. Six cases (out of ≥ 394) occurred in 11 years at the University of Minnesota Veterinary Medical Center, each under a different supervising internal medicine clinician.

Affected cats were $12.6 \text{ yr} \pm 1.8$ (mean \pm SD) and weighed $3.5 \text{ kg} \pm 0.6$ (mean \pm SD). Represented breeds included domestic short hair (n = 3), domestic medium hair (n = 1), domestic long hair (n = 1) and Persian (n = 1). Recent histories included weight loss (n = 5), anemia (n = 3), vomiting (n = 3), diarrhea (n = 2), anorexia (n = 2), diabetes mellitus (n = 2), hematemesis (n = 1) and/or melena (n = 1).

ASA status included ASA-II (n = 2) and ASA-III (n = 4). Pre-anesthetic management included no premedications (n = 5) or IM ketamine (n = 1). Induction agents included propofol (n = 1), diazepam-propofol (n = 2), diazepam-etomidate (n = 1), isoflurane by mask (n = 1) or sevoflurane by mask (n = 1). Maintenance was with isoflurane (n = 5) or sevoflurane (n = 1) in oxygen, delivered via a non-rebreathing anesthetic circuit. At the time of inadvertent GI perforation, changes in heart rate/rhythm and respiratory rate were inconsistent. Alterations in mucous membrane color, capillary refill time and indicators of depth (withdrawal, palpebral reflexes) were not reported. A sudden decrease in SpO₂ (90-92%) was the first indicator of iatrogenic pneumoperitoneum in 5 cats; in 1 cat, the peritoneum was visualized.

After resolving the low SpO₂ values via manual ventilation with or without abdominocentesis, 2 cats were euthanized and 4 underwent exploratory laparotomy. Following surgery, case outcomes included euthanasia 2 days postoperatively (n = 1); cardiac arrest/death 4 days postoperatively (n = 1); euthanasia after 3 months of chemotherapy (n = 1); ongoing chemotherapy (n = 1). Final diagnoses were GI and/or generalized lymphoma (n = 5) or severe lymphoplasmacytic gastritis (n = 1).

A sudden decrease in SpO₂ (90-92%) during gastroduodenoscopy may be an early indicator of acute pneumoperitoneum subsequent to inadvertent GI perforation. Pulse oximetry is strongly recommended during feline gastroduodenoscopy.

THE EFFECTS OF ORAL TRAMADOL ALONE OR CONCURRENT WITH OPIOIDS ADMINISTRATION ON THE SEVOFLURANE MINIMUM ALVEOLAR CONCENTRATIONS IN CATS. JC Ko,^{*1} LA Abbo,¹ AB Weil,^{*1} BM Johnson,¹ ME Payton.² ¹Purdue University, West Lafayette, IN; and ²Oklahoma State University, Stillwater, OK.

Tramadol is purported to be a weak opioid agonist with inhibition of norepinephrine and serotonin reuptake. Inhalant anesthetic sparing effect of tramadol in combination with an opioid is currently unknown. The objectives of this study were to evaluate and compare the sevoflurane (Sevo) sparing effect of tramadol with and without butorphanol or hydromorphone in cats. Eight, 3-year-old healthy research cats, weighing 4.3-5.8 kg, were used in this randomized cross-over 6x2 factorial design. Cats were mask induced with Sevo in 100% O₂, intubated and maintained with normocapnia on Sevo/100% O₂ in a circle system using a mechanical ventilator. Bracketing technique using tail clamp as supramaximal stimulus was used to determine minimum alveolar concentration (MAC) of Sevo with each of the following treatments, saline control (S), tramadol (T, 8.6-11.6 mg kg⁻¹ PO 10 min before Sevo induction), butorphanol (B, 0.4 mg kg⁻¹ IV), hydromorphone (H, 0.1 mg kg⁻¹ IV), the same doses of tramadol and butorphanol combined (TB), and the same doses of tramadol and hydromorphone combined (TH). After each of the treatment MAC was determined, naloxone (10 µg kg⁻¹ IV) was given to reverse potential drug-induced MAC sparing effect and a new MAC was then redetermined. Data were analyzed with repeated measures methods using ANOVA techniques with significant level was set at $P < 0.05$. Results showed that Sevo MAC was $2.5 \pm 0.2\%$ and B had the largest Sevo MAC sparing effect ($1.2 \pm 0.2\%$), followed by T ($1.5 \pm 0.2\%$) and H ($1.8 \pm 0.2\%$). Tramadol used with an opioid (TB: $1.5 \pm 0.2\%$ or TH: $1.9 \pm 0.2\%$) did not further reduce Sevo MAC in cats. Tramadol and opioid Sevo MAC sparing effects were reversed by naloxone. We concluded that tramadol sevo MAC reduction effect was related to its action at opioid receptors in these cats and there was no advantage to combining tramadol with opioids to reduce MAC of Sevo compared to using each drug alone.

