

The effect of metoclopramide on food intake and faecal output in healthy rabbits undergoing sedation

Mead SA¹, Allen MJ², Hassouna Elsayed SA², Self IA¹, Bird AR¹, Gittel CS¹

¹ Queen's Veterinary School Hospital, University of Cambridge, UK

² Surgical Discovery Centre, University of Cambridge, UK

This study aimed to investigate whether metoclopramide affected food intake and faecal output. Reduced feed intake and faecal output are associated with ileus, a complication of rabbit anaesthesia.

In this randomized, blinded, crossover study, fourteen female New Zealand White Rabbits aged 25-27 weeks undergoing sedation for radiography were divided into two groups: MET (metoclopramide 0.5 mg kg⁻¹ SC) and CONTROL (no treatment). After 30-minute sedation with medetomidine (200 µg kg⁻¹), fentanyl (5 µg kg⁻¹) and midazolam (0.5 mg kg⁻¹) IM, atipamezole (0.5 mg kg⁻¹ IM) was administered and metoclopramide according to group allocation (T0). At T4, 8, 12, and 20 hours, faeces were collected and weighed. Pelleted food was weighed, and intake calculated. Two weeks later, the study was repeated in crossover groups. Food was not withheld at any time pre- or post-sedation. Data were analysed using Wilcoxon signed-rank tests for matched samples; significant if $p < 0.05$.

No significant differences were detected between the groups in food intake and faecal output at any time point. Ten rabbits in CONTROL and nine rabbits in MET ate hay by T4. Nine rabbits in CONTROL and eight rabbits in MET ate pelleted food by T4. Nine rabbits in each group produced faeces by T4, all rabbits produced faeces by T8.

Metoclopramide did not change markers of GI motility in healthy rabbits after sedation. The dose range for metoclopramide is large (0.1 – 2 mg kg⁻¹) and therefore alternative dosing regimens should be investigated.

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Evaluation of three doses of oral trazodone and its impact on handling, activity, and physiological parameters in rabbits: a prospective randomized blinded cross-over study

Watanabe R¹, Gibert A¹, Benito J¹, Garbin M¹, Kwong G², Desmarchelier M¹, Cruz Benedetti IC¹

¹ Department of Clinical Sciences, Faculty of Veterinary Medicine, Université de Montréal, Saint-Hyacinthe, QC, Canada

² Department of Community Health Sciences, Faculty of Veterinary Medicine, University of Calgary, Calgary, AB, Canada

Trazodone reduces stress in many species. In rabbits, however, no study has determined the minimal effective dose of trazodone required to induce behavioural changes and its safety profile.

This study aimed to determine the minimal effective dose of trazodone on handling and activity in rabbits and to evaluate changes in physiological and arterial blood gas parameters. Eight intact female New Zealand White rabbits (2-month-old; 1.66 ± 0.12 kg) were included in this prospective, blinded, randomized cross-over study. After 6-days of acclimation, rabbits randomly received placebo or trazodone 10, 20 or 30 mg kg⁻¹ orally (TRAZ10, TRAZ20, TRAZ30; T0) with a 1-week wash-out period. Compliance scoring (dynamic interactive visual analog scale; DIVAS), activity levels measured with accelerometry (T0 - T600), physiological parameters (temperature, HR, f_R), and arterial blood gas parameters (up to T240) were evaluated. Compliance scores, accelerometry, physiological and arterial blood gas parameters and the prevalence of hypoxemia (PaO₂ < 60 mmHg) were analysed using linear mixed models and Chi-squared tests, respectively ($p < 0.05$).

When compared with placebo, DIVAS scores were significantly higher at T80-120, T40-120 and T120-200 in TRAZ10, TRAZ20 and TRAZ30 post-administration, respectively. When compared with baseline, DIVAS scores were significantly higher from T80-160, T40-240 and T80-200 in TRAZ10, TRAZ20 and TRAZ30, respectively. All other parameters were not significantly different. In TRAZ30, hypoxemia was observed in 2/8 rabbits ($p = 0.06$).

In conclusion, oral trazodone improved rabbit compliance at all studied dosages. At 20 mg kg⁻¹ trazodone improved rabbit compliance for over three hours without causing hypoxemia.

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Pharmacupuncture: Comparison of the effects of dexmedetomidine administered at the GV20 acupoint, subcutaneously on the head or intramuscularly in laboratory rabbits

Benito J¹, Garbin M¹, Gibert A², Juette T², Cruz Benedetti IC¹

¹ Clinical Service of Anesthesia, Department of Clinical Sciences, Faculty of Veterinary Medicine, University of Montreal, Saint-Hyacinthe, QC, Canada

² Faculty of Veterinary Medicine, University of Montreal, Saint-Hyacinthe, QC, Canada

This prospective, randomized, blinded, cross-over study aimed to explore the efficacy of a low dose of dexmedetomidine injected SC on the head (GV20 acupoint and non-acupoint) and IM in rabbits.

