The following studies received ethical approval by institutional and/or national review committees if appropriate.

Manchester AVA Spring Meeting April 2017
Cardiovascular findings during pre-anesthetic assessment in dogs undergoing two different pre-anesthetic assessment protocols and usefulness of the diagnostic tests performed

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The objectives of this study were to describe cardiovascular abnormalities (CVA) found during pre-anesthetic assessment in dogs in a veterinary teaching hospital and to evaluate the usefulness of the different diagnostic tests performed. One hundred and eight client-owned dogs underwent a basic pre-anesthetic assessment protocol including history, physical examination, hematology and biochemistry performed and evaluated by an anesthesia specialist; and a comprehensive pre-anesthetic assessment protocol that included, in addition to the tests performed in the basic assessment protocol, thoracic radiographs, ECG, and echocardiography evaluated by a licensed veterinarian.

CVA were identified in twenty-five of ninety-seven dogs (25.8%) by cardiac auscultation; in 15 dogs (13.9%) by ECG; in 6 dogs (5.6%) by thoracic radiographs; and in 39 dogs (36.1%) by echocardiography (95% of which were diagnosed of chronic valvular heart disease, CVHD). Since CVHD was the cardiovascular condition that showed the highest prevalence, sensitivity, specificity and likelihood ratios of the other performed clinical tests were calculated for the diagnosis of this condition (taking echocardiography as gold standard). Cardiac auscultation showed the best sensitivity, specificity (64.5%, 93.8% respectively) and likelihood ratios (LR+ 10.48, LR- 0.38); outcome parameters improved when considering auscultation of the two evaluating clinicians together (71.0%, 93.8%, LR+ 11.35, LR- 0.31). This study indicates that cardiac auscultation can detect CVA during pre-anesthetic assessment in 61.76% of affected dogs. Accuracy is improved when performed by two clinicians. Electrocardiography and thoracic radiographs are questionable diagnostic tools for the pre-anesthetic diagnosis of CVHD.
Sonographic evaluation of diaphragm function during a subscalenic brachial plexus block in dogs: technique and clinical applications.

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The phrenic nerve (PN) shares its origin and pathway along the interfascial space with the brachial plexus. With the hypothesis that a brachial plexus block would also affect the PN, this study aimed to evaluate diaphragmatic function using M-mode ultrasonography after a brachial plexus block through a subscalenic approach (SBPB) in dogs undergoing forelimb surgery.

In eight dogs under general anaesthesia and spontaneous breathing, hemidiaphragmatic sonography was performed bilaterally before and twenty minutes after a unilateral SBBP with 0.3 mL kg⁻¹ of bupivacaine 0.5%. A microconvex probe was placed below the right and left costal margin, between the sternum and the costocondral joint, and directed craniodorsolaterally. Initially, the two-dimensional mode was used to select the exploration line; the M-mode was then used to measure the diaphragm displacement, as the altitude of the ascending limb of the curve (cm). Data were analyzed using T-test and expressed as mean ± SD (p < 0.05).

Before the SBBP, both hemidiaphragms’ displacement measured 1.1 ± 0.3 cm, in all the animals. No significant differences were registered after the SBBP on the non-blocked side. However, in all the animals there was a significant reduction in the measured displacement on the blocked side (0.3 ± 0.2 cm). In all the animals, the lack of cardiovascular response to surgery deemed the block successful. In the studied dogs, there was a constant presence of hemidiaphragmatic paralysis after the SBBP. This shows that it could be used to early confirm a successful injection.
Alfaxalone and midazolam co-induction: a prospective randomised blinded clinical trial

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Propofol midazolam co-induction has been investigated in the dog (Robertson and Borer-Weir 2013, Sanchez et al 2013). This study investigates co-induction of anaesthesia with alfaxalone and midazolam.

All dogs received 0.02 mg kg⁻¹ acepromazine and 0.3 mg kg⁻¹ methadone IM as premedication. Baseline measurements of HR, fR, SAP, MAP and DAP were assessed pre-induction and at 0, 2 and 5 minutes post-induction. Induction was initiated with 0.5 mg kg⁻¹ alfaxalone given over 30 seconds which was followed immediately by either 0.4 mg kg⁻¹ midazolam IV (GM) or an equal volume of saline (GS). Conditions were assessed for intubation and further boluses of 0.25 mg kg⁻¹ alfaxalone were given as required. Effect of co-induction, intubation and quality of induction were assessed and total volume of alfaxalone required for intubation recorded. Parametric data was assessed using t-tests and nonparametric data using Mann-Whitney U tests.

Twenty nine dogs were included (14 GM, 15 GS) and there was a significant difference in the total volume of alfaxalone required for intubation (p = 0.02, 0.65 mg kg⁻¹ ± 0.20 GM and 0.94 mg kg⁻¹ ± 0.26 GS). Apnoea occurred significantly more frequently in GM (p = 0.0007). There were no significant differences in HR or BP at the measured time points between groups.

Co-induction with midazolam had significant alfaxalone sparing effects with no clinically detectable cardiovascular changes. Apnoea is common after co-induction using drugs and doses studied and clinicians should be prepared to provide ventilatory support.

References

Robertson R and Borer-Weir K (2013) A dose titration study into the effects of diazepam or midazolam on the propofol dose requirements for induction of general anaesthesia in client owned dogs, premedicated with methadone and acepromazine. Vet Anaesth Analg, 40, 455-463

Respiratory system compliance determination in anaesthetized, mechanically ventilated, healthy dogs

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Respiratory system compliance (Crs) is the sum of the compliance of the lungs and chest wall. This study aimed to determine factors affecting Crs, and Crs variation during one hour in anaesthetized, mechanically ventilated, healthy dogs. This retrospective clinical study included 121 dogs undergoing elective surgeries, between January 2015 and July 2016 at a Veterinary Teaching Hospital. Anaesthetic protocols were chosen by the anaesthetist in charge. Volume controlled ventilation settings were: $V_T = 8 - 12 \text{ mL kg}^{-1}$, positive end expiratory pressure (PEEP) = 2 - 6 cmH$_2$O, fR adjusted to maintain FE'CO$_2$ within 35-45 mmHg and FiO$_2$ = 0.5. Compliance values were collected when mechanical ventilation (MV) started and every 15 minutes. Pearson’s correlation and ANOVA with Bonferroni’s correction were performed (p < 0.05).

Compliance and body weight (BW) followed a linear correlation [Crs = (1.1 × weight (kg)) + 2.3]. Compliance per kg was $1.2 \pm 0.3 \text{ mL cmH}_2\text{O}^{-1} \text{ kg}^{-1}$ at the beginning of MV. Compliance was affected by body condition (1.1 ± 0.3 and 1.7 ± 0.3 mL cmH$_2$O$^{-1}$ kg$^{-1}$ in high and low corporal condition, respectively), age (1.2 ± 0.3 and 1.5 ± 0.3 mL cmH$_2$O$^{-1}$ kg$^{-1}$ in geriatric and young dogs, respectively) and thorax shape (1.0 ± 0.2 and 1.3 ± 0.3 mL cmH$_2$O$^{-1}$ kg$^{-1}$ in barrel-chested and normal dogs, respectively). Compliance did not change during one hour of MV (2 ± 17%).

Compliance in healthy anaesthetized dogs under MV is linearly correlated with BW, and is influenced by body condition, age and thorax shape.
Comparison of methadone and buprenorphine for peri-operative analgesia in female cats undergoing anaesthesia for neutering

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The study aim was to compare anaesthetic quality between methadone and buprenorphine in combination with medetomidine in feline ovariohysterectomy after induction with IM alfaxalone. Fifty-one female cats (ASA I - II), median age 12 months (range 2 – 60), weighing 2.5 ± 0.5 kg were recruited and randomly allocated to receive medetomidine (600 µg m²) and buprenorphine (180 µg m²) (MB) or medetomidine (500 µg m²) and methadone (5 mg m²) (MM) IM. Induction was 15 minutes later using alfaxalone (3 mg kg⁻¹) IM. Anaesthesia was maintained with isoflurane in oxygen. All cats received meloxicam prior to induction. Quality of premedication and induction were recorded. Cats were continuously monitored and HR, fr, SPO2, SBP, indirect MAP and DAP, aural temperature, mucous membrane colour, quality of surgical conditions and vaporizer setting were recorded. Atipamazole was administered at the end of surgery. Cats were assessed postoperatively by the same blinded observer using SDS, NRS, DIVAS and UNESP Botucatu multidimensional composite pain scales, at 15, 30 and 60 minutes. Parametric and nonparametric data were compared using Student’s t-test or Mann-Whitney U tests, respectively.

There were no significant differences (p > 0.05) between groups before or during anaesthesia. No cats required rescue analgesia. DIVAS scores at 10 minutes were significantly less in MM (2.76 ± 4.70) group than MB (6.95 ± 11.86). No differences were detected at any other time points using the four metrology instruments. Both protocols provided good anaesthesia for feline ovariohysterectomy.
Pharmacokinetics and pharmacodynamics after a single intravenous injection of different doses of alfaxalone (Alfaxan®) in pigs

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Alfaxalone is a neuroactive steroid used in various species as induction and maintenance agent. It has been associated with a wide safety margin and minimal cardiovascular and respiratory depression. No pharmacokinetic (PK) nor pharmacodynamic (PD) data are present in pigs.

To investigate the suitability of alfaxalone as an induction agent in pigs, twelve male Seghers hybrids weighing 55.7 ± 5.6 kg and aged 17 ± 2 weeks were used in this crossover randomized study. Pigs were randomly allocated in two groups receiving a constant rate infusion (CRI) of alfaxalone at 3.5 mg kg⁻¹ delivered with an syringe driver at a rate of 1 mg kg⁻¹ minutes⁻¹ (group low dose (LD)) or 10.7 mg kg⁻¹ at a rate of 2 mg kg⁻¹ minutes⁻¹ (group high dose (HD)) intravenously. Induction and recovery quality were scored and recorded. Blood was collected at the time of intubation and at 2, 5, 10, 15, 30, 45, 60, 90, 120, 240, 360 and 480 min afterwards. Alfaxalone was quantified in the plasma samples by LC-MS/MS. A two-compartmental model fitted the plasma alfaxalone data.

Induction was scored as smooth in 3/5 and 4/6 and recovery 4/5 and 4/6 in group LD and HD respectively. The volumes of distribution (Vd) were 668,88 ± 309,74 and 436,69 ± 150,46 mL kg⁻¹ and plasma clearances (Cl) were 718,34 ± 627,34 and 1466,11 ± 571,62 mL/(kg*hr) for LD and HD respectively.

Alfaxalone produce a rapid and smooth induction and a dose dependent duration of anaesthesia.
Abstract session 2
The development of an anaesthesia machine to deliver xenon and its use as part of an anaesthetic technique in a horse

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Xenon, due to its interesting anesthetic properties, could improve the quality of anesthesia protocols in horses despite its high price (Derwall et al. 2009). This study aimed to develop and test an anesthesia machine capable of delivering xenon at a lower cost.

An equine anesthesia machine (Tafonius) was modified by including a T-connector in the valve block to introduce xenon, so that the xenon was pushed into the cylinder by expired gases. A xenon analyzer was connected to the expired limb. The operation of the machine was modeled and experimentally tested for denitrogenation, wash-in and maintenance phases. The system was considered made of two compartments, one being the horse's functional residual capacity, the other one being the cylinder and circuit.

A 15 year-old, 514 kg, healthy gelding horse was anesthetized using acepromazine, romifidine, morphine, diazepam and ketamine. Anesthesia was maintained for 70 minutes with xenon and oxygen, co-administered with lidocaine constant rate infusion. Ventilation was controlled. Cardiorespiratory variables, expired fraction of xenon (FeXe), blood gases were analyzed at 10, 30 and 60 minutes after induction and xenon plasma concentrations were measured.