A COMPARISON OF TWO TECHNIQUES FOR BRACHIAL PLEXUS BLOCKADE IN DOGS. DV Wilson,* JK Dhanjal, F Garcia-Pereira. Michigan State University, E. Lansing, MI.

Injection of local anesthetic solution over the brachial plexus can provide anesthesia for forelimb structures up to the elbow. Brachial plexus blocks are relatively safe and easy to perform, but are not always effective. The use of nerve stimulators has been described to enhance accuracy in performing this block. The purpose of the present study was to compare two techniques for performing brachial plexus blockade: injection based upon anatomic landmarks, and injection guided by a nerve stimulator (NS).

Five anesthetized dogs weighing an average 7.8 ± 0.3 kg, were positioned in lateral recumbency. Either a spinal needle or an insulated needle were utilized to inject 5 mls of 0.1% methylene blue solution into the region of the brachial plexus. Injection of the dye was made either based upon anatomic landmarks, or the needle placement was guided by the response to the NS. The dog was then repositioned, and the alternative method was utilized to guide injection over the second plexus. At least 20 minutes after injection, the dogs were euthanized. The brachial plexus was exposed bilaterally. Distribution of the injectate over each plexus was assessed, scored and described by an evaluator unaware of injection technique. A visual analog scale (VAS) was used to score staining of the nerves; a score of 10 cm would represent the maximal possible staining of the plexus. Student's t-test was used to compare scores associated with each technique with $P < 0.05$ considered significant.

Scores of dye distribution over nerves in the plexus averaged 4.3 ± 1.5 and 3.7 ± 1.1 cm (SEM) following landmark-guided or NS-assisted techniques, respectively. There was no significant difference between the scores following either technique ($P = 0.39$). Staining of the nerves of the plexus was very variable, with one plexus almost unstained following both injection techniques. The use of a NS to assist in performance of the brachial plexus block seems to offer little advantage over use of landmarks to locate the plexus.

ANALGESIC EFFECT OF TRAMADOL COMBINED WITH TOLFENAMIC ACID IN CATS AFTER OVARIOHYSTERECTOMY. HC Chen, R Radzi, NA Rahman, SF Lau. Universiti Putra Malaysia, Serdang, Malaysia.

The purpose of this study was to determine the analgesic effect of tramadol in combination with tolfenamic acid in cats following ovariohysterectomy.

Twelve healthy cats (2.7 ± 0.4 kg; 1.1 ± 1.0 years) were randomly assigned to two groups. Control group (CTRL) was premedicated with acepromazine (0.1 mg kg^{-1} SC). Tramadol group (TRA) was premedicated with acepromazine (0.1 mg kg^{-1} SC) and tramadol (4 mg kg^{-1} SC). Cats in both groups were induced with thiopental and maintained on halothane for routine ovariohysterectomy by experienced veterinarians. All cats received tolfenamic acid (4 mg kg^{-1} SC) at the end of surgery. Serum creatinine and ALT were determined before, and 24 hours after surgery. A blinded observer determined the level of sedation and the composite pain scores based on behavior, appearance, posture, movement, and response to palpation of the surgical site prior to surgery (baseline), and at 1, 2, 3, 4, 6, 8, and 24 hours after surgery. Rescue pethidine (5 mg kg^{-1} IM) was to be administered when necessary. Data were analyzed between and within group using Mann-Whitney and Wilcoxon-Signed Rank Test. A *P* value of < 0.05 was considered significant.

Composite pain scores in CTRL were higher than TRA at 3, 4, 6, and 8 hours. Within CTRL, pain scores at 3, 4, 6, 8, and 24 hours were higher than baseline. Within TRA, higher pain score was detected only at 24 hours. Sedation score for TRA at 1 hour tended to be higher than CTRL. None of the cats required rescue analgesia. There were no differences in the pre and post-surgery creatinine and ALT levels in both groups.