Eight intact female New Zealand White rabbits (5-month-old; 3.29 ± 0.23 kg) were randomly administered $10 \mu\text{g kg}^{-1}$ of dexmedetomidine SC on the GV20 acupoint, SC lateral to the ear and IM (lumbar muscles) with a 24-hour wash-out period. A blinded evaluator assessed onset of action and degree of sedation every 5 minutes up to 60 minutes, with a validated sedation Numerical Rating Scale (NRS; Raulic et al. 2021) and a Dynamic Interactive Visual Analogue Scale (DIVAS). Physiological parameters (HR, f_R , temperature) and adverse events were also recorded. Multiple pairwise comparisons and Benjamini-Hochberg corrections were performed among times and treatment-groups after data was log- transformed for normal distribution ($p < 0.05$).

Regardless of the administration route, rabbits were safely sedated with dexmedetomidine (time effect $p \leq 0.001$). Two rabbits showed abnormal behaviours and the sedation was repeated after one week. Sedation level was not different between groups ($p = 0.150$ and $p = 0.442$; NRS and DIVAS, respectively). Time and treatment affected changes in HR ($p \leq 0.001$ and $p = 0.004$) and temperature ($p \leq 0.001$ and $p = 0.016$), respectively. Only time affected f_R ($p \leq 0.001$ and $p = 0.112$; time-treatment respectively).

In conclusion, in rabbits, a low dose of dexmedetomidine administered GV20 or SC on the head produced mild sedation similar to that observed after IM administration.

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Ethical approval

This project was approved by the Institutional Animal Care and Use Committee of the University of Montreal (21-Rech-2135).

Conflict of Interest

The authors have no conflict of interest to declare.

Methadone versus buprenorphine in New Zealand white rabbits undergoing calvarium surgery

Casoni D¹, Garcia Casalta LG¹, Saulacic N², Spadavecchia C³

¹ Department for Biomedical Research, Faculty of Medicine, University of Bern, Switzerland

² Clinic of Cranio-Maxillofacial Surgery, University Hospital Bern - Inselspital, Switzerland

³ Department for Clinical Veterinary Sciences, Vetsuisse Faculty, University of Bern, Switzerland

Buprenorphine has gained widespread popularity in rabbits, while much less is known about methadone. Our aim was to compare sedative, anti-nociceptive and respiratory effects of methadone and buprenorphine as part of balanced anaesthesia.

Forty-eight New Zealand White rabbits undergoing calvarium defects were randomly equally assigned to receive either 0.03 mg kg⁻¹ buprenorphine (group B) or 0.3 mg kg⁻¹ methadone (group M) in combination with 15 mg kg⁻¹ ketamine and 0.01 mg kg⁻¹ dexmedetomidine SC. Fifteen minutes after, sedation was scored (modified from Raekallio et al. 2002). A laryngeal mask was placed, anaesthesia was maintained in spontaneous breathing with isoflurane in oxygen (maximal Et Isoflurane 1.3%). Rescue analgesia was administered if MAP or f_R increased at least 20% from baseline. Arterial blood gases were analysed intraoperatively and 30 minutes after removal of the laryngeal mask. The relative risk (rR) of receiving rescue analgesia was calculated. Intraoperative PaO₂, PaCO₂ (mmHg), pH, degree of sedation, postoperative pH and PaCO₂ were compared between groups with Mann-Whitney test.

Results are presented in table as median and interquartile range:

	Group M	Group B	<i>p</i>
Sedation score	9 (7.25 – 10)	8 (6 – 9)	0.026
Intraoperative pH	7.29 (7.27-7.32)	7.29 (7.27-7.33)	0.632
Intraoperative PaO ₂	365.5 (317.25- 406.5)	313 (204.5- 399)	0.132
Intraoperative PaCO ₂	69.05 (60.82- 76.12)	74.1 (64.72- 83)	0.122
Post-operative pH	7.44 (7.4 – 7.48)	7.44 (7.4- 7.47)	0.854
Post-operative PaCO ₂	52.5 (47.5-57.65)	55.7 (49.5-59.25)	0.28
rR rescue analgesia	1.4		0.739

Groups M and B showed non-different short-term respiratory acidosis and anti-nociception, with deeper sedation in group M.

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Pharmacokinetics of gamma-hydroxybutyric acid in juvenile swine after intravenous and oral administration

Cuypers C¹, Schauvliege S¹, Devreese M², Uytfanghe K³, Gasthuys F¹, Stove C³

¹ Department of Large Animal Surgery, Anaesthesia and Orthopedics, Faculty of Veterinary Medicine, Ghent University, Merelbeke, Belgium

² Department of Pathobiology, Pharmacology and Zoological Medicine, Faculty of Veterinary Medicine, Ghent University, Merelbeke, Belgium

³ Department of Bioanalysis, Faculty of Pharmaceutical Sciences, Ghent University, Ghent, Belgium

Gamma-hydroxybutyric acid (GHB) is an endogenous neuromodulator with sedative and protective effects during hypoxia in humans and animals. The pharmacokinetics of GHB were studied in juvenile swine after IV and PO administration. Six juvenile swine received 500 mg kg⁻¹ GHB IV, and 500 and 750 mg kg⁻¹ GHB PO, in a randomized cross-over design. Dried blood samples were analysed using a gas chromatography-mass spectrometry method followed by non-compartmental pharmacokinetic modelling.