FeXe remained around 65%, using a xenon total volume of 250L. Five additional bolus of ketamine (0.6 mg kg\(^{-1}\)) were required to maintain anesthesia. Mean PaO\(_2\) was 45 ± 1 mmHg. Xenon was detected in blood during all the administration time.

This pilot study shows that some refinement is necessary to achieve a good level of anesthesia with xenon at a reasonable price.

References


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Ocular damage and microbial contamination in horses following general anaesthesia for non-ocular surgery.

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Corneal abrasions/ulceration are perioperative complications reported in humans (Segal et al. 2014) and dogs (Dawson and Sanchez 2016). This study aimed to evaluate the incidence of corneal abrasions/ulceration and microbial contamination in horses undergoing general anaesthesia.

Forty healthy horses, older than one year, undergoing elective non-ocular procedures, without history of ocular disease were included in the study. Following administration of pre-anaesthetic medication, conjunctival sac swabs were taken, fluorescein dye applied and digital images recorded from both eyes. These procedures were repeated 24 hours after recovery from general anaesthesia. A paraffin-based bland ophthalmic ointment was applied on the ocular surface intra-operatively following collection of a sample into a sterile container. All samples underwent aerobic, anaerobic and fungal culture. Subject demographics, chronology of ophthalmic ointment use, anaesthesia duration, recumbency after induction, during surgery and recovery, fluorescein uptake and culture results were recorded. Descriptive statistics were performed.

Complete data were collected from thirty-four horses; six (17.6 %) developed mild unilateral generalized fluorescein uptake consistent with corneal abrasions. Anaesthesia time and recumbency did not appear to influence the incidence of abrasions. A total of 11 bacterial species were identified; Staphylococcus spp. (15 eyes) and Micrococcus spp. (8 eyes) were the most frequently isolated bacteria. Two fungal species were isolated post-operatively (Aspergillus spp., Saccharomyces spp.) in 2 eyes. Ointment contamination was recorded in two cases (5%) but cross-contamination was not recognized.

Incidence of corneal abrasion/ulceration in horses undergoing general anaesthesia and contamination rate of ophthalmic solutions is similar to that previously reported in dogs.

References
Evaluation of non invasive and continuous monitoring of hemoglobin in anesthetized horses

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Pulse co-oximetry is indicated for non-invasive and continuous monitoring of total hemoglobin concentration (SpHb), along with SpO2 and pulse rate, and used in human patients with good accuracy. As pulse oximetry is routinely used in equine anesthesia monitoring, a clinical study was performed to assess SpHb accuracy and measure hemoglobin (Hb) continuously in anesthetized horses.

19 healthy adult horses were anesthetized for routine surgeries and monitored for continuous SpHb with a Masimo Radical 7 rainbow co-oximeter. During the procedures, a total of 53 arterial blood samples were analyzed with a Vet ABC Scil machine and results compared by time to the non-invasive values from the oximeter. Data were analysed with student t-test (p < 0.05).

Mean (SD; median) SpHb and Hb were 10.12 g dl$^{-1}$ (2.19; 9.95) and 12.11 g dl$^{-1}$ (1.51; 11.95) respectively and not significantly different. Mean difference [Hb-SpHb] = 1.99 (1.64; 2.00) and calculated linear regression coefficient was $r^2=0.445$.

Applying correction factors to SpHb (SpHbc = SpHb + C) by category (SpHb>14, C=-1; SpHb 12 to 14, C= 0; SpHb 8 to 12, C= +2; SpHb<8, C= +3), mean SpHb reached 11.84 (1.24; 11.95), [Hb-SpHbc] = 0.27 (1.18; 0.30) and $r^2=0.421$. 60% of obtained SpHbc results correlated within ± 0.5 g dl$^{-1}$ to blood Hb values, and 80% in a ± 1.5 g dl$^{-1}$ range.

As in humans, SpHb measured by co-oximetry seems to be an accurate measure of Hb concentration in healthy anesthetized horses.
A randomized clinical study of the effects of low (20 μg kg$^{-1}$) or high (50 μg kg$^{-1}$) dose butorphanol with detomidine as IV premedication in healthy warmblood horses

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Opioid agents are commonly given with alpha-2 agonists to improve sedation before induction of general anaesthesia in horses, but the combination may also produce more pronounced ataxia. This study investigated the effects of two doses of butorphanol with detomidine IV on the quality of sedation, degree of ataxia and quality of induction in ASA-1 and -2 mature warmblood horses undergoing general anaesthesia.

Horses were randomized to receive 8 μg kg$^{-1}$ detomidine IV plus 20 or 50 μg kg$^{-1}$ butorphanol IV, with the principal investigator unaware of treatment allocation. Head height (chin – floor) was measured prior to IV injection in the stall and 2 minutes thereafter, with groups compared by t-test. Scores were assigned for sedation, ataxia and quality of induction, and compared using Chi-squared tests. Significance was set at $p < 0.05$.

In total, 31 horses were included, n = 14 receiving high dose (HD) and n = 17 low-dose (LD) butorphanol. Sedation did not differ between groups (median score 3, range: 1(HD), 2 (LD); $p = 0.09$; mean head height reduction 59 ± 25 cm (LD) vs. 54 ± 21 cm (HD); $p = 0.39$), nor did quality of induction ($p = 0.99$). However, ataxia was significantly worse in the HD (median 2.5, range 2) compared to the LD group (2, range 2; $p = 0.017$).

In conclusion, addition of 50 rather than 20 μgkg$^{-1}$ butorphanol did not provide superior potentiation of detomidine-induced sedation, but did cause more pronounced ataxia.
A mortality audit of a propofol based injectable anaesthetic technique in dogs.

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In India, multiple total intravenous anaesthesia techniques (FiO² 0.21) are employed for canine neutering procedures “in-field” with no objective assessment of mortality. The first audit of a propofol (P) based anaesthetic technique was undertaken. Technique was consistent; free-ranging dogs were captured and obviously “sick” dogs excluded. Pre-anaesthetic medication was IM xylazine (2 mg kg⁻¹) and butorphanol (0.2 mg kg⁻¹) (when available). Age, sex, and body mass were recorded. Following diazepam (0.25 mg kg⁻¹) IV; P (1 mg kg⁻¹) was administered (induction) and then IV to effect (maintenance). Dogs breathed room air and tracheae were not intubated. Dogs received meloxicam, tramadol and lidocaine IV before surgery. HR, RR, SpO₂ were recorded every five minutes and dogs constantly observed until head-lifting (Yadev et al, 2016). Manual logs and records from Worldwide Veterinary Services International Training Centre (ITC) were manually searched for mortality data from technique commencement (2014) until November 2016. Peri-operative mortality was defined as “dog did not recover from anaesthesia”, with no further assessment. In records from 10,000 dogs undergoing surgery at ITC, 20 deaths were recorded (0.2 %), no cause of death was recorded; ~30,500 cases were recorded for “in-field” programmes but records were incomplete and mortality data lacking. The ITC mortality rate compares favourably with Brodbelt et al. (2008) and Bille et al. (2012) but inclusion criteria differ. Mortality was acceptable given the resource limitations. Data relating to “in-field” mortality and to cause of death would enhance audit utility. A digital “app” to enhance contemporary recording is being trialled.

References

Yadav, KK et al. (2016) Comparison between two different injectable anaesthetic techniques in dogs: effects on physiologic variables, including SpO₂. AVA Lyon abstract.
Pharmacokinetics and antinociceptive effects of a methadone constant rate infusion (CRI) in healthy beagle dogs

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The study aimed to investigate methadone via CRI in dogs. In a randomized, blinded crossover design seven beagles received either a bolus of methadone (0.2 mg kg\(^{-1}\)) followed by CRI (0.1 mg kg\(^{-1}\) h\(^{-1}\)) (M) or saline (P) IV for three days. During CRI administration and 24 hours after discontinuation mechanical (MT) and thermal (TT) threshold testing and blood sampling for pharmacokinetic analysis were performed. Data was analyzed by 2-way repeated ANOVA with alpha = 5%.

In M MT was significantly higher than baseline at 0.5; 1; 1.5; 2; 3; 4; 6; 8; 12; 24; 28; 32; 36; 52; 60, 72 hours after CRI start and 0.5; 2; 4; 7; 9 hours after discontinuation. Comparing treatments MT was higher in M than P at 0.5; 1; 2; 3; 4; 6; 8; 12; 32 and 60 hours. Methadone increased TT significantly at 0.5; 1; 2; 3; 4; 6; 8; 24; 28; 32; 36; 48; 56; 60 and 72 after CRI start and 0.5; 2; 3; 7; 11 and 24 hours after discontinuation, placebo only 2 hours after CRI start. However TT did not differ between treatments.

Table 1: Pharmacokinetic data

<table>
<thead>
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<th>Parameter</th>
<th>mean</th>
<th>SD</th>
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<td>Area under the curve (ng h(^{-1})mL(^{-1}))</td>
<td>2400.76</td>
<td>435.96</td>
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<tr>
<td>Clearance (mL kg(^{-1}) min(^{-1}))</td>
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<td>9.47</td>
</tr>
<tr>
<td>Mean residence time (h)</td>
<td>3.40</td>
<td>1.74</td>
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<td>Volume of distribution (L kg(^{-1}))</td>
<td>10.26</td>
<td>5.53</td>
</tr>
<tr>
<td>Terminal half-life (h)</td>
<td>2.36</td>
<td>1.20</td>
</tr>
</tbody>
</table>

After bolus administration methadone CRI at the investigated dose is antinociceptive in an acute pain model. Further studies are needed about its effects in clinical patients.
Comparison of cardiovascular effects of methadone and levomethadone determined by pulmonary artery thermodilution cardiac output measurement in healthy beagle dogs

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Aim of this study was to compare the cardiovascular effects of methadone and levomethadone in dogs. Seven beagles received intravenously methadone (M) (1.0 mg kg\(^{-1}\)) and levomethadone (L) (0.5 mg kg\(^{-1}\)) in a blinded, randomized crossover design. Cardiac output (CO), HR, MAP, CVP, pulmonary arterial pressure (PAP) and pulmonary arterial occlusion pressure (PAOP) were recorded before (baseline), and 5, 15, 30, 45, 60, 90 and then every 30 minutes after opioid treatment until reaching baseline CO. Standard cardiovascular parameters were calculated (Shoemaker and Parsa (2000)) and indexed to body surface area. Data was analyzed by 2-way repeated ANOVA with alpha = 5 %.

Both treatments decreased cardiac index from 5 until 60 minutes (BL M 3,9 ± 0,7; L 4,3 ± 0,7 l min\(^{-1}\) m\(^{-2}\); minimum 2,5 ± 0,8 and 2,4 ± 0,7 l min\(^{-1}\) m\(^{-2}\)). Heart rate (BL M: 93 ± 16; L: 91 ± 20 beats min\(^{-1}\)) decreased in L for 120 minutes (minimum 60 ± 19 beats min\(^{-1}\)), in M for 150 minutes (minimum 57 ± 16 beats min\(^{-1}\)), whereas stroke volume index increased with both treatments. In L MAP (BL 111 ± 14 mmHg) increased at 5 minutes (133 ± 17 mmHg) whereas in M it increased for 90 minutes (BL 105 ± 11 mmHg; maximum 132 ± 14 mmHg). Systemic and pulmonary vascular resistance index, CVP, PAP and PAOP increased with both treatments. None of the cardiovascular parameters differed significantly between treatments. At the investigated doses, cardiovascular effects of levomethadone and methadone did not differ.

References

Variations in respiratory mechanics and expired CO₂ volume per breath after a cyclic or sustained inflation alveolar recruitment maneuver and during decremental PEEP titration in healthy anaesthetized dogs.