Compared to the use of post-operative tolfenamic acid alone, addition of tramadol at 4 mg kg^{-1} SC in the premedication provided better analgesia in the immediate 8 hours post-ovariohysterectomy in cats.

COMPARISON OF TWO DIFFERENT TECHNIQUES FOR BRACHIAL PLEXUS BLOCK IN DOGS USING THREE DIFFERENT VOLUMES OF METHYLENE BLUE. C Ricco, L Graham,* M Killos, R Mandsager.*
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Brachial plexus blocks are commonly performed for front limb surgeries. The blocks' success rate in animals is unknown, but in humans the use of an electrostimulator to assist nerve location has been demonstrated to increase efficacy.

Thirty adult Beagle dogs (10.5 ± 1.8 kg) were enrolled in this randomized, blinded, crossover study performed under general anesthesia. Each dog served as its own control with one brachial plexus injected via blind technique (BLN) and the other injected using an electrostimulator (ECS; 1Hz, < 1mA) to locate the nerves before injection. Dogs were randomized as to which plexus received each technique. Dogs were also randomized into one of three groups according to the volume of methylene blue 0.1% ($0.15, 0.3, \text{ and } 0.6 \text{ mL kg}^{-1} \text{ site}^{-1}$) used to stain the nerves. After euthanasia, the sites were dissected and the brachial plexus nerves (musculocutaneous, axillary, radial, median, and ulnar) identified. The number of nerves stained (0-5), and presence of dye surrounding the nerves (positive = 1, negative = 0) were noted by an independent evaluator. Paired permutation tests compared differences between techniques. Differences among volumes were determined by linear square test. $P < 0.05$ was considered significant.

The electrostimulator current used was 0.15 ± 0.11 mA; response obtained was carpal extension (77%) or flexion (23%). Volume injected did not affect success rate. The average score for surrounding tissue staining was equal between techniques (0.83). The number of nerves stained using BLN and ECS were, respectively, 2.1 ± 1.8 and 1.5 ± 1.5 (not different). Flexion of the carpus was associated with higher success rate than extension ($P = 0.0088$). BLN was statistically better than ECS when carpal extension was elicited ($P = 0.035$). When flexion was elicited, techniques were similar ($P = 0.16$).

The electrostimulator offered no advantage over the blind technique for brachial plexus block in dogs.

PHARMACOKINETICS OF TRAMADOL AND O-DESMETHYLTRAMADOL IN CATS. BH Pypendop,* JE Ilkiw. University of California-Davis, Davis, CA.

Tramadol is a centrally acting analgesic drug that interacts with opioid, adrenergic and serotonin receptors. O-desmethyltramadol, one of tramadol's metabolites, is active and has been reported to have a higher affinity for opioid receptors than the parent drug. The purpose of this study was to characterize the disposition of tramadol and O-desmethyltramadol in cats.

Six healthy cats (mean \pm SD age: 11.8 ± 1.1 months, weight; 4.1 ± 0.4 kg) were used. The day before an experiment, cats were anesthetized with isoflurane in oxygen, and a jugular catheter was placed. The following day, tramadol was administered intravenously (2 mg kg^{-1}) in a medial saphenous vein, or orally (5 mg kg^{-1}). The order of administration route was selected randomly. At least 3 weeks were allowed between successive administrations. Blood samples were obtained prior to tramadol administration and 1, 2, 4, 8, 15, 30, 60, 90, 120, 180, 240, 360, and 480 min following intravenous administration, or 5, 10, 20, 30, 45, 60, 90, 120, 180, 240, 360, 480, and 600 min following oral administration. Tramadol and O-desmethyltramadol concentrations were determined using liquid chromatography/mass spectrometry. Intravenous data were used to assess systemic availability after oral administration. Nonlinear least squares regression was performed on plasma tramadol concentrations after oral administration. Data from each cat were fitted to 1 and 2 compartment models and the appropriate model was selected. Changes in plasma O-desmethyltramadol concentrations were evaluated by use of standard non-compartmental analysis. Data are presented as mean \pm SEM.