Mean peak plasma concentrations after PO administration were 2471 ± 312 and 3904 ± 1028 µg mL⁻¹ for 500 and 750 mg kg⁻¹ respectively. These were respectively recorded at 1.30 ± 0.25 and 1.49 ± 0.39 hours after PO administration. Maximal plasma concentration after IV administration was 13295 ± 2014 µg mL⁻¹, with a volume of distribution of 55 ± 9 mL kg⁻¹ and clearance of 23.06 ± 4.29 mL kg⁻¹ hour⁻¹. Elimination half-lives for IV and PO 500 and 750 mg kg⁻¹ were 1.26 ± 0.34, 0.98 ± 0.19 and 0.96 ± 0.39 hours respectively. The bioavailability for 500 mg kg⁻¹ PO administration was 41%. Area under the curve / dose for PO 500 and 750 mg kg⁻¹ were 17.8 ± 1.8 and 19.9 ± 7.0 kg hour⁻¹ L⁻¹ respectively. No clear sedation was seen after PO administration. Deep sleep was seen in one animal after IV administration, other animals showed head pressing and ataxia.

The pharmacokinetic analysis suggests linear kinetics, which differs from findings in other species, but further research is needed to confirm this.

Patient state index and suppression ratio response during nociception in pigs undergoing front-limb amputation

Petrucci M, García Casalta LG, Rieben R, Casoni D

Department for BioMedical Research, Faculty of Medicine, University of Bern, Bern, Switzerland

The utility of processed EEG monitors in assessing intraoperative nociception is still debated (García et al. 2021). We aimed at evaluating the influence of nociception on patient state index (PSI), suppression ratio (SR) and HR in pigs.

Fifteen pigs undergoing front-limb amputation in general anaesthesia were enrolled. After IM dexmedetomidine 0.02 mg kg⁻¹, ketamine 10 mg kg⁻¹ and methadone 0.2 mg kg⁻¹, anaesthesia was induced with IV ketamine 1 mg kg⁻¹ and propofol to effect and maintained with isoflurane in oxygen and air. Paravertebral cervical block was performed. Nociception (N) was defined as MAP increase ≥ 20% compared to baseline. Values of PSI, SR and HR were recorded at N, 5 (5AN) and 10 (10AN) minutes after N and compared with ANOVA on rank.

Twenty-two nociceptive events were recorded. No significant differences were found for PSI and SR ($p = 0.306$; $p = 0.059$). Heart rate was significantly lower at N, 5AN and 10AN compared to baseline ($p < 0.001$).

MAP (mmHg)	Median	25 %	75 %
Baseline	66	61.7	69.5
N	92	83.2	102
5AN	88	81	98
10N	86	78.7	98
PSI	Median	25 %	75 %
Baseline	22	21	25
N	22.5	20	26.2
5AN	21.5	18.7	24
10AN	21	19	24.5
SR	Median	25 %	75 %
Baseline	0	0	0
N	4	0	15
5AN	6	0	24
10AN	4	0	23
HR	Median	25 %	75 %
Baseline	111.5	105.7	125.7
N	97.5	84	104.7
5AN	97.5	85.7	108.2
10AN	97	87.5	108

Nociceptive stimulus triggered a decrease in HR without being mirrored by PSI. Suppression ratio showed a positive trend.

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Correlation of Sedline-generated variables with anaesthetic depth in propofol anaesthetized pigs

Mirra A^{1,2}, Spadavecchia C¹, Levionnois O¹

¹ Section of Anaesthesiology and Pain Therapy, Department of Clinical Veterinary Medicine, Vetsuisse Faculty, University of Bern, Bern, Switzerland

² Graduate School for Cellular and Biomedical Sciences, University of Bern, Bern, Switzerland

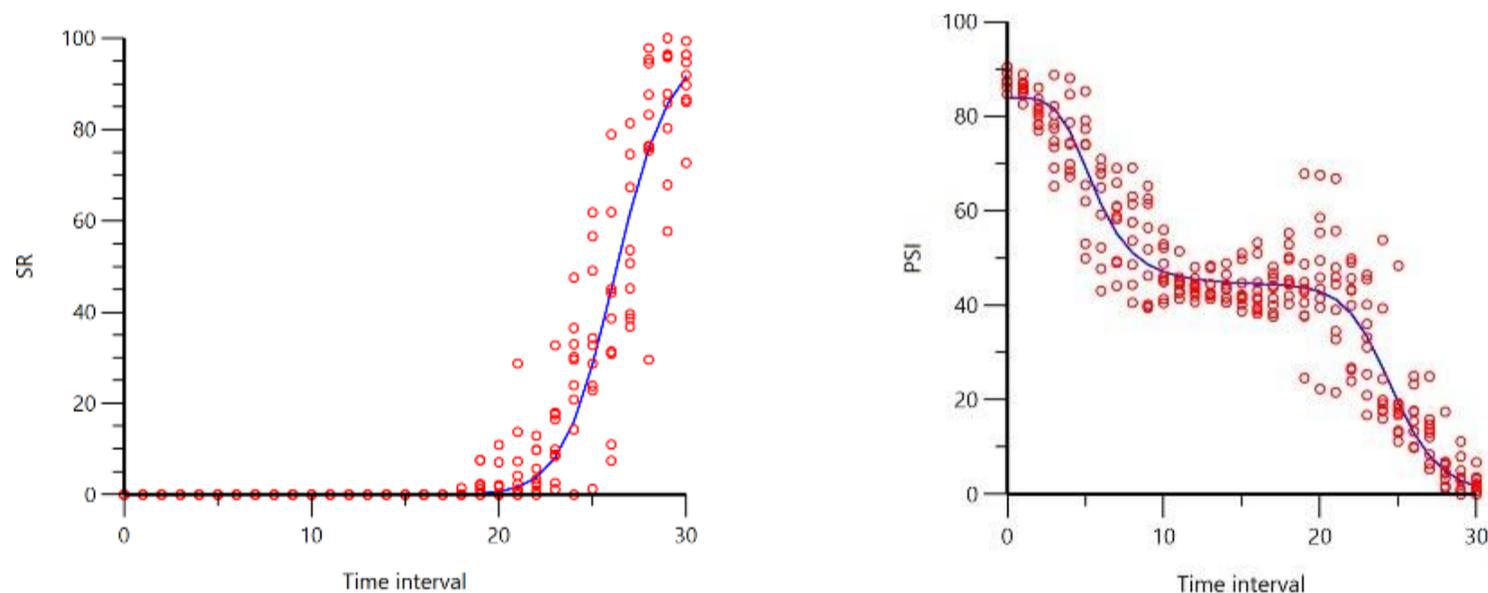
Few depth of anaesthesia (DoA) monitors have been studied in pigs. We investigated the dose-effect relationship between increasing propofol dose and variables generated by the EEG-DoA monitor Sedline.