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This study evaluated variations in respiratory mechanics and expired CO₂ volume per breath (VTCO₂/breath) after two different alveolar recruitment manoeuvres (ARM) and decremental positive end-expiratory pressure (PEEP) titration. Twice under general anesthesia and with a two-month washout period, six adult healthy beagles were mechanically ventilated and assigned to a cyclic (C) or sustained inflation (SI) ARM, followed by a decremental PEEP titration. The ARM, in pressure control, achieved 30 cmH₂O for 20 seconds in SI and in 60-second incremental steps of 5 cmH₂O in C. Then, PEEP was reduced from 15 to 12 and then in steps of 2 cmH₂O using a driving pressure of 10 cmH₂O. Dynamic compliance (Cdyn), expiratory resistance (Raw) and VTCO₂/breath were measured before ARM (T₁), during PEEP titration and after 10 (T₂), 30 (T₃) and 60 (T₄) minutes. Optimal PEEP was determined as the level of maximal Cdyn plus 2 cmH₂O (Suarez-Sipmann 2007). Data were analyzed using Wilcoxon test and expressed as median [range] (p < 0.05).

Cdyn was significantly higher at T₂ vs. T₁ in C (26.3 vs. 21.5 mL cmH₂O⁻¹) and in SI (25.3 vs. 20.9 mL cmH₂O⁻¹). However, Cdyn decreased significantly in SI at T₄ (22.3 mL cmH₂O⁻¹) vs. T₂. At optimal PEEP, Cdyn was significantly higher in C (32.6 [27.7-36.6]) than in SI (30.1 [24.4-34.8] mL cmH₂O⁻¹). There was no significant difference in Raw or VTCO₂/breath between groups and times.

In this study, both ARM improved Cdyn. However, this improvement was bigger and longer lasting after C than after SI ARM.

Reference

Differences in the score of the equine pain face based on the skill level of the observer – a pilot study

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Ideally pain scores should be easily understood, repeatable and independent of the scorer's previous experience. We assessed the impact of skill level on the scoring using the equine pain face.

Videos of 13-51 seconds duration of 10 horses with different levels of pain (none n=3, moderate n=4, severe n=3) as assessed by two blinded, well-trained individuals were compared to the assessment of three groups of students (each n=12): group A pre-clinical, no equine experience, group B pre-clinical, with equine experience, group C final clinical, with equine experience. The score sheet of the equine pain face was explained to all participants prior to their assessment. Coefficients of variation (COV) were calculated comparing the three groups to the ones of the experts' scoring (ears, eyes, nostril, muzzle, masseter muscle). The pain score was correlated between the groups and the experts.

Parameters ears and eyes had the lowest COV in all groups (65.1%, 57.1%, 54.2%), nostrils intermediate (89.3%, 87.7%, 67.3%), and muzzle and masseter the highest (92.7%, 84.2%, 72.2% and 89%, 86.8%, 82.2%) indicating that the former are easier to assess compared to the latter. The all over pain score correlated best between group C and the experts, then group B and A. Students in groups A/B tended to give higher scores to non-painful horses and lower scores to painful horses, divergence was found in the moderately painful horses.

Individuals with no or limited equine and no clinical experience might not recognize moderate pain, while overestimating low/no pain and underestimating severe pain.
Cardiovascular findings during pre-anesthetic assessment in dogs undergoing two different pre-anesthetic assessment protocols and usefulness of the diagnostic tests performed

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The objectives of this study were to describe cardiovascular abnormalities (CVA) found during pre-anesthetic assessment in dogs in a veterinary teaching hospital and to evaluate the usefulness of the different diagnostic tests performed.

One hundred and eight client-owned dogs underwent a basic pre-anesthetic assessment protocol including history, physical examination, hematology and biochemistry performed and evaluated by an anesthesia specialist; and a comprehensive pre-anesthetic assessment protocol that included, in addition to the tests performed in the basic assessment protocol, thoracic radiographs, ECG, and echocardiography evaluated by a licensed veterinarian.

CVA were identified in twenty-five of ninety-seven dogs (25.8%) by cardiac auscultation; in 15 dogs (13.9%) by ECG; in 6 dogs (5.6%) by thoracic radiographs; and in 39 dogs (36.1%) by echocardiography (95% of which were diagnosed of chronic valvular heart disease, CVHD). Since CVHD was the cardiovascular condition that showed the highest prevalence, sensitivity, specificity and likelihood ratios of the other performed clinical tests were calculated for the diagnosis of this condition (taking echocardiography as gold standard). Cardiac auscultation showed the best sensitivity, specificity (64.5%, 93.8% respectively) and likelihood ratios (LR+ 10.48, LR- 0.38); outcome parameters improved when considering auscultation of the two evaluating clinicians together (71.0%, 93.8%, LR+ 11.35, LR- 0.31). This study indicates that cardiac auscultation can detect CVA during pre-anesthetic assessment in 61.76% of affected dogs. Accuracy is improved when performed by two clinicians. Electrocardiography and thoracic radiographs are questionable diagnostic tools for the pre-anesthetic diagnosis of CVHD.
The analgesic effects of gabapentin and buprenorphine in cats undergoing ovariohysterectomy: a randomized clinical trial

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The aim of this study was to evaluate the analgesic efficacy of gabapentin in combination with buprenorphine in cats. Fifty-two adult healthy cats (3.0 ± 0.7 kg) were included in a randomized, prospective, blinded study. Anesthetic protocol included acepromazine-buprenorphine-propofol-isoflurane. Gabapentin group (GG, n = 19) received gabapentin capsules (50 mg PO) while positive (PG, n = 15) and negative groups (NG, n = 18) received placebo capsules, 12 hours and 1 hour before surgery. Meloxicam (0.2 mg kg\(^{-1}\) SC) was administered in PG before surgery. Ovariohysterectomy was performed and postoperative pain was evaluated up to 8 hours using a multidimensional composite pain scale (MCPS) (Steagall et al. 2017) and the Glasgow pain scale (GPS) (Calvo et al. 2014). A dynamic interactive visual analog scale (DIVAS) was used to evaluate sedation. Rescue analgesia was provided with buprenorphine and/or meloxicam if MCPS ≥ 6. Repeated measures linear model was used for statistical analysis (\(p \leq 0.05\)). Prevalence of rescue analgesia with MCPS was not significantly different (\(p = 0.08\); GG, n = 5, 26%; PG, n = 2, 13%; and NG, n = 9, 50%). Prevalence of rescue analgesia would have been significantly higher in NG (n = 14, 78%) than GG (\(p = 0.003\); n = 5, 26%) and PG (\(p = 0.005\); n = 4, 27%) if intervention was based on GPS. DIVAS sedation and MCPS/GPS pain scores were not significantly different among treatments. Gabapentin-buprenorphine produced similar analgesia to meloxicam-buprenorphine, however these effects were not superior to buprenorphine alone.

References


Dr. Beatriz Monteiro is a recipient of the Vanier Canada Graduate Scholarship.
Anaesthetic complications in 596 dogs undergoing elective gonadectomy as part of a third-year veterinary surgical training program


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The aim of this study was to determine the incidence of anaesthetic complications in dogs undergoing ovariohysterectomy (OVH) or castration (CAS), with 3rd year veterinary students performing anaesthesia and surgery in a laboratory setting. Medical records of 596 dogs were reviewed. The information collected was: breed, age, ASA status, anaesthetic protocol, length of anaesthesia and procedure, and any anaesthetic complications. Descriptive statistics were performed. Ninety-nine % of dogs were mixed breed, with a mean body weight of 11.6 ± 4.6 kg and a mean age of 28 ± 23 months. All animals were assigned ASA I or II. The anaesthetic protocol included acepromazine or dexmedetomidine with morphine, propofol or ketamine-diazepam, lidocaine or bupivacaine, carprofen and isoflurane. Mean duration of surgery and anaesthesia was 141 ± 32 (OVH) and 68 ± 21 minutes (CAS) respectively 196 ± 34 (OVH) and 125 ± 26 minutes (CAS). In 75 % of dogs one or more of the following minor complications was recorded: hypotension (SAP < 90 mmHg; 53 %), tachycardia (HR > 140 beats minute⁻¹; 27 %), hypothermia (T < 36.6 °C; 20.3 %), hypertension (SAP > 140 mmHg; 2.5 %), bradycardia (HR < 60 beats minute⁻¹; 10.4 %), hypoventilation (P_{\text{E}CO_2} > 60 mmHg and/or RR < 5 breaths minute⁻¹; 4.7 %), and hypoxaemia (SpO₂ < 90; 0.8 %). Major complications occurred in 5.2 % including regurgitation (4.2 %) and clinical signs of pulmonary oedema (0.67 %). Complication rates in this study were high; however, complications were mostly minor and no fatalities occurred.
Two intra-articular regimens of administration of tramadol after arthroscopic surgery in the horse: effects on pain control

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The analgesic efficacy of intra-articular 50 mg tramadol is documented in human surgery. We aim to compare the analgesic effect of tramadol administered at two different doses in horses after arthroscopy.

Twenty-two horses (413 ± 70 kg) underwent arthroscopy: after skin closure they received intra-articular tramadol, 1 mg kg\(^{-1}\), diluted in 10 (carpus, fetlock) or 20 (hock, stifle) mL 0.9% NaCl (group T), or 0.4% tramadol in the same final volumes (group TD). Pain was assessed pre-treatment (PRE), 15/30/60/120/360 minutes and 24 hours after standing with a modified Composite Pain Scale (CPS, total score 56; Bussières et al. 2008). Data were analyzed by Linear Mixed model (\(p \leq 0.05\)) and reported as median, Q1-Q3.

Group (\(p < 0.001\)), time (\(p < 0.001\)), their interaction (\(p = 0.05\)), and PRE (\(p < 0.05\)) affected CPS. At T15 (T: 8, 6-9; TD: 14, 11-15; \(p < 0.001\)), T30 (T: 9, 5-9; TD: 11, 11-12; \(p < 0.01\)), T60 (T: 6, 4-8; TD: 9, 8-9; \(p < 0.01\)), and T24 (T: 1, 0-3; TD: 4, 3-5; \(p < 0.01\)) CPS was higher in TD. The orthopaedic component of CPS (maximum score 6) was affected by group (\(p < 0.05\)), lesion’s severity (\(p < 0.001\)), and PRE (\(p < 0.001\)). At T24 (T: 0, 0-0; TD: 1, 1-1; \(p < 0.01\)) it was higher in TD.

Intra-articular 0.4% tramadol was less effective than 1 mg kg\(^{-1}\) in horses after arthroscopy.

References
Serum concentrations and analgesic efficacy of intra-articular tramadol administration in the horse: a preliminary study

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¹University of Perugia, Perugia, Italy; ²University of Pisa, Pisa, Italy.

The purpose of this study was to evaluate the efficacy of the intra-articular (IA) administration of tramadol on postoperative pain after arthroscopy in horses. Twelve horses affected by osteochondrosis were premedicated with phenylbutazone, romifidine and methadone. Anaesthesia was induced with diazepam and ketamine, and maintained with isoflurane in oxygen. Joint distension was obtained with 2% mepivacaine. At the end of surgery, horses were randomly divided in two groups and injected IA with tramadol (4 mg mL⁻¹) or saline, respectively. The concentration of the tramadol solution was chosen after an “in vitro” test, where chondrocytes’ viability resulted lower than 70 ± 7% when cells were exposed for 15 minutes to concentrations > 4 mg mL⁻¹. A visual analogue scale (VAS) and a Composite Pain Score (CPS) modified from Bussières et al. (2008) were applied at predefined time points after standing. Blood samples were withdrawn in order to define the extent of tramadol absorption. The Mann-Whitney test was performed to assess the homogeneity of groups and the differences between treatments (p ≤ 0.05).