The apparent volume of distribution of the central compartment, the apparent volume of distribution at steady-state, the clearance, and the terminal half-life following IV administration were $1.55 \pm 0.12 \text{ L kg}^{-1}$, $3.10 \pm 0.13 \text{ L kg}^{-1}$, $20.8 \pm 3.2 \text{ mL min}^{-1} \text{ kg}^{-1}$ and $134 \pm 18 \text{ min}$, respectively. Bioavailability of orally administered tramadol was $62 \pm 11\%$. Time to reach maximum concentration after oral administration was $43 \pm 11 \text{ min}$. After oral administration, the apparent volume of distribution of the central compartment, the apparent volume of distribution at steady-state, the clearance, and the terminal half-life were $1.99 \pm 0.87 \text{ L kg}^{-1}$, $3.31 \pm 0.61 \text{ L kg}^{-1}$, $11.8 \pm 2.5 \text{ mL min}^{-1} \text{ kg}^{-1}$ and $191 \pm 14 \text{ min}$, respectively. O-desmethyl-tramadol rapidly appeared in plasma following oral tramadol administration, and closely followed tramadol's disposition profile. Terminal O-desmethyltramadol half-life was $289 \pm 19 \text{ min}$ after oral tramadol administration.

This study shows that tramadol is rapidly absorbed after oral administration to cats, and is relatively slowly eliminated.

A COMPARISON BETWEEN AN ELECTROCARDIOGRAM TECHNIQUE WITH A BLIND TECHNIQUE FOR ACCURATE CENTRAL VENOUS CATHETER PLACEMENT IN THE DOG. AK Claude, DH Riedesel. Iowa State University, Ames, IA.

The purpose of this study was to compare two techniques for placing central venous catheters. The conventional blind technique was compared to an ECG-guided central venous catheter technique. If ECG-guidance is accurate it may be useful in situations where the external landmarks are not available, *e.g.* surgical patients draped for a thoracic surgery. Twelve anesthetized laboratory Beagle dogs (mean \pm SD, 13.8 \pm 3.4 kg) were used for this study. For the blind technique, catheter length was estimated based on the distance from the skin insertion site to the first/second intercostal spaces. The ECG-guided technique utilized V-lead placement with the positive electrode attached to the j-wire and the catheter length was determined by moving the catheter cephalad and caudad to the point of maximum P-wave amplitude. Final catheter position for both techniques was determined using a lateral thoracic radiograph. Success of catheter placement was evaluated on the lateral radiograph by comparing the position of the distal tip of the catheter to the cranial edge of the central 2/3 of the base of the heart (right atrium). Successful catheter placement was 1-2 cm rostral to the cranial edge of this area. Two evaluations of these techniques were made: 1) the length of the catheter inserted, and 2) accurate positioning of the catheter tip. Data was analyzed using the matched paired t-test for insertion length (cm) and the McNemar analysis for probability of success between the two techniques. There was no significant difference in length of catheter insertion between the two techniques. The probability of success of the ECG technique approached significance (0.0704 with $P = 0.05$) when compared to the blind technique. The ECG-guided central catheter placement technique was as successful as the blind technique.

PHARMACOKINETICS OF REMIFENTANIL IN CONSCIOUS AND ISOFLURANE-ANESTHETIZED CATS. BH Pypendop,* RJ Brosnan,* KT Siao, SD Stanley. University of California- Davis, Davis, CA.

Remifentanil is an ultra-short acting opioid. The purpose of this study was to characterize the disposition of remifentanil in conscious, and isoflurane-anesthetized cats.

Remifentanil ($1 \mu\text{g kg}^{-1} \text{min}^{-1}$ for 5 min) was administered IV in 6 conscious cats (age 1.5 years, mean weight \pm SD 4.2 ± 0.4 kg), or during isoflurane anesthesia (1 MAC), in random order. A jugular catheter was placed under isoflurane anesthesia (the day before the experiment for studies in conscious cats) for blood sampling. A catheter was placed in a medial saphenous vein for drug administration. Blood samples were obtained prior to remifentanil administration, and after the infusion was started, every minute for 10 minutes, every 2 minutes for another 10 minutes, and at 25 and 30 minutes. Blood remifentanil concentration was determined using liquid chromatography/mass spectrometry. Concentration-time data were examined using non-compartmental analysis. The area under the curve was calculated using the linear trapezoidal method. Data are presented as mean \pm SEM.