Nine pigs (11 ± 0.5 weeks old; 30 ± 4.6 kg) were included. An ethical approval was obtained. Propofol infusion was administered at $10 \text{ mg kg}^{-1} \text{ hour}^{-1}$, increased by $10 \text{ mg kg}^{-1} \text{ hour}^{-1}$ every 15 minutes, and stopped when an EEG suppression ratio (SR) $>80\%$ was reached. Endotracheal intubation was performed as deemed appropriate by the anaesthetist. At the end of the investigation, the animals were euthanised. The best pharmacodynamic model was assessed for patient state index (PSI), SR and spectral edge frequency (SEF) 95% in response to propofol administration, by visual analysis of goodness-of-fit plots, -2LL significance ($p < 0.05$), Akaike and Bayesian information criterion. Anaesthesia duration was normalized among pigs (30 time intervals) to compare data at equipotent propofol doses.

The decrease of PSI best fitted an inhibitory double-sigmoid model (including a plateau at $\text{PSI} = 44$); the increase of SR fitted a typical sigmoid E_{max} model (Figure 1). No relevant relationship could be identified between SEF 95% and propofol administration.

The relationship between propofol dose and PSI/SR described can be used for prediction in future investigations.

Figure 1 Observed data (circles) and prediction from the final population model (line) for PSI and SR values during increasing propofol infusion rate. The time axis shows the normalized time intervals.



Application of an AI technology based on image vision for objective assessment of activity in pigs receiving fentanyl or buprenorphine – a pilot study

Ryden A, Olsén L, Marntell S, Jensen-Waern M, Nyman G

Department of Clinical Sciences, Swedish University of Agricultural Sciences, Uppsala, Sweden

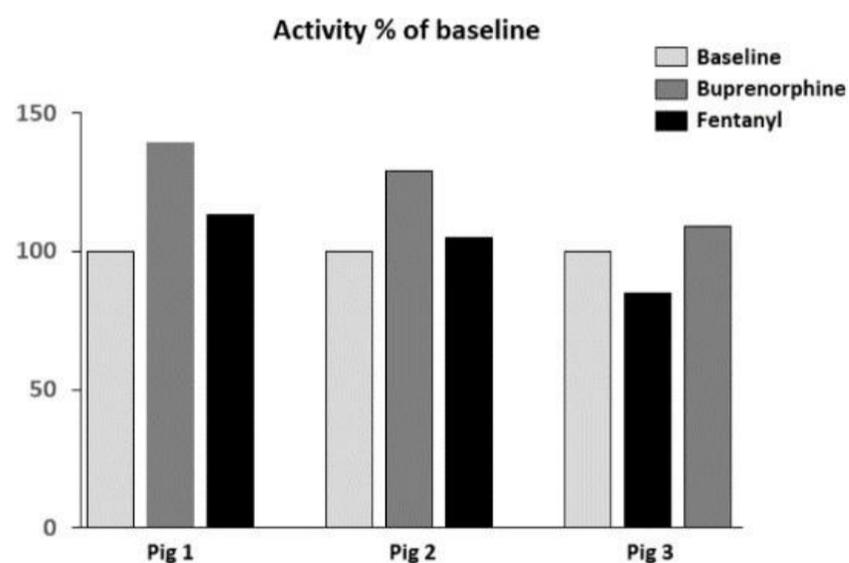
Pigs should have adequate pain relief when surgical procedures are performed. Pain evaluation has so far been based on direct observations of pain-related behaviours, and evaluation of recordings of activity and behaviours (Malavasi et al. 2005; Luna et al. 2020).

An artificial intelligence (AI) technique based on image vision was adapted for the monitoring of pigs' activity. The average activity three days prior to anaesthesia without surgery or noxious stimulus was compared to average activity three days post-anaesthesia. The pigs were randomly allocated to treatment with fentanyl patch ($100 \mu\text{g hour}^{-1}$) or buprenorphine injectable solution (0.03 mg kg^{-1}). Baseline measurements were collected during three days before anaesthesia and the start of treatment. The pigs were treated three days with either transdermal fentanyl or buprenorphine injections. Plasma concentrations of the drugs were analysed.