Only traces of tramadol (ranging from 11.6 to 19.3 ppb) were found in the serum samples. Groups were homogenous regarding age, sex, weight, lesion’s severity and surgical invasiveness. No horse needed rescue analgesia for the following 24 hours. Differences between treatments with respect to the obtained pain scores were not statistically significant at any experimental point both with the VAS and the CPS, indicating that the concentration of IA tramadol used here could not be distinguished from saline.

References


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Ethical challenges in veterinary anaesthesia; preliminary findings.

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Client requests for futile treatment represents the most stressful ethical challenge facing UK veterinarians (Batchelor & McKeeghan, 2012). Whether these pressures are transferred to veterinary anaesthetists is unknown. To investigate veterinary anaesthetists’ experiences of ethical challenges encountered in clinical practice. A questionnaire requesting: 1) respondents’ training and workplace details; 2) the frequency ethical challenges were encountered; 3) information (via free-text boxes) on: i) the nature of challenges faced; ii) the respondent’s response to challenges; iii) the presence or otherwise of institutional ethical resolution processes, was posted on the Association of Veterinary Anaesthetists (AVA) website with an invitation to membership participation (n= 490) provided by online newsletter. Qualitative data was analysed to identify major themes using Nvivo (QSR international UK limited). Eighty-two AVA members (including 41 ECVAA Diplomates) responded. Median (range) year of undergraduate veterinary degree completion was 2001 (1971 – 2015). Thirty-four percent of respondents experienced ethical challenges monthly, or more frequently; 36% experienced challenges ‘every few months’. Twelve percent of respondents had access to formal clinical ethical review processes. The commonest challenge reported was expected involvement in cases being treated for contestable reasons: i) prioritization of primary clinicians’ interests; ii) erroneous decision making; iii) failure to consider animals’ post procedural welfare or “interests”; v) client consent being “uninformed”. Less common challenges were: i) being unable to treat suitable cases because of financial constraints; and ii) being prevented from giving analgesics.

Ethical challenges perceived by veterinary anaesthetists originate mainly from expected participation in futile treatment which seldom arises from client demand.

Reference

Population pharmacokinetics and clinical evaluation of acetaminophen in dogs at two doses: Beagles vs Galgo Español

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The objective was to assess the pharmacokinetics and clinical evaluation of acetaminophen in Beagle and Galgo Español using a population approach. A prospective, randomized experimental trial was performed. Ten Beagles and ten Galgo Español (six males and four females in both groups) received an intravenous administration of acetaminophen at 10 and 20 mg kg⁻¹ in two different occasions. Population pharmacokinetics analysis was undertaken using a non-linear mixed effects modeling. Haemogram, total proteins, alanine aminotransferase, aspartate aminotransferase, urea and creatinine were measured before and 24 hours post-acetaminophen administration combined with clinical examination to assess side effects. Data were compared between breeds (Mann-Whitney test) and before and after administration for both doses (Wilcoxon rank sum test).

A two-compartment model best described time-concentration profiles. Significant differences were found between breeds for volume of distribution of the central compartment (0.885 ± 0.19 L kg⁻¹ and 0.716 ± 0.15 L kg⁻¹), clearance (1.65 ± 0.45 L kg⁻¹ h⁻¹ and 1.05 ± 0.30 L kg⁻¹ h⁻¹) and distribution clearance (0.172 ± 0.08 L kg⁻¹ h⁻¹ and 0.0976 ± 0.05 L kg⁻¹ h⁻¹). The significant differences found in red blood cells, haematocrit, haemoglobin, white blood cells and serum alanine aminotransferase before drug administration were maintained 24 hours after, independently to the dose used. No side effects were observed neither at 10 or 20 mg kg⁻¹.

Intravenous pharmacokinetics of acetaminophen was different between both breeds. Some clinical values were different due to a breed effect. Side effects were not detected. Further studies are necessary to evaluate the pharmacokinetics in a clinical context.
Ultrasound-guided subscalenic brachial plexus block in dogs: a cadaveric study.

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The study aimed to describe the subscalenic space (SS) sonoanatomy and to compare distribution of two volumes of dye injected on the brachial plexus (BP). Using a wide linear 13 MHz ultrasound probe, the SS was scanned in eight dog cadavers, placed in lateral recumbency, with the limb of interest uppermost. The transducer was placed parallel to the spine, cranial to the first rib, 1-2 cm above the costochondral joint and then displaced caudodorsally until the BP branches (C6, C7, C8 and T1) were identified. The needle was inserted at a 30º angle caudad. The left SS was randomly assigned to a low (0.3 mL kg⁻¹) (LV) or high (0.4 mL kg⁻¹) (HV) volume of dye injection, and the right SS to the alternative volume. Dissections were performed to determine BP branches staining (> 1 cm circumferential coverage), phrenic nerve staining and other locations of dye.

In all cadavers, the SS space appeared between the scalenus medius and longus colli muscles, cranial to the first rib, and containing the BP bounded by the deep fascia of the neck and the prevertebral fascia. C7-8 and T1 were stained in LV and HV, whereas C6 was stained only in HV. The phrenic nerve, located next to the BP, was stained in all LV and HV. No intrapleural, mediastinal or epidural distribution was observed.

Ultrasound-guided subscalenic approach to the BP is a reliable technique in dogs. In this study, 0.4 mL kg⁻¹ of dye appeared mandatory to completely stain all the branches of the BP.
Effects of Lidocaine and Morphine on canine mammary tumor cells proliferation: preliminary results

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Anesthesia for cancer surgery might influence recurrence via multiple mechanisms (Snyder and Greenberg 2010). The effects of analgesics on canine tumor cell proliferation are unknown. Primary (CypP) and metastatic (CypM) canine mammary tumor cells were incubated with cell culture media (control), lidocaine (1, 5 and 10 μg ml⁻¹; Valverde et al. 2004) or morphine (0.005, 0.05 and 0.5 μg ml⁻¹; Kukanich et al. 2005). A 3-(4,5-Dimethylthiazol-2-Yl)-2,5-Diphenyltetrazolium Bromide (MTT) assay was performed after 6 and 12 hours of incubation. Cell concentrations (i.e. absorbance) were obtained with a spectrophotometer. Values were compared using a 3-way ANOVA (n = 6). Significance was set at p < 0.05.

After 6 hours, no statistically significant effects were observed in CypM, while in CypP the middle concentration of lidocaine increased absorbance. At 12 hours both treatments showed a statistically significant decrease in cells number in CypM at all concentrations (table 1). Conversely, all concentrations of lidocaine and the lower concentration of morphine significantly increased cell number in CypP compared to controls. Both treatments influenced cell proliferation with divergent effects depending on exposure time and cellular line. Concentrations seemed to have a minor role. Further studies are warranted to better understand this phenomenon and potential clinical implications.

Table 1: Mean absorbance of cells incubated for 12 hours with lidocaine, morphine or cell media only (control).

<table>
<thead>
<tr>
<th>Canine mammary tumor cells</th>
<th>μg ml⁻¹</th>
<th>Primary</th>
<th>Metastatic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>-</td>
<td>0.239</td>
<td>0.469</td>
</tr>
<tr>
<td>Lidocaine</td>
<td>1</td>
<td>0.561</td>
<td>0.327</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>0.523</td>
<td>0.420</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>0.521</td>
<td>0.275</td>
</tr>
<tr>
<td>Morphine</td>
<td>0.005</td>
<td>0.466</td>
<td>0.401</td>
</tr>
<tr>
<td></td>
<td>0.05</td>
<td>0.305</td>
<td>0.365</td>
</tr>
<tr>
<td></td>
<td>0.5</td>
<td>0.274</td>
<td>0.387</td>
</tr>
</tbody>
</table>

References
Pre-anaesthetic clinical assessment of hydration for prediction of intra-operative hypotension in anaesthetised horses.

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Dehydration may predispose horses to intra-operative hypotension. This prospective clinical study evaluated the ability of pre-operative measurements linked to hydration to predict hypotension or the need for inotropic support. Healthy horses admitted for anaesthesia and surgery were recruited. Pre-operative assessment included physical examination (PE) and measurement of packed cell volume (PCV), total plasma protein (TPP), urea and creatinine from venous blood. Examination included HR, fR, temperature and subjective assessment of hydration. Anaesthesia was induced and maintained according to clinical requirements. Intraoperatively blood pressure was measured via a cannula in the facial artery. Hypotension was defined as MAP < 60 mmHg for ≥ 5 minutes. Dobutamine was infused and dose recorded using a fluid pump. Data was compared between hypotensive and normotensive horses and between dobutamine treated and untreated horses, using T-tests; Mann-Whitney U-test; and Chi-Squared test as appropriate.

Forty nine horses were included. Hypotension occurred in 21 (42.9%) and 28 (57.1%) received dobutamine. No abnormalities were detected on any PE. There was no significant difference (p > 0.05) in any PE parameters, PCV, or TPP between normotensive and hypotensive; or dobutamine treated and untreated horses. Urea and creatinine (6.8 ± 1.50 mmol L\(^{-1}\) and 119.74 ± 21.45 µmol L\(^{-1}\) respectively) were significantly higher in hypotensive horses compared to normotensive horses (5.57 ± 1.66 mmol L\(^{-1}\) and 106.81 ± 17.25 µmol L\(^{-1}\)). Azotaemia was present in 7 (33.3%) hypotensive and 2 (7.1%) normotensive horses. Measurement of urea and/or creatinine may be useful for detecting sub-clinical dehydration and predicting intra-operative hypotension.
Effects of a single bolus of paracetamol on the minimum alveolar concentration of sevoflurane in healthy Beagle dogs

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\textsuperscript{1}Complutense University of Madrid, Madrid, Spain; \textsuperscript{2}Centro Nacional de Investigaciones Cardiovasculares Carlos III Madrid, Spain, Charles River Barcelona, Spain.

Paracetamol analgesic effects have been assessed in the postoperative period but not during the intraoperative period in dogs. This study aimed to determine the effect of paracetamol on the sevoflurane MAC in healthy dogs.

Seven adult healthy Beagle dogs (six males and one female) weighing 14.4 ± 2.1 kg were enrolled in a prospective, randomized, blinded, crossover, experimental study. Anaesthesia was induced with propofol IV and maintained with sevoflurane in oxygen and air. The MAC was determined, using the tail clamp method, before (MAC\textsubscript{1}) and after treatment (MAC\textsubscript{2}) with paracetamol 15 mg kg\textsuperscript{-1} (PRC group) or equivalent volume of saline (CTL group) administered IV. Paracetamol plasma concentrations were assessed just after paracetamol administration and at the end of the procedure. A paired Student's t-test was performed for statistical analysis with an alpha error of 0.05.

Minimum alveolar concentration \textsubscript{1} (MAC\textsubscript{1}) was similar in both groups (1.7 ± 0.4%, pooled data) and there were no significant differences between treatments in MAC\textsubscript{2} (2.0 ± 0.4% and 1.7 ± 0.5%; CTL and PRC groups, respectively). Paracetamol plasma concentrations were initially 34.5 ± 9.9 µg mL\textsuperscript{-1}, decreasing at the end of the procedure to 8.5 ± 4.2 µg mL\textsuperscript{-1} (PRC group).

In conclusion, a single paracetamol intravenous bolus did not produce a sevoflurane sparing effect in dogs.