The maximum concentration, time at which that concentration was reached, area under the curve, mean residence time, clearance, terminal half-life, and volume of distribution at steady state were 1.3 ± 0.2 and 3.9 ± 0.4 ng mL⁻¹, 4.7 ± 0.3 and 4.5 ± 0.3 min, 7.2 ± 1.2 and 16.0 ± 2.3 ng.min mL⁻¹, 7.1 ± 5.4 and 4.9 ± 3.7 min, 807 ± 148 and 342 ± 41 mL min⁻¹ kg⁻¹, 9.2 ± 2.4 and 8.2 ± 7.8 min, and 5.03 ± 1.24 and 1.71 ± 0.6 L kg⁻¹ respectively, in conscious and anesthetized cats.

In cats, remifentanil appears to have a large volume of distribution and a rapid clearance. Overall, this results in rapid elimination. Isoflurane anesthesia altered the disposition of remifentanil, most likely as a result of altered blood flow.

EFFECT OF ANESTHESIA ON CARDIAC TROPONIN I AND C-REACTIVE PROTEIN CONCENTRATIONS IN HEALTHY DOGS. AS

Hanzlicek, AB Saunders, EA Martinez,* MJ Stickney, JM Steiner, G Fosgate. Texas A&M University, College Station, TX.

Cardiac troponin I (cTnI) is a myocardial specific protein released in association with myocardial damage and C-reactive protein (CRP) is an inflammatory biomarker. Elevations in both proteins are associated with prognosis and outcome in human patients following cardiovascular surgery. The use of volatile anesthetics has been shown to have a protective effect on the myocardium during an ischemic insult. The purpose of the study was to evaluate the effect of two anesthetic regimens on cTnI and CRP concentrations in healthy dogs undergoing general anesthesia for elective surgery. Twenty dogs (age: 9.5 ± 6.6 months; weight: 16.3 ± 10.8 kg) undergoing ovariohysterectomy or castration were randomly allocated to 2 groups. Group 1 was premedicated with glycopyrrolate, 0.011 mg kg^{-1} IM and hydromorphone, 0.1 mg kg^{-1} IM, induced with diazepam, 0.2 mg kg^{-1} IV, and etomidate, 2 mg kg^{-1} IV to effect, and maintained on a constant rate infusion of fentanyl, $0.8 \mu\text{g kg}^{-1} \text{ min}^{-1}$ and midazolam, $8 \mu\text{g kg}^{-1} \text{ min}^{-1}$ with a low level of sevoflurane ($1.28 \pm 1\%$; range: 0.5-4%) delivered to maintain an appropriate plane of anesthesia. Group 2 was premedicated with glycopyrrolate, 0.011 mg kg^{-1} IM and hydromorphone, 0.1 mg kg^{-1} IM, induced with propofol, 6 mg kg^{-1} IV to effect, and maintained on sevoflurane ($2.95 \pm 0.85\%$; range: 1.5-5%). Blood was collected to determine cTnI and CRP concentrations immediately prior to induction and at 6, 18, and 24 hours post induction. Data was analyzed using a student's *t*-test with statistical significance set at $P < 0.05$. There was no significant difference in cTnI and CRP between groups at any time. Two dogs in Group 1 with evidence of mild hypotension and bradycardia had increased, but not statistically significant, cTnI levels postoperatively. cTnI levels were not significantly increased in Group 2. In both groups, CRP was significantly increased, compared to baseline, at each time.

In conclusion, neither anesthetic regimen resulted in a significant increase in cTnI, indicating that myocardial damage did not occur. The increase in CRP was attributed to surgically induced inflammation.

EFFECTS OF REMIFENTANIL ON MEASUREMENTS OF ANALGESIA AND ANESTHETIC IMMOBILITY IN CATS. RJ Brosnan,* BH Pypendop,* KT Siao, SD Stanley. University of California-Davis, Davis, CA.

A drug's ability to decrease anesthetic minimum alveolar concentration (MAC) has been used as a surrogate estimate of its analgesic potency. However, we hypothesized that analgesia effects may be unrelated to MAC effects.