Based on the AI data, activity levels could be analysed. After treatment with transdermal fentanyl, the activity of the animals increased compared to baseline by 13% and 5% in two pigs and decreased with 15% in one pig. When pigs received buprenorphine, their activity levels based on the data increased by 39%, 29% and 9% respectively. Treatment with both opioids, resulted in plasma concentrations above the suggested therapeutic levels.

The study showed that the use of AI technology for measurement of activity was promising. In the future, the technique might be used as a tool to evaluate activity among pigs expressing pain or discomfort.

Average activity of three pigs post-anaesthesia measured with AI technique as percent of baseline.



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Description and feasibility of a modified periconal block: a cadaveric study in dogs

Faugier C, Benito J, Garbin M

Clinical Service of Anesthesia, Department of Clinical Sciences, Faculty of Veterinary Medicine, University of Montreal, Saint-Hyacinthe, QC, Canada

This prospective, randomized, blinded, exploratory study described the injectate spread following a modified periconal block technique using an over-the-needle intravenous catheter.

A dye-lidocaine solution was injected into 10 thawed canine heads (20 eyes) using a catheter inserted subconjunctival at the medial third of the dorsal eyelid and slid to the apex of the extraocular muscle cone (EOMC). The eyes of each dog were injected randomly with low volume (LV; 0.1 mL cm⁻¹ cranial length) or high volume (HV; 0.2 mL cm⁻¹ cranial length) (Klaumann et al. 2018). Sixteen eyes were dissected and the injectate spread was scored as 0%, 25%, 50%, 75%, 100% based on its approximate contact area around the EOMC apex and the globe. In two dogs, gadodiamide was added to the injectate and magnetic resonance imaging (MRI) was performed post-injection. Comparisons between HV and LV were performed using Wilcoxon signed-rank test ($p < 0.05$).

Mean cranial length was 14 ± 0.93 cm, LV and HV were 1.43 ± 0.09 and 2.85 ± 0.18 mL, respectively. MRI and dissections showed an injectate pattern around the EOMC. HV and LV resulted in a median (IQ25-IQ75) spread of 100% (100-100%) and 100% (75-100%) ($p = 0.125$) at the EOMC apex, and 75% (50-100%) and 50% (6-50%) ($p = 0.046$) around the globe, respectively.

This periconal technique is feasible in dogs. The two volumes resulted in a similar spread around the EOMC and the globe, but HV produced a wider spread than LV, therefore its efficacy should be evaluated clinically.

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Anti-nociceptive and behavioural effects of butorphanol alone or in combination with detomidine in experimental calves. A prospective, randomized, blinded cross-over study

Gámez Maidanskaia E¹, Mirra A¹, Marchionatti E², Levionnois O¹, Spadavecchia C¹

¹ Department of Veterinary Anaesthesiology and Pain Therapy, Vetsuisse Faculty, University of Bern, Switzerland

² Clinic for Ruminants, Department of Clinical Veterinary Medicine, Vetsuisse Faculty, University of Bern, Switzerland

Aim of this study was to evaluate the antinociceptive efficacy of butorphanol alone or combined with detomidine in calves, using the electrically evoked trigemino-cervical reflex (TCR) model (Casoni et al. 2019).

Eight calves, aged 61.5 (41.3-73.5) days, were included. Baseline values for TCR threshold (TCRt), sedation (0 = no sedation to 3 = maximum sedation) and excitation (0 = no excitation; 3 = maximum excitation) were recorded. Then, butorphanol alone (SB; 0.1 mg kg⁻¹) or combined with detomidine (DB; 0.02 mg kg⁻¹) was administered IV. Finally, median values and interquartile ranges of TCRt, sedation and excitation scores, over at least 120 minutes post-injection, were calculated. Differences within groups were evaluated with Wilcoxon signed rank test, differences between groups with Mann Whitney U test.

Values for TCRt, sedation and excitation scores are reported in Table 1.

In clinical settings, the combination of butorphanol and detomidine can be recommended as premedication. Butorphanol administered alone should be used cautiously as it might evoke excitatory behaviours.

Table 1 Values for TCR threshold, sedation, and excitation scores for butorphanol (SB) and butorphanol-detomidine (DB) groups.

	Baseline		Post-injection	
	SB	DB	SB	DB
TCRt	11.1 (9.8, 13.6)	10.4 (8.2, 13.8)	15.5 (12.8, 21.6)*,‡	29 (19.3, 37)*,‡
Sedation score	0 (0, 0)	0 (0, 0)	0 (0, 0)‡	1 (1, 2)*,‡
Excitation score	0 (0, 1)	0 (0, 1)	1 (0, 2)*,‡	0 (0, 0)‡

*significant difference compared to baseline

‡significant difference between groups

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Casoni D, Mirra, A, Suter MR, Gutzwiller A, Spadavecchia C (2019) Can disbudding of calves (one versus four weeks of age) induce chronic pain? *Physiol Behav* 199, 47–55. <https://doi.org/10.1016/j.physbeh.2018.11.010>.

Applicability and repeatability of cutaneous cold stimulation to assess aversive threshold values in healthy dogs using four different cooling protocols

Wittenberg-Voges L¹, Kästner S², Schütter A²

¹ Equine Clinic, University of Veterinary Medicine Hanover, Germany

² Small Animal Clinic, University of Veterinary Medicine Hanover, Germany

Cold stimulation is used to assess chronic and neuropathic pain in humans. Aim of the study was to evaluate the applicability and repeatability of cold stimulation in dogs.