References


One of the authors (PG) was the recipient of a co-funded contract from the Autonomic Counseling of Education, Youth and Sport (Madrid) and the European Social Fund; one of the authors (AS) was the recipient of a co-funded contract from the Spanish National System of Youth Guarantee and European Social Fund, both of them included in the Youth Employment Initiative (YEI) 2014-2023.
Comparison of the cardiorespiratory effects of isoflurane or propofol anaesthesia in dogs undergoing orthopaedic surgery

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Total intravenous anaesthesia (TIVA) is an alternative to inhalational anaesthetic maintenance in dogs. This study aimed to compare the cardiorespiratory effects of propofol TIVA and isoflurane in healthy dogs undergoing orthopaedic surgery. In a prospective, randomized, non-blinded clinical trial, dogs were premedicated IM with dexmedetomidine (4 µg kg\(^{-1}\)) and methadone (0.3 mg kg\(^{-1}\)). Anaesthesia was induced with propofol IV (dosed to effect). Dogs were randomly assigned to maintenance with either isoflurane (group I) or propofol (group P) (n = 14 in each group). Isoflurane concentration and propofol infusion rate were adjusted to maintain a suitable anaesthetic depth. All dogs received bupivacaine (1 mg kg\(^{-1}\)) and morphine (0.1 mg kg\(^{-1}\)) at the lumbosacral epidural space. Cardiorespiratory data were recorded every 5 minutes during the procedure. Statistical analysis was performed using the Student’s t-test, Mann-Whitney U test or Chi-square test.

Anaesthetic maintenance in groups I and P was accomplished by providing a mean F\(_{E}^{\text{ISO}}\) of 1.12 ± 0.15% and a mean propofol infusion rate of 0.25 ± 0.08 mg kg\(^{-1}\) min\(^{-1}\), respectively. Mean arterial pressure was significantly higher in group P than in group I (92 ± 17 mmHg versus 78 ± 10 mmHg; \(p = 0.021\)). Eleven dogs required mechanical ventilation in group P and two dogs in group I (\(p = 0.001\)). In combination with epidural blockade, propofol TIVA is a suitable alternative to isoflurane in orthopaedic surgery in healthy dogs, allowing improved arterial pressures. Nevertheless, it was associated with increased respiratory depression; therefore, provision of mechanical ventilation is advisable.

One of the authors (RB) was the recipient of a scholarship from the Complutense University of Madrid (PhD program UCM CT45/15 - CT46/15).
Comparison of the postoperative analgesic effects of cimicoxib, buprenorphine and their combination in healthy dogs undergoing ovariohysterectomy

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The most frequently used perioperative analgesics in dogs are opioids and NSAIDs. Cimicoxib is a recently marketed member of the coxib family in Europe approved for use in dogs.

The aim of this study was to compare postoperative analgesia following elective ovariohysterectomy in bitches produced by cimicoxib and/or buprenorphine. Sixty-three dogs were included in a prospective, randomized, blinded, controlled clinical trial. Dogs were premedicated with acepromazine (0.05 mg kg\(^{-1}\)) and either cimicoxib 2 mg kg\(^{-1}\) (CMX), buprenorphine 0.02 mg kg\(^{-1}\) (BUP), or their combination (CMXBUP). Anaesthesia was induced with propofol to effect and maintained with isoflurane in 100% oxygen. Numerical rating scale (NRS), Glasgow composite pain score, and mechanical nociceptive thresholds on surgical wound (MNT, Newtons [N]) were assessed preoperatively and postoperatively over 27 hours after extubation. Parametric (ANOVA) and non-parametric (Kruskal-Wallis) tests were employed as appropriate to compare between-subjects differences (treatment) with an alpha error of 0.05.

The MNT were not different between CMX and BUP (lowest thresholds; 6.2 ± 4.5 N and 6.6 ± 5.3 N, respectively), but significantly higher lowest thresholds were found when both drugs were combined (8.1 ± 4.7 N). The NRS and Glasgow pain scores in CMX, BUP and CMXBUP groups were (peak values): NRS: 3 (1–7), 4 (1–8), and 2.5 (1–6) respectively; Glasgow: 3 (1–5), 5 (1–9), and 4 (0–6) respectively. Need for rescue analgesia was not different between groups.

In conclusion, cimicoxib and buprenorphine provided similar postoperative analgesia in bitches undergoing elective ovariohysterectomy.

This study was founded by the Cimalgex Research Grant Program.
MK-467 accelerates the absorption of sedative agents in dogs – preliminary results

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Department of Equine and Small Animal Medicine, University Of Helsinki, Finland.

We investigated whether a peripheral alpha-2-adrenoceptor antagonist MK-467 would affect the absorption rate of medetomidine, butorphanol and midazolam after IM co-administration.

Five adult, healthy beagle dogs received two IM treatments in a prospective, experimental, blinded, cross-over design:
1) MED: medetomidine (20 µg kg\(^{-1}\)) + butorphanol (100 µg kg\(^{-1}\)) + midazolam (200 µg kg\(^{-1}\)) and 2) MED-MK: MED + MK-467 (500 µg kg\(^{-1}\))

Blood was sampled from the jugular vein at 3, 6, 10, 15, 20, 25, 30, 40, 50, 60 and 90 minutes after drug administration. Sedation was assessed by a visual analog scale (0 – 100). Plasma drug concentrations were analyzed with liquid chromatography tandem mass spectrometry. Times to maximum plasma drug concentrations (T\(_{\text{max}}\)) were detected from the data. The areas under the sedation-time curves (AUCsed) were calculated for the first 15 minutes. Paired Student’s t-test (T\(_{\text{max}}\)) was used for treatment comparisons.

MK-467 approximately halved the T\(_{\text{max}}\) of midazolam and butorphanol. No significant difference was detected in dexmedetomidine (Table 1). The AUCsed (mean ± SD) appeared larger for MED-MK (996 ± 261) than MED (598 ± 256) (p = 0.047).

MK-467 hastened the absorption of the investigated drugs after IM co-administration, which appeared to shorten the onset of sedation.

Table 1. Times (mean ± SD) to maximum plasma drug concentrations (minutes).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>dexmedetomidine</th>
<th>butorphanol</th>
<th>midazolam</th>
<th>MK-467</th>
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<tr>
<td>MED</td>
<td>27 ± 15</td>
<td>27 ± 4.5</td>
<td>22.5 ± 9</td>
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</tr>
<tr>
<td>MED-MK</td>
<td>17 ± 4.5</td>
<td>15 ± 5</td>
<td>11.4 ± 6</td>
<td>23 ± 6</td>
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<tr>
<td>p-value</td>
<td>0.2</td>
<td>0.03</td>
<td>0.06</td>
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Funding provided by Vetcare Ltd, Finland and the Doctoral Programme in Clinical Veterinary Medicine
Cardiorespiratory effects of xylazine and brotizolam sedation in calves

G Touzot-Jourde, O Nikolayenkova-Topie, A Bellanger, R Guatteo.

Oniris, Nantes Atlantic National College of Veterinary Medicine, Food Sciences and Engineering, France.

The cardiorespiratory effects of 3 sedation protocols were assessed in calves. In a crossover design, six healthy male dairy calves (26 to 51 days, 44.5 ± 4.3 kg) were assigned to receive randomly 3 treatments: xylazine 0.05 mg kg⁻¹ IV (XyIV), 0.01 mg kg⁻¹ in the triceps muscle (XyIM) and brotizolam 0.006 mg kg⁻¹ IV (BzIV). Invasive blood pressure, PR, fR were recorded at baseline T₅ (5 minutes before the injection), T₅, T₅, then every 5 minutes until T₃₀. Cardiac output by lithium dilution and arterial blood gases were measured at T₅, T₅ and T₃₀. Statistical mixed effect models were used with p set at 0.05.

No difference was found for all baseline measurements between treatments. With XyIM and XyIV, PR, MAP, PaO₂ decreased and PaCO₂ increased significantly compared to baseline at all times and were different from brotizolam (Table). Other parameters stayed stable (fR = 26 ± 10 movements minute⁻¹) or tended to be lower after treatment (CO with XyIM and XyIV). Both xylazine protocols caused a moderate cardiorespiratory depression but parameters stayed within acceptable limits (Kerr et al. 2007). Brotizolam had lesser effects.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Time</th>
<th>PR beats minute⁻¹</th>
<th>MAP mmHg</th>
<th>CO L min⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>XyIM</td>
<td>T₅</td>
<td>97</td>
<td>18</td>
<td>99</td>
</tr>
<tr>
<td></td>
<td>T₅</td>
<td>70</td>
<td>14</td>
<td>81</td>
</tr>
<tr>
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<td>T₅</td>
<td>92</td>
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<td>96</td>
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<td></td>
<td>T₅</td>
<td>75</td>
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<td>75</td>
</tr>
<tr>
<td>BzIV</td>
<td>T₅</td>
<td>104</td>
<td>11</td>
<td>103</td>
</tr>
<tr>
<td></td>
<td>T₅</td>
<td>94</td>
<td>18</td>
<td>103</td>
</tr>
</tbody>
</table>

Table: Cardiovascular parameters

References

Comparison of xylazine and brotizolam for sedation in young calves

G Touzot-Jourde, O Nikolayenko-Topie, A Bellanger, R Guatteo.

Oniris, Nantes Atlantic National College of Veterinary Medicine, Food Sciences and Engineering, France.

In a crossover design, six healthy male dairy calves (26 to 51 days, 44.5 ± 4.3 kg) were assigned to receive randomly 3 treatments: xylazine 0.05 mg kg⁻¹ IV (XyIV), 0.01 mg kg⁻¹ IM in the triceps muscle (XyIM) and brotizolam 0.006 mg kg⁻¹ IV (BzIV). Drug dosages were selected based on a literature review and a pilot study. Sedation was evaluated with a scoring system (0-3) adapted from Condino et al. (2002) and Doherty et al. (1988) by a single observer unaware of treatments at T₅ (5 minutes before the injection), T₂₋₅, T₅, then every 5 minutes until Tₓ₃₀ and every 10 minutes thereafter until sedation score was 0. Statistical mixed effect models were used with p set at 0.05.

Maximal sedation score was significantly higher for XyIM and XyIV than BzIV (2.3 ± 0.8 versus 1.2 ± 1.2, p = 0.014). Onset of maximal sedation for XyIM and XyIV tended to be faster than for BzIV (3.7 ± 2.3, 3.6 ± 1.9, 6.8 ± 6.3 minutes respectively). Duration of sedation was longer for XyIM than for XyIV and BzIV, 54.7 ± 8.5 (p = 0.0068) versus 27.2 ± 3.5 and 15.5 ± 3.3 minutes respectively. Duration of maximal sedation was longer for XyIM than for BzIV (22.9 ± 16.7 versus 10.8 ± 8.3 minutes, p = 0.04).

Sedation in calves with IM xylazine was longer and more profound than IV brotizolam. At the doses tested, both routes of administration of xylazine provided similar onset and depth of sedation.

References


A comparison of cardiovascular effects of two different anaesthetic protocols in chimpanzees (Pan troglodytes)

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The use of alpha-2 agonists in great apes undergoing anaesthesia for cardiovascular evaluation is controversial. This pilot study aimed to evaluate the effect of medetomidine in healthy chimpanzees.

Six chimpanzees (Pan troglodytes) (4 to 16 years old; 2 males, 4 females) were anaesthetized on two occasions in a cross over design. All animals were offered midazolam (1 mg kg⁻¹) orally prior to anaesthesia. Anaesthesia was induced IM with zolazepam/tiletamine (3-4 mg kg⁻¹) (ZT) or zolazepam/tiletamine (2 mg kg⁻¹) and medetomidine (0.02 mg kg⁻¹) (ZTM), and maintained with intermittent boluses of ketamine (IV) or zolazepam/tiletamine (IM).

Quality of induction, time to recumbency, number of supplemental boluses, anaesthesia quality and recovery characteristics were recorded. Chimpanzees were continuously monitored and HR, PR, fr, SpO₂, rectal temperature, indirect arterial blood pressure and mucous membrane colour recorded. Animals underwent full haematology, biochemistry and detailed echocardiographic examination (carried out by one observer unaware of the treatment). Data were compared using Student’s paired t-test or Wilcoxon rank tests as appropriate.