For 6 healthy 18 month-old cats weighing 4.2 ± 0.2 kg (mean \pm SEM), we measured isoflurane MAC and thermal threshold responses 45 min after starting each of the remifentanil infusions: 0, 0.0625, 0.125, 0.25, 0.5, 1, 2, 4, 8, and 16 $\mu\text{g kg}^{-1} \text{min}^{-1}$. In isoflurane-anesthetized cats, MAC was determined once for each remifentanil infusion rate, administered in either ascending or descending order, using a standard tail clamp technique. Thermal threshold was measured in awake cats using an analgesiometric probe on the lateral thorax; remifentanil infusions were administered in randomized order, and thermal threshold determinations were made by a single individual who was blinded to the infusion rate. A maximum thermal test of 55°C was used as a cut-off temperature to avoid skin burns. Data were fit to the Hill equation for analysis. $P < 0.05$ was considered significant.

Dysphoria was observed in all awake cats at the two highest rates. Isoflurane MAC was $1.97 \pm 0.09\%$ and did not change during any remifentanil infusion. Therefore, excitement from high-dose opioids appears unrelated to inhaled anesthetic requirement. However, remifentanil did increase thermal threshold responses; cut-off temperatures were reached for remifentanil infusions of $1.6 \pm 0.5 \mu\text{g kg}^{-1} \text{min}^{-1}$.

We conclude that anesthetic endpoints of immobility and analgesia, insofar as reflected by thermal threshold testing, are independent effects. Based on these findings, MAC-sparing studies should not be used to infer analgesic potency.

EFFICACY OF PRE-ANESTHETIC INTRA-MUSCULAR (IM) ADMINISTRATION OF EPHEDRINE FOR PREVENTION OF ANESTHESIA-INDUCED HYPOTENSION IN CATS AND DOGS. CM Egger,* MA Stevenson, EH Hofmeister,* G Touzot-Jourde,* B Rohrbach. University of Tennessee, Knoxville, TN.

Because monitoring of arterial blood pressure, and the use of continuous rate infusions of sympathomimetic drugs to support blood pressure, are not always used in anesthetized patients in private veterinary practices, the objective of this study was to determine if pre-anesthetic administration of ephedrine (0.1 mg kg^{-1} IM) is a safe and effective method of preventing anesthesia induced hypotension. It was hypothesized that IM ephedrine would prevent anesthesia-induced hypotension.

Ten purpose-bred, healthy, adult cats (3.2-4.3 kg; 1-2 years of age) and 8 healthy, adult, mongrel dogs (9-27 kg; unspecified ages) were studied. All dogs underwent general anesthesia on two occasions, receiving IM saline (S) or ephedrine (E) 30 min prior to anesthetic induction, in a random fashion, with a two week washout. Cats undergoing general anesthesia for castration or ovariohysterectomy were randomly assigned to receive either E or S 20 min prior to anesthetic induction and were only studied once. The animals were anesthetized and respiratory rate (RR), heart rate (HR), end-tidal CO_2 (ETCO_2) and isoflurane (ETIso; cats) or halothane concentrations (ETHalo; dogs), O_2 saturation (SpO_2), cardiac rhythm, Doppler systolic blood pressure (SAP), and rectal temperature (RT) were monitored every 5 minutes. The effects of treatment, time, week, and treatment by time interaction on HR, RR, SAP, RT, ETCO_2 , and SpO_2 were evaluated using a mixed model analysis of variance procedure. Dog and cat were included in the models as random factors. Significant differences in least squares means among the various levels of treatment, time, and treatment by time interaction were adjusted using the method of Bonferroni. A P value < 0.05 was considered significant.

For cats, there was no significant overall effect of treatment on SAP, although clinically significant hypotension ($\text{SAP} < 80 \text{ mmHg}$) developed earlier after anesthetic induction in Group S (10 min) than in Group E (25 min). For dogs, there was no significant difference in the SAP between groups overall, although the SAP in Group S was significantly lower than baseline by 5 min after pre-medication and in Group E was not significantly lower than baseline until 10 min after induction. No dysrhythmias were noted. There was no significant effect of treatment on HR, RR, ETCO_2 , ETIso, ETHalo, RT, SpO_2 , or cardiac rhythm.

Although prophylactic IM ephedrine did not result in sustained increases in blood pressure when compared to saline treatment, it delayed the onset of clinically significant hypotension, and did not have any obvious adverse effects.