Ten Beagles were used in this experimental, randomized, blinded study. Measurements were performed in triplicate at neck, lumbosacral-area, elbow, and knee. The probe was placed on the skin and temperature decreased according to cooling-protocols: three cooling-rates (0.5; 1 and 5 °C second⁻¹, 32 to 10 °C) and latency measurement (11 °C, 60 seconds maximally). The stimulation was discontinued when avoidance reactions were detected. Thermal threshold or time-to- reaction were recorded. The experiment was performed three times per animal in week one, two and five. Feasibility of cold stimulation was scored (0 - 5). Data were analysed with mixed logistic regression.

There were no significant differences in the number of avoidance reactions between cooling-rates. Significantly more reactions ($p < 0.001$) were observed in week one compared to week two and five. Thermal thresholds were 13 +/- 2.6 °C, 17.7 +/- 4°C and 16.3 +/- 4.6 °C for 5, 0.5 and 1 °C second⁻¹, respectively. Latency to reactions could be determined in 37% of measurements. The mean time-to-reaction was 13 +/- 11 seconds. In 85% of measurements a feasibility score of 0 (best feasibility) was assigned.

The applicability of the method was satisfying, although habituation to the stimulus could not be excluded. It was not possible to recommend one protocol over the others. Future studies should include dogs with neuropathic changes to assess altered sensitivity.

Pharmacokinetics of buprenorphine and norbuprenorphine in isoflurane-anesthetized cats

Pypendop BH, Stoddard S, Barter LS

Department of Surgical and Radiological Sciences, School of Veterinary Medicine, University of California, Davis, USA

Buprenorphine is commonly used perioperatively in cats. The pharmacokinetics have not been reported in cats during inhalant anesthesia.

Six healthy adult cats were used. Anesthesia was induced and maintained with isoflurane in oxygen. Catheters were placed in a jugular vein for blood sampling and in a medial saphenous vein for drug administration. Isoflurane concentration was set at 0.7 MAC and subsequently adjusted to prevent spontaneous movement. Buprenorphine, 40 $\mu\text{g kg}^{-1}$ was administered IV over 5 minutes. Blood was sampled before administration and at various times for 8 hours. Cats were allowed to recover from anesthesia and an additional blood sample was obtained approximately 12 hours after buprenorphine administration. Plasma buprenorphine and norbuprenorphine concentrations were measured using liquid chromatography/mass spectrometry. Compartment models were fitted to the data using nonlinear mixed effect modeling.

A 5-compartment model (3 compartments for buprenorphine, 2 compartments for norbuprenorphine) fitted the data best. Typical value (% interindividual variability) for the 3 buprenorphine volumes of distribution, and the metabolic clearance to norbuprenorphine, the remaining metabolic clearance and the 2 distribution clearances were 153 (38), 772 (29) and 1325 (60) mL kg^{-1} , and 1.5 (110), 19.6 (12), 58.2 (29) and 5.6 (23) $\text{mL minute}^{-1} \text{kg}^{-1}$, respectively. Typical value (% interindividual variability) for the 2 norbuprenorphine volumes of distribution, and the norbuprenorphine metabolic and distribution clearances were 387 (58) and 2626 (71) mL kg^{-1} and 11.0 (142) and 72.8 (120) $\text{mL minute}^{-1} \text{kg}^{-1}$, respectively.

The pharmacokinetics of buprenorphine were characterized by a medium clearance and a moderate volume of distribution.

The study was funded by the Center for Companion Animal Health, School of Veterinary Medicine, University of California, Davis

The study was approved by the Institutional Animal Care and Use Committee (protocol 22440)

Effects of low-level laser therapy on impaired mobility in dogs with naturally occurring osteoarthritis

Barale L¹, Monticelli P², Adami C³

¹ Private Practitioner, Turin, Italy

² Dick White Referrals, London Road, UK

³ Department of Veterinary Medicine, University of Cambridge, UK

Osteoarthritis (OA) is a common condition in dogs resulting in impaired mobility and chronic pain. The main objective of this study was to determine whether low-level laser therapy (LLLT) would increase physical activity in dogs with OA.

Twenty-two dogs with osteoarthritis underwent six consecutive weekly laser treatments. Forty-eight hours before the first LLLT session (baseline), each dog was instrumented with an accelerometer validated for use in dogs with OA (Brown et al. 2010), to record their daily steps and activities during the whole six-week study period. The accelerometer epoch length was set at 1 minute (Dow et al. 2009). Dog owners were instructed to maintain a standard level of activity of their dogs, in terms of both length of daily walks and daily time off the lead/in open spaces.

The number of daily activities increased during week 2 (161674 ± 103666) and remained higher than baseline (93481 ± 107878) until week 6 (179309 ± 126044 ; $p < 0.001$). Daily step count increased from week 1 (4472 ± 3427) compared to baseline (1109 ± 1061) and remained higher than the baseline until the end of week 6 (8416 ± 3166 ; $p < 0.001$). Average energy expenditure during the study period was $179 [2 - 536]$ kcal day⁻¹; there were no statistically significant differences in this variable between weeks of treatment.