The ZTM protocol resulted in significantly lower HR (62 ± 6 versus 87 ± 3 beats minute⁻¹) and MAP (85 ± 8 versus 114 ± 6 mmHg). No significant differences in the echocardiographic measurements were evident. Quality of anaesthesia was significantly better with ZTM and no additional boluses were required. The ZT protocol required multiple ‘top ups’.

Both combinations are suitable for immobilization and cardiovascular evaluation of healthy chimpanzees. Further work is required to evaluate the effect of medetomidine in cardiovascular disease.
Evidence for impaired diffuse noxious inhibitory controls in naturally occurring canine hindlimb osteoarthritis

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Diffuse noxious inhibitory controls (DNIC) is a mechanism of descending nociceptive modulation which is compromised in chronic pain conditions, including osteoarthritis (OA), in man (Lewis et al. 2012). It is evaluated by assessing changes in response to a nociceptive test stimulus, in the presence of a second nociceptive (conditioning) stimulus. DNIC has not been investigated in dogs.

During alfaxalone anaesthesia (0.09 mg kg\(^{-1}\) min\(^{-1}\)) DNIC was measured in twelve control and eleven OA dogs. Paired stimulating electrodes were placed subdermally into the plantar aspect of digit 3 of the right hindlimb; recording electrodes were placed into the right cranial tibial muscle. The electromyographic (EMG) response threshold (Thr) was determined to increasing stimulating current. The test stimulus was 100 stimuli at 2xThr current, delivered at 1Hz. After 5 minutes the test stimulus was repeated with a 20N mechanical pinch (conditioning) stimulus applied to the third digit of the left forelimb. A multilevel statistical analysis was used; predictor variables were retained within the model based upon a Wald test at \(\alpha \leq 0.05\) (Rasbash et al. 2009).

Conditioning stimulation decreased the EMG response to 65 ± 28% of pre-conditioning levels in control dogs, but only to 83 ± 25% in OA dogs. Multilevel modelling predicted that the magnitude of response was decreased by the application of the conditioning stimulus \((p = 0.0001)\), and that the effect of conditioning was significantly greater in control, compared to OA dogs \((p = 0.003)\). These data suggest a diminished DNIC efficacy in OA dogs.

References


This work was supported by the BBSRC grant number BB/L00240X/1
Generation of reconstruction models for electrical impedance tomography in large animals

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1Bern University of Applied Sciences, Biel, Switzerland; 2Swisstom AG, Landquart, Switzerland; 3University of Zurich, Zurich, Switzerland; 4Wildlife Services, Kruger National Park, Skukuza, South Africa; 5L’arche de noe, Vicques, Switzerland.

Electrical impedance tomography (EIT) is a non-invasive medical imaging technique to monitor regional lung function. Finite element models (FEM) are used to reconstruct EIT images from surface voltage measurements. Usually these models are created by segmenting computer tomography (CT) scans of individual subjects and by building the respective FEM models from these segments. Due to a lack of CT data for large animals this abstract suggests a new method to create FEMs for large animals.

A live-sized synthetic rhinoceros was scanned using a hand-held 3D scanner (Cubify 3D Sense, Rock Hill, USA) (Figure 1). The optical information was transformed into a stereolithographic (STL) model using Autodesk Meshmixer software. The acquired STL model is processed and improved in regions, where the accuracy of the scanner was not sufficient (comprising only feet and head). The adapted STL model (Figure 2) is then fed into Matlab (Mathworks, USA) to generate a FEM. Netgen (Joachim Schoberl) was used to generate the FE model. Further, the 32 electrodes are placed equidistantly on the FEM along the 6th intercostal space and the mesh was refined around the electrodes.

The result is a FEM that can be applied for EIT image reconstruction achieving better image quality than a circular reconstruction would do.

Figure 1: (A) Live-sized synthetic rhinoceros model with EIT belt on, (B) STL model generated by the 3D scanner, (C) Final FEM

Figure 2: Circular reconstruction (A) compared to the reconstruction based on the FEM reconstruction model (B)
Analysis of the geometrical thorax expansion due to breathing of beagles

GM Grambone\(^1\), WAD Waldmann\(^2\), MC Meira\(^3\), CI Campagna\(^3\), BS Böhm\(^2\), KMV Koch\(^1\), MM Mosing\(^3\).

\(^1\)Bern University of Applied Sciences, Biel, Switzerland; \(^2\)Swisstom AG, Landquart, Switzerland; \(^3\)University of Zurich, Zurich, Switzerland; \(^4\)Murdoch University, Perth, Australia.

Electrical impedance tomography (EIT) is a novel non-invasive imaging modality to monitor regional lung function. Usually finite element models (FEM) are used to reconstruct EIT images from surface voltage measurements. These models are created by segmenting computer tomography (CT) scans of individual subjects and by building the respective FM models from these segments. Since in general the CT scans are taken at the end of inspiration, the accuracy at the end of expiration is questionable. We investigated the extent of the geometrical changes in the thoracic region occurring during respiration.

CT scans of nine beagles were acquired at the end of expiration and at the end of inspiration. Lungs and heart at the CT scans at the 6\(^{th}\) intercostal space were manually segmented using ITK-Snap software. The segmented data was then imported into Matlab and the relative lateral, anterior-to-posterior and cross-sectional area changes for all subjects were analyzed.

The mean cross-sectional area change amounts to 3.8 ± 1.5 % of the cross-sectional area at the end-expiratory phase. The mean lateral change amounts to 2.8 ± 0.7 %.

These are the geometrical changes due to respiration. Changes are shown graphically in Figure 1.

It could not be shown if a reconstruction taking into consideration the geometrical changes, improves the accuracy of the reconstructed images or not. Even if theoretically considering the changes should lead to a better accuracy, to make this statement, requires further investigation.

Figure 1: Transverse slice of a beagle at the end of expiration (magenta) and inspiration (blue)
Evaluation of a supraglottic airway device (SGAD, v-gel) for use in rabbits

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¹Western Veterinary Specialist and Emergency Centre, Calgary, Canada; ²University of Calgary, Calgary, Canada; ³University of Saskatchewan, Saskatoon, Canada; ⁴University of Cincinnati, Cincinnati, USA; ⁵Université de Montréal, Saint-Hyacinthe, Canada.

Achieving a secure airway in rabbits is generally considered more difficult than in cats or dogs. Their relatively large tongue, small oropharynx and glottis limit direct visualisation. A rabbit-specific supraglottic airway device (SGAD) may offer benefits over orotracheal intubation (ETT).

Fifteen adult New Zealand white rabbits were randomised to SGAD or orotracheal intubation. Two investigators placed one device type each. Animals were sedated with dexmedetomidine (0.1 mg kg⁻¹ IM) and midazolam (0.5 mg kg⁻¹ IM), followed by induction with alfaxalone (0.3 mg kg⁻¹ IV). Two CT scans of the head and neck were performed; following sedation and SGAD/ETT. The following were recorded: time to successful device insertion, smallest cross-sectional area, airway sealing pressure and histological score of tracheal tissue (after euthanasia under general anaesthesia). Data were analysed with a Mann-Whitney test. Significance was set as p < 0.05.

Two rabbits were excluded following failed ETT. Body masses were similar (ETT; n = 6, 2.6 [2.3-4.5] kg, SGAD; n = 7, 2.7 (2.4-5.0) kg). SGAD placement was significantly faster (33 [14-38] seconds) than ETT (59 [29-171] seconds). Cross-sectional area was significantly reduced from baseline (12.2 [6.9-13.4] mm²) but similar between groups (SGAD; 2.7 [2.0-12.3] mm², ETT; 3.8 [2.3-6.6] mm²). ETT airway seals were higher (15 [10-20] cmH₂O), but not significantly (SGAD; 5 [5-20] cmH₂O, p = 0.06). ETT resulted in significantly more damage (histological score 3.3 [1.0-5.0]), SGAD; 0.67 [0.33-3.67]). The SGAD studied was faster to place and caused less damage than orotracheal intubation, but resulted in a similar cross-sectional area.
Sedation levels in dogs: a validation study

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1University of Calgary, Calgary, Canada; 2Université de Montréal, Saint-Hyacinthe, Canada.

The aim of this study was to assess validation evidence for a sedation scale for dogs. We hypothesized that the chosen sedation scale would be reliable when used by different raters and show poor discrimination between sedation protocols. A sedation scale (range 0-21) was used to score 62 dogs scheduled to receive sedation at two veterinary clinics in a prospective trial. Drugs, doses and administration routes varied at the discretion of the responsible clinician. Scores recorded by a single observer were used to assess internal consistency (Cronbach’s alpha) and construct validity (Mann-Whitney test) of the scores. To assess inter-rater reliability (intraclass correlation coefficient, ICC), video-recordings of sedation assessment were randomized and blinded for viewing by 5 raters untrained with the scale. Videos were also edited to allow assessment of inter-rater reliability of an abbreviated scale (range 0-12) by 5 different raters.

Both sedation scales exhibited excellent internal consistency and very good inter-rater reliability (full scale; ICC = 0.95, abbreviated scale; ICC = 0.94). The full scale discriminated between the most common sedative combinations: dexmedetomidine-hydromorphone (sedation score, 11 [1-18], n = 20) and acepromazine-hydromorphone (5 [0-15], n = 36, p = 0.02). Five dogs given dexmedetomidine (4-10 µg kg⁻¹)-hydromorphone (0.05-0.1 mg kg⁻¹) had scores of 17-18 and did not have a swallow reflex.

Both full and abbreviated scales were reliable in use and able to differentiate different levels of sedation. Using these scales to assess sedation facilitates comparison of results between studies.

This project was funded by a Zoetis summer student scholarship (MCW)
Cardiopulmonary effects of the peripheral α2-adrenoseptor antagonist MK-467 in medetomidine sedated sheep receiving atipamezole

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1Department of Equine and Small Animal Medicine, Faculty of Veterinary Medicine, University of Helsinki, Helsinki, Finland.

MK-467 alleviates the cardiopulmonary effects of α2-adrenoseptor agonists. We examined the impact of MK-467 in sheep receiving atipamezole after medetomidine. Eight sheep with previously elevated carotid artery were treated twice in a blinded, randomized, cross-over design: medetomidine 30 µg kg⁻¹ (MED) or MED + MK-467 300 µg kg⁻¹ (MMK) and 30 minutes later atipamezole (150 µg kg⁻¹) IM. HR, invasive blood pressures, blood gases and cardiac output (lithium dilution method) were recorded. Sedation was evaluated subjectively (scale 0–10). Data were analyzed with repeated measures ANOVA.

Data are presented in Table 1. After an initial decrease induced by atipamezole, sedation score increased by 3 or more grades (re-sedation) for 10 to 65 minutes in 4 sheep with MED and in 1 sheep with MMK. Although atipamezole itself reversed some medetomidine induced cardiopulmonary side effects, the presence of MK-467 led to their faster return towards their baseline levels.

Table 1.

<table>
<thead>
<tr>
<th>Time (minutes)</th>
<th>Baseline</th>
<th>40</th>
<th>60</th>
<th>90</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR (bpm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MED</td>
<td>72 ± 10</td>
<td>64 ± 13†</td>
<td>61 ± 10†</td>
<td>61 ± 9†</td>
</tr>
<tr>
<td>MMK</td>
<td>71 ± 7</td>
<td>65 ± 4</td>
<td>71 ± 10</td>
<td>74 ± 14</td>
</tr>
<tr>
<td>SVR (dynes sec cm⁻⁵)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MED</td>
<td>1698 ± 222</td>
<td>2243 ± 359†</td>
<td>2022 ± 396†</td>
<td>1928 ± 373</td>
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<tr>
<td>MMK</td>
<td>1827 ± 268</td>
<td>1965 ± 424</td>
<td>1775 ± 261</td>
<td>1789 ± 408</td>
</tr>
<tr>
<td>PaO₂ (mmHg)</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>MED</td>
<td>104 ± 4</td>
<td>90 ± 10†</td>
<td>99 ± 11</td>
<td>102 ± 5</td>
</tr>
<tr>
<td>MMK</td>
<td>100 ± 4</td>
<td>96 ± 9</td>
<td>100 ± 6</td>
<td>106 ± 9</td>
</tr>
</tbody>
</table>

† Significantly (p < 0.05) different from baseline.

Funding for this study was provided by Vetcare Ltd, Finland
Cardiovascular and sedative effects of MK-467, a peripheral alpha2-adrenoceptor antagonist, in sheep sedated with intramuscular medetomidine

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1Department of Equine and Small Animal Medicine, Faculty of Veterinary Medicine, University of Helsinki, Helsinki, Finland.

We investigated the cardiovascular and sedative effects of MK-467 administrated IM in the same syringe with medetomidine in sheep.

Eight sheep with previously elevated carotid artery received medetomidine 30 µg kg⁻¹ (MED) with or without MK-467 300 µg kg⁻¹ (MMK), in a randomized, blinded, cross over design. Invasive blood pressures were monitored and sedation was assessed. Cardiac index (CI) was measured with lithium dilution method, and systemic vascular resistance (SVR) was calculated. Repeated measures ANOVA followed by Holm-Bonferroni’s and Kruskall-wallis test were used where appropriate.

Hemodynamic results (mean ± SD) are shown in Table 1. MK-467 hastened the induction of sedation. MK-467 attenuated the cardiovascular effects and enhanced the sedation induced by medetomidine.

Table 1.

<table>
<thead>
<tr>
<th>Time (minutes)</th>
<th>Baseline</th>
<th>20</th>
<th>40</th>
<th>60</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR (bpm)</td>
<td>MED</td>
<td>74 ± 9</td>
<td>54 ± 10†</td>
<td>50 ± 3‡</td>
</tr>
<tr>
<td></td>
<td>MMK</td>
<td>75 ± 7</td>
<td>59 ± 8†</td>
<td>80 ± 18*</td>
</tr>
<tr>
<td>MAP (mm Hg)</td>
<td>MED</td>
<td>110 ± 9</td>
<td>107 ± 8</td>
<td>105 ± 10</td>
</tr>
<tr>
<td></td>
<td>MMK</td>
<td>106 ± 7</td>
<td>103 ± 7</td>
<td>88 ± 10*</td>
</tr>
<tr>
<td>CI (ml kg min⁻¹)</td>
<td>MED</td>
<td>91.3 ± 23.3</td>
<td>69.8 ± 11.7†</td>
<td>65.0 ± 5.9‡</td>
</tr>
<tr>
<td></td>
<td>MMK</td>
<td>92.2 ± 17.7</td>
<td>76.1 ± 17.3</td>
<td>78.7 ± 11.0*</td>
</tr>
<tr>
<td>SVR (dynes sec cm⁻⁵)</td>
<td>MED</td>
<td>1852 ± 289</td>
<td>2222 ± 568</td>
<td>2275 ± 356</td>
</tr>
<tr>
<td></td>
<td>MMK</td>
<td>1706 ± 300</td>
<td>1970 ± 247</td>
<td>1606 ± 343*</td>
</tr>
</tbody>
</table>

* significantly (p < 0.05) different from baseline. †significantly different from MED.

Funding provided by Vetcare Ltd, Finland and the Doctoral Programme in Clinical Veterinary Medicine.
Influence of a head and tail rope on quality and duration of recovery from general anaesthesia in horses

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Recovery is the most critical part of general anaesthesia in horses. Many hospitals use head and tail ropes for recovery (Kästner 2010), but the benefits in elective cases are not clearly shown.

In a prospective, randomized clinical trial 301 horses (ASA 1, 2) were anaesthetized for elective procedures (arthroscopy, castration, splint bone surgery, head surgery). Horses were randomly assigned to recover either with head-tail-rope assistance (group A) or without (group O). After premedication (detomidine, xylazine, levomethadone) and induction (diazepam, ketamine), anaesthesia was maintained with isoflurane in oxygen and triple drip (guaifenesin, ketamine, xylazine). For each recovery (group A: n = 153; group O: n = 152) duration and number of attempts to stand were recorded. Quality was evaluated by a recovery score (Clarke-Price et al. 2008). Data were analyzed by linear regression, ANCOVA and Fisher’s-exact test (p < 0.05).

In group A, the number of attempts to stand were lower (1 [1 - 7]) than in group O (3 [1 - 34]) (p< 0.0001). The time to stand was shorter for group A (37 ± 12 Minutes) than for group O (40 ± 15 Minutes) (p = 0.0025). Recovery quality score in group A (28 [15 - 70]) was lower than in group O (38 [11 - 87]) (p < 0.0001). There were two horses in group A and nine in group O with injuries (p = 0.035). The use of head and tail rope improved recovery quality and reduced recovery associated injuries in horses undergoing elective surgical procedures.

References

Kästner, S. B. R. (2010): How to manage recovery from anaesthesia in the horse - to assist or not to assist? Pferdeheilkunde 26, 604-608
Effect of fentanyl on thermal and mechanical nociceptive thresholds in horses and estimation of anti-nociceptive plasma concentrations

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There are no published studies relating thermal and mechanical nociceptive effects to plasma concentrations of fentanyl in horses. The study was carried out as a randomized, blinded, controlled trial with complete cross-over design. Eight horses were treated with saline (S) and fentanyl (F₂₅ = 2.5 µg kg⁻¹; F₅ = 5 µg kg⁻¹; F₁₀ = 10 µg kg⁻¹) intravenously over 5 minutes with a 10 day wash-out period. To evaluate thermal (°C) and mechanical (N) nociceptive threshold single stimulations were performed prior (baseline) and 10, 30, 60, 90, 120, 180, 240, 300, 360, 420, 540 and 1350 minutes after treatment. Simultaneously plasma fentanyl concentrations were measured. Locomotor activity, HR, fR, body temperature and gastrointestinal sounds were recorded. For data analysis one-way-ANOVA and Tukey-Kramer were used (p < 0.05).

In group F₁₀, there was a significant increase above baseline (47.2 ± 4.07 °C) in thermal threshold at t₁₀ (53.7 ± 4.16 °C) and t₃₀ (52.1 ± 5.56 °C), whereas mechanical threshold increased significantly above baseline (3.7 ± 1.27 N) at t₁₀ (6.6 ± 3.56 N). Corresponding mean fentanyl concentrations were 18.99 ± 5.68 ng ml⁻¹ (t₁₀) and 9.44 ± 5.67 ng ml⁻¹ (t₃₀). Mean minimal anti-nociceptive plasma concentration estimated by thermal stimulation was approximately 6 ng ml⁻¹. Dose-dependent increased locomotion was noticed, but no significant changes in HR, fR, body temperature and gastrointestinal sounds. Fentanyl plasma concentrations of 6 ng ml⁻¹ and higher seem to be required to induce detectable analgesia in healthy horses. As main side effect dose-dependent increased locomotion was observed.
Feasibility and repeatability of electrical, mechanical and thermal nociceptive testing in healthy dogs

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Université de Montréal, Canada.

This study aimed to evaluate the feasibility and repeatability of electrical (E), mechanical (M) and thermal (T) nociceptive testing in dogs. Sixteen client-owned healthy dogs [4.8 (2-9 years); 32 ± 17 kg (six males/10 females)] were included. Nociceptive stimulation was applied to the dorsal aspect of the metacarpus and the plantar aspect of the metatarsus in a randomized order until a behavior response was observed or a cut-off reached. For E, transcutaneous electrical stimulation (TENS) was provided using two adhesive electrodes. For M, an increasing pressure was applied with a 3.5 mm flat tip of an algometer. For T, a probe was applied at 25°C and decreased gradually to 0°C. Tests were performed twice (60 seconds apart) and by two observers. Retesting was performed five hours later. Sham testing was performed for E and T. Statistical analysis included mixed linear model; inter-observer repeatability was calculated using intra-class correlation coefficient (ICC) (p < 0.05).

There was no influence of time or limb tested on mean values for E and M (p > 0.05). Only five dogs responded to thermal stimulation; data for T were not tested. Mean ± SD were 48 ± 23 mA for E and 12 ± 3 N for M. Data collection was feasible in 99% for E, 93.6% for M and 93.5% for T. Inter-observer repeatability was excellent for E (91.3%) and moderate for M (60.9%). False-positive responses were 15% and 28.6% for E and T, respectively.

Electrical nociceptive testing was feasible, repeatable and superior to M/T.

This study was funded by Boehringer Ingelheim (Canada) Ltd and MITACS Accelerate.
An ultrasound-guided parasacral approach to the sciatic nerve has been described by Shilo et al. (2010) but alternative approaches may be investigated. Both sciatic nerves of seven cadavers were identified using a modified in-plane ultrasound-guided approach. Methylene blue solution (0.2 mL) was injected perineurally and success was evaluated through dissection. The same approach was repeated in seven sedated (dexmedetomidine 50 µg kg\(^{-1}\) IM) beagles. After randomisation, 0.2 mL/kg of levobupivacaine 0.5% (Limb L) and 0.2 mL/kg of saline 0.9% (Limb C) was injected perineurally in either right or left limb. Block success was evaluated by sensory deficit every hour (T60-T420) after an atipamezole injection (0.2 mg kg\(^{-1}\) IM). Reaction to pinprick (binary score) over the course of the sciatic nerve (4 locations) and locomotion were assessed. Wilcoxon matched-pairs signed rank tests were applied to compare Limb L and Limb C.

The overall sciatic nerve block success was 93% in cadavers and 86% in sedated dogs. It was impossible to localise the sciatic nerves in one obese sedated dog. Significant differences between Limb L and Limb C were observed for pinprick at great trochanter, caudal thigh, lateral tarsal joint (p < 0.0001) and interdigital (p = 0.0369) sites. Reaction to pinprick was absent in all dogs at great trochanter and caudal thigh sites up to at least T180 on Limb L. Locomotion was impaired in all but one dog on Limb L. No complications were observed.

This modified parasacral ultrasound-guided technique seems to be an effective approach to the sciatic nerve.

References

The relationship between empathy in veterinary and medical undergraduates and their assessment of pain in humans and animals.

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When assessing pain in humans, highly empathetic observers award greater pain scores than low-empathy observers, but not necessarily with any more accuracy (Green et al. 2009). We aimed to quantify empathy in veterinary and medical undergraduates; then test association between student empathy levels and the pain scores they allocated to animals and humans in pain. An online questionnaire was developed comprising of an Empathy Quotient (EQ) Questionnaire (Baron-Cohen and Wheelwright 2004); Numerical rating score (NRS); and a modified Face Limbs Activity Crying & Consolability score (FLACC) (Merkel et al. 1997). Third and fourth year veterinary and medical students completed the EQ before viewing videos of three animals and three humans and completing NRS and FLACC scores for each of the six videos. Video footage was obtained from clinical cases at RDSVS and edits of television documentaries.

The study was completed by 100 veterinary and 75 medical students, with no difference in mean EQ scores (42.7 ± 8.8 and 41.6 ± 10.9, respectively, P = 0.26). There was correlation between NRS and FLACC scores allocated by students for four of the videos (spearman correlation ρ>0.41, P<0.05). There was no correlation between NRS or FLACC pain scores allocated by students and EQ scores (spearman correlation ρ<0.19, P>0.3).

The empathy levels of veterinary and medical students were not associated with the NRS- and FLACC-derived pain scores they award to animals and humans in pain.