Low-level laser therapy increased mobility in dogs with natural occurring OA and could be an adjunctive treatment in canine OA to improve subjects' quality of life.

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Anaesthesia with midazolam, butorphanol and ketamine combined with isoflurane in harbour seals (*Phoca vitulina*)

Wenger S¹, Hoby S²

¹ Kleintierpraxis Laupeneck, Bern, Switzerland

² Berne Animal Park, Bern, Switzerland

Anaesthesia in pinnipeds can be challenging due to numerous anatomical und physiological adaptations such as the dive response.

Within one year, three female and one male captive harbour seals were anaesthetized for transport related, dental and ocular procedures. The animals were aged between 3 - 30 years and weighed between 50 - 76 kg. One seal was anaesthetized twice and in total five anaesthesias were performed.

In total, 0.39 mg kg⁻¹ midazolam (0.28 - 0.49), 0.27 butorphanol mg kg⁻¹ (0.22 - 0.34) and 2.07 ketamine mg kg⁻¹ (1.6 - 2.6) were administered via blow dart for the first procedure and then via dartgun for the following seals. Once a deep sedation was achieved, the animals were masked down with isoflurane in oxygen to allow intubation. Anaesthesia was maintained with 1 - 2% isoflurane for 30 - 95 minutes. All seals were given intermittent positive pressure ventilation as necessary to aim for $\text{PE}^{\prime}\text{CO}_2$ below 80 mmHg and SpO_2 above 91 %. Body temperature, HR, f_R , $\text{PE}^{\prime}\text{CO}_2$ and SpO_2 were monitored throughout anaesthesia. At the end of the procedure, midazolam was antagonized with 0.014 mg kg⁻¹ sarmazenil IM in two seals.

Onset of deep sedation varied from 13 - 45 minutes. Body temperature varied from 33.9 - 36.1°C, HR 43 - 123 beats minute⁻¹ and f_R 2 - 13. All animals recovered uneventfully within 20 minutes from antagonization or turning isoflurane off.

Effect of fentanyl on cough reflex and quality of endotracheal intubation in cats

Martin Bellido V, Martinez Ferre B, McDonald H, Vettorato E

Dick White Referrals, Station Farm, Six Mile Bottom, Cambridgeshire, UK

Fentanyl reduced the incidence of cough reflex during endotracheal intubation (ETI) in dogs but its effect is unknown in cats. This randomized blinded negative controlled clinical trial assessed the effects of IV fentanyl on cough reflex and quality of ETI in cats.

After dexmedetomidine ($2 \mu\text{g kg}^{-1}$ IV) administration, 30 cats received either fentanyl ($3 \mu\text{g kg}^{-1}$, group F) or saline (group C). Anaesthesia was induced with alfaxalone (1.5 mg kg^{-1} IV). After spraying 2% lidocaine on the larynx, ETI was attempted: if unsuccessful within 30 seconds, alfaxalone (1 mg kg^{-1} IV) was administered and ETI re-attempted. This process was repeated until successful ETI. The variables reported in Table 1 were recorded. Student's t-test or Mann-Whitney U-test and Fisher's Exact test were used: $p < 0.05$ was considered statistically significant.

Results are reported on Table 1.

In cats sedated with dexmedetomidine, fentanyl reduced the alfaxalone dose to allow ETI, the cough reflex, and improved the overall quality of ETI.

Variables	Group C ($n = 14$)	Group F ($n = 16$)	P value	Relative Risk (95% CI)
Alfaxalone (mg kg^{-1})	2.5 (1.5 – 4.5)	1.5 (1.5 – 2.5)	0.001	
ETI attempts (n)	3 (1 – 12)	1 (1 – 4)	0.041	
Cough reflex	11 Yes – 3 No	6 Yes – 10 No	0.033	2.1 (1.10 – 4.41)
Quality of ETI (0 = easy; 6 = difficult)	3 (1 – 4)	1 (0 – 3)	0.001	
Post-induction apnoea (n)	5 Yes – 9 No	3 Yes – 13 No	0.417	

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Occurrence, drivers, and definition of postanesthetic pulmonary complications in dogs, cats and horses in the current veterinary literature. A scoping review.

Braun C¹, Vill J¹, Soares JH²

¹ Anaesthesiology and Perioperative Intensive-Care Medicine, Vetmeduni Vienna, Austria

² Department of Surgical and Radiological Sciences, School of Veterinary Medicine, University of California, Davis, USA

Postanesthetic pulmonary complications (PPCs) are considered a substantial risk in veterinary medicine with 30-40% of anesthesia related mortalities in dogs and 40-50% in dogs considered due to PPCs (Brodgelt et al. 2015). This scoping review aims to summarize occurrence, drivers and definitions of PPCs in veterinary peer reviewed literature in dogs, cats and horses.

Five data banks (vetmedseeker, PubMed, Scopus, Science Direct, Web of Science) were searched using key words postoperative/postanesthetic pulmonary/respiratory complications/arrest, dog, cat, horse, veterinary medicine, lung oedema, pneumonia. After title and abstract screening full articles were assessed for type of article, species, PPCs mentioned including definition of PPCs, surgery type and anesthetics.