References


Sedation of sheep following the administration of acepromazine with buprenorphine or morphine is similar

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The aim of this study was to compare sedation of sheep following the IM administration of acepromazine with buprenorphine or morphine. Twenty merino sheep were administered acepromazine (0.03 mg kg⁻¹) with buprenorphine (0.02 mg kg⁻¹) (AB, n = 10) or morphine (0.3 mg kg⁻¹) (AM, n = 10) by intramuscular injection 45 minutes prior to assessment. Sedation (SS) was scored on a scale from 0 (no sedation: normal spontaneous activity and reaction to approach; no head lowering or ataxia; standing) to 10 (heavy sedation: no spontaneous activity; no reaction to approach; head lowered; sternal recumbency). The response to restraint (RS) in the shearing position was scored on a scale from 0 (agitated, difficult to maintain in position) to 4 (relaxed, did not resist positioning). Three independent blinded observers and a single blinded observer determined the SS and RS, respectively. The SSs were summed (maximum 30). Data were tested for normality and compared using a t-test. Data is mean ± SD (95% confidence interval). Each group comprised 2 wethers and 8 ewes. There was no difference between the AB and AM groups: weight 44 ± 3.1 kg and 44.7 ± 3 kg (p = 0.58); SS 4.6 ± 3.2 (2.4 – 6.9) and 6.6 ± 3.5 (4.1 – 9.1) (p = 0.21); and RS 1.6 ± 1.3 (0.5 – 2.7) and 2 ± 1.5 (0.7 – 3.3) (p = 0.6). No adverse effects of the drugs were observed. Sedation with AB or AM at these doses is similar in sheep without observed adverse effects.
A critical incident technique (CIT) is used to identify processes which can be modified to improve future outcomes. The purpose of this study was to apply CIT to a series of peri-anesthetic cardiac arrest events at a university teaching hospital in order to describe how cardiac arrest events occur and identify processes which may benefit from remediation to improve patient outcome.

Any patient which had a cardiopulmonary arrest between premedication and transfer to an appropriate service after recovery from anesthesia was included. Each case was discussed within one week of the event and a written summary generated. The medical record and summary were reviewed using CIT.

Sixteen patients met the inclusion criteria during 36 months of data collection. Eight of the arrests were attributable to anesthesia (e.g. arrest after induction), 4 to solely patient factors (e.g. pulmonary thromboembolism), and 4 to solely surgical factors (e.g. hemorrhage). Half of cases in each of the attributable causes had return of spontaneous circulation. Only two cases, both in the anesthesia-attributable cause, survived to discharge. In six cases, there was no clear error made by personnel.

Eighteen errors or possible errors were identified. Errors were attributed to skill (11), cognitive bias (3), communication (1), machine (1), knowledge (1), and decision-making (1).

Some cases suffer a peri-anesthetic arrest for a reason which the medical team cannot foresee or change. In others, the medical team can improve skill to minimize the likelihood of causing an error.
Development of frontal, zygomaticotemporal and major b nerve block techniques for regional anesthesia of the dorsal cranium in dog cadavers

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Regional anesthesia for craniotomies is routine practice in people; however, it has not been described in dogs. The aim of this study was to identify landmarks for nerve blockade of the dorsal cranium in dogs.

Thirty-eight canine cadavers, weighing 2.5 – 40 kg were used in two phases of this study. In the initial phase, cadavers were dissected to determine the location of the frontal, zygomaticotemporal and major occipital (MO) nerves, and to identify prominent landmarks for their blockade, using 1% methylene blue diluted 1:200 with bupivacaine. One technique was developed for the frontal and zygomaticotemporal nerves and two techniques, rostral (MOR) and caudal (MOC), were developed for the MO nerve. In the second phase, cadavers were used to test the techniques developed in the first phase with 0.04 ml kg⁻¹ of the same injectate administered at each site (maximal volume 0.5 ml / site). The length of nerve stained was measured, with a length of ≥ 6 mm considered successful. Confidence intervals (CI) were calculated using Fisher's exact test.

Success rates (95% CI) for the frontal, zygomaticotemporal, and both techniques for the MO nerve (MOR, and MOC) were 94% (80.3 - 99.3%), 91% (76.3 - 98.1%), 74% (58.0 - 86.2%), and 77% (58.8 - 89.3%), respectively. With a combination of both the MOR and MOC technique, the success rate for the MO nerve was 100% (89.7 - 100%).

Simple anatomical landmarks can be used for regional anesthesia for craniotomy in dogs. However, further evaluation in live dogs is warranted.
The aims of this study were to describe a novel approach to paravertebral brachial plexus (PBP) blockade in cats, and compare bupivacaine-methylene blue solution (BMS) spread using two volumes of injection.

Six cadavers (4.4 ± 1.8 kg) randomly received 0.15 mL kg⁻¹ per injection (LOW) or 0.2 mL kg⁻¹ per injection (HIGH) of BMS into the PBP. The first injection was made ventral to the transverse process of the sixth cervical vertebra (nerves C6 and C7) at the emergence of nerve roots. A second injection was performed at the edge of the cranial border of the scapula and directed ventrally towards the first rib (C8 and T1). Cadavers were dissected; positive staining with BMS and length were recorded for each nerve (C6/C7/C8/T1). Complications (aspiration of blood and staining of spinal cord) were recorded. Paired t-tests and Chi-Squared tests were used for statistical analysis when appropriate (p < 0.05).

Eleven thoracic limbs were injected. Aspiration of blood occurred during one injection. Success rate (positive nerve staining) in LOW and HIGH were as follows: C6: 83% and 80%; C7: 66% and 100%; C8: 66% and 100%; T1: 50% and 60%, respectively (p > 0.05). Length of nerve staining was 22 (15 - 39) mm for LOW and 21 (13 - 35) mm for HIGH (p > 0.05).

This study describes a novel approach to PBP in cats with minimal complications. Percentage of successful staining and length of nerve staining were similar between LOW and HIGH.
Distribution of bupivacaine hydrochloride after sciatic and femoral nerve blocks in cats: a magnetic resonance imaging study

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This study aimed to evaluate the distribution of bupivacaine using magnetic resonance imaging (MRI) after electrical nerve stimulator-guided sciatic (ScN) and femoral (FN) nerve blocks in cats. Six adult healthy research cats (4.8 ± 0.6 kg) were anesthetized with acepromazine-buprenorphine-propofol-isoflurane. Transverse and sagittal plan sequences of pelvic limbs were obtained using MRI. The ScN and FN blocks (one block per limb) were performed using bupivacaine 0.5% (0.1 mL kg⁻¹) per site and sequences were repeated after each block. Anesthesia recovery was uneventful. Distribution was considered successful when bupivacaine was in contact with the nerve. Injectate location and complications were recorded. The length of the ScN in contact with bupivacaine was measured and classified as fair (< 15 mm) or adequate (≥ 15 mm). Five out of six ScN injections had successful distribution. The length of the ScN in contact with bupivacaine was 26 (13-39) mm and adequate in four out of five successful injections. All FN injections had successful distribution. In one injection (FN), bupivacaine was administered distal to the bifurcation between the femoral and saphenous nerve and over the motor branch of FN. Magnetic resonance imaging was useful for the evaluation of bupivacaine distribution following ScN and FN blocks in cats. Injections produced successful bupivacaine spread and adequate length of contact (ScN), however nerve injuries or hematomas could not be observed. Individual variability regarding the injectate location may explain differences in sensory and motor blockade in the clinical setting.

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Development of a video-based teaching tool on local anesthetic techniques in small animals

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Video-based learning provides effective training in medical education (Buch et al. 2014; Farooq et al. 2015). This abstract describes the development of a video-based teaching tool on local anesthetic techniques in small animals.

Two board-certified anesthesiologists (PS/SL) prepared a script for filming 13 local anesthetic techniques in dogs and cats based on the World Small Animal Veterinary Association Global Pain Council (WSAVA-GPC) guidelines, text-books and peer-reviewed literature. Text included indications, contra-indications, description of anatomical landmarks and clinical application for each block. Four healthy adult dogs (24.8 ± 12 kg), one canine cadaver, one feline and one canine skull were used. Aseptic technique was used when appropriate. Anesthetic protocol included methadone-propofol-isoflurane-meloxicam. All videos were filmed using a high-definition (1920 X 1020p) video camera. Legends were added and video-editing was performed and reviewed. The final script was edited and peer-reviewed by an English native-speaker board-certified anesthesiologist (PB) who recorded the audio. A list of materials, drugs, and closing credits were added at the end of each video. Duration of video recording was approximately 12 hours. Thirteen techniques were filmed; one was excluded due to technical issues. The final product was used for teaching students of the Université de Montréal (UdeM), endorsed by the WSAVA-GPC, funded by UdeM, and published on YouTube (https://www.youtube.com/channel/UCaDaAco76nwBq7BWEO-dLcA) as open-access.

Development of this tool was feasible but requires several hours of editing and significant financial resources. Further studies are required to assess the impact and effectiveness of this tool in small animal veterinary anesthesia.

References


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Effect on intraoperative cardiopulmonary function and perioperative nociception of local mepivacaine during castration in horses under medetomidine isoflurane balanced anesthesia

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This prospective blinded clinical study investigated the effect of mepivacaine before castration on perioperative lactate, cytokines and pain in horses. Twenty stallions were randomly assigned to group C (control) or M (Mepivacaine). Animals received flunixin and medetomidine followed by induction with ketamine/diazepam IV. Anaesthesia was maintained with isoflurane and medetomidine. Mepivacaine horses received mepivacaine 2% bilaterally prior to incision (3.5ml SC, 1ml 100kg⁻¹ intrafunicularly, 2ml 100kg⁻¹ intratesticularly). For recovery horses received 2 µg kg⁻¹ medetomidine IV and 0.1 mg kg⁻¹ morphine IM. One hour before premedication and 4, 8 and 24 hours post castration pain was scored (Composite Pain Scale, CPS) and plasma lactate and cytokines (interleukin6, IL-6; tumor necrosis factor alpha, TNF-α) measured.

Data were analysed using repeated measures linear regression or unpaired t-test, significance level P ≤ 0.05.

Pain scores, plasma lactate, and cytokines increased in both groups compared to baseline (Table). However, group M postoperatively exhibited significantly lower pain scores and cytokine levels.

Local mepivacaine before castration incision in medetomidine-isoflurane-anesthetized horses attenuated increases in plasma lactate and cytokines and improved perioperative analgesia.

Table - Results

<table>
<thead>
<tr>
<th>Time/ group</th>
<th>CPS</th>
<th>IL-6 pg ml⁻¹</th>
<th>TNF-α pg ml⁻¹</th>
<th>Lactate mmol L⁻¹</th>
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<tbody>
<tr>
<td>0 C</td>
<td>3.2±2.4</td>
<td>0</td>
<td>0</td>
<td>0.95±0.5</td>
</tr>
<tr>
<td>M</td>
<td>2±2.7</td>
<td>0</td>
<td>0</td>
<td>0.81±0.3</td>
</tr>
<tr>
<td>4 C</td>
<td>9.5±2.7*</td>
<td>827±14*</td>
<td>85.3±45.8*</td>
<td>1.02±0.6</td>
</tr>
<tr>
<td>M</td>
<td>4.8±1.9*</td>
<td>66.4±27*</td>
<td>24.5±12.7*</td>
<td>0.85±0.4</td>
</tr>
<tr>
<td>8 C</td>
<td>13.3±2*</td>
<td>565.8±14*</td>
<td>144.1±43.8*</td>
<td>1.07±0.5*</td>
</tr>
<tr>
<td>M</td>
<td>6.3±1*</td>
<td>147.1±30*</td>
<td>42.3±15.9*</td>
<td>1.02±0.5*</td>
</tr>
<tr>
<td>24 C</td>
<td>16±2*</td>
<td>1609.6±44*</td>
<td>1423.6±41.5*</td>
<td>1.2±0.5*</td>
</tr>
<tr>
<td>M</td>
<td>7.2±2*</td>
<td>177.8±24*</td>
<td>82.1±11.9*</td>
<td>1.1±0.3*</td>
</tr>
</tbody>
</table>

*significant difference between the groups
**significant difference to baseline (0).