Out of 39 articles included, ten were retrospective, 13 prospective studies, nine reviews and eight case reports. Dogs appeared in 26 articles, horses in 12 and cats in eight. Most frequently mentioned PPCs in dogs / cats / horses, respectively, were pneumonia (12/3/2), pulmonary oedema (4/2/9) and hypoxemia (11/4/1). Airway surgeries (4/1/0), laparotomies (3/0/1) and neurosurgery (4/1/1) were named, among others, in association with PPCs. Main mentioned drugs were opioids (3/0/2) and alpha-2-adrenergic-agonists (0/1/3), but also ketamine, lidocaine, propofol, acepromazine and cisapride (1 each in dogs). In only three articles PPCs were explicitly defined including hypoxemia, hypoventilation, dyspnea, acute respiratory distress, respiratory failure, pulmonary atelectasis and acute infectious or inflammatory pulmonary disease.

The current veterinary literature does not reflect the considered importance of PPCs. Further, particularly prospective studies are needed to correctly classify, help identify and treat PPCs in veterinary medicine.

Accuracy of three types of disposable PEEP valves

Ambrisko TD¹, Korodi M², Braun C³

¹ Department of Veterinary Clinical Medicine, College of Veterinary Medicine, University of Illinois at Urbana- Champaign, USA

² Rakosliget Veterinary Clinic, Budapest, Hungary

³ Anaesthesiology and Perioperative Intensive-Care Medicine, Department for Companion Animals and Horses, University of Veterinary Medicine, Vienna, Austria

Disposable PEEP valves with pressure adjustment possibility are often used in combination with manual resuscitator bags. Despite their potential usefulness when incorporated in anaesthesia breathing systems as pressure relief or PEEP devices, their accuracy has not been examined.

Three types of PEEP valves were tested (red: Ambu; green: SunMed; blue: CareFusion). Twelve units were tested from each type. The devices were attached to a non-rebreathing system (NRS; Dispomed) at the neck of the reservoir bag. Pressures within the NRS were measured using blood pressure transducers. Two L minute⁻¹ fresh gas flow was used. The adjustable pressure limit valve and the patient port were closed. One PEEP valve was tested at a time using different PEEP settings (5, 10, 15 and 20 cmH₂O). The order of device types and PEEP settings were randomized. The differences between the measured pressures and the settings of the PEEP valves were plotted against the PEEP settings and Bland-Altman analysis was performed.

Biases [limits of agreements (LOA)] were 0.4 [-1.1 1.9], -1.0 [-3.9 2.0] and 1.1 [-0.1 2.4] cmH₂O and the 95% confidence intervals for the LOAs were 0.38, 0.74 and 0.32 cmH₂O for the red, green, and blue devices, respectively. The red and the blue devices were accurate according to the a-priory definition (error <3 cmH₂O).

Some of the adjustable PEEP devices may be suitable for use with anaesthetic breathing systems.

Respiratory mechanics and dead space effects of individualized levels of positive-end expiratory pressure in anesthetized cat

Soares JHN¹, Machado ML², Aguiar AJ^{1,3}, Pypendop BH¹, Braun C⁴, Hulsebosch S⁵, Johnson LR⁵, Motta-Ribeiro GC⁶, Jandre FC^{6,7}

¹ Department of Surgical and Radiological Sciences, School of Veterinary Medicine, University of California Davis, USA

² William Pritchard Veterinary Medical Teaching Hospital, University of California Davis, USA

³ Department of Anaesthesia and Surgery, Faculty of Veterinary Medicine, UNESP, Botucatu, Brazil

⁴ Anaesthesiology and Perioperative Intensive Care, University of Veterinary Medicine Vienna, Austria

⁵ Department of Medicine and Epidemiology, School of Veterinary Medicine, University of California Davis, USA

⁶ Laboratory of Pulmonary and Cardiovascular Engineering, Biomedical Engineering Program/COPPE, Federal University of Rio de Janeiro, Brazil

⁷ Biomedical Instrumentation Laboratory, Biomedical Engineering Program/COPPE, Federal University of Rio de Janeiro, Brazil

Positive end-expiratory pressure (PEEP) selected by maximal respiratory system compliance (PEEPmaxCrs) can improve respiratory function. This study evaluated respiratory mechanics and dead spaces in six male adult healthy cats ventilated for 180 minutes with no PEEP (ZEEP), PEEPmaxCrs, PEEPmaxCrs minus 2 cmH₂O (PEEPmaxCrs-2) and PEEPmaxCrs plus 2 cmH₂O (PEEPmaxCrs+2).

Each treatment was tested in each cat in separate experiments. Anesthesia was induced and maintained at 1.3 times MAC of isoflurane. Respiratory mechanics and dead spaces were recorded at 5, 30, 60, 120 and 180 minutes of ventilation. Data were compared between and within treatments by mixed-model ANOVA followed by Tukey's and Dunnett's tests and Friedman's followed by Dunn's test for parametric and nonparametric data, respectively.

Weight-normalized respiratory system (Crs) and lung (CL) compliances were higher in PEEPmaxCrs than ZEEP until 60 min of ventilation. The highest values of Crs were 2.1 ± 0.2 and 1.7 ± 0.1 mL cmH₂O⁻¹ kg⁻¹ and of CL were 4.7 ± 0.5 and 3.2 ± 0.4 mL cmH₂O⁻¹ kg⁻¹ for PEEPmaxCrs and ZEEP at 5 minutes of ventilation, respectively. In all treatments, Crs and CL significantly decreased after 120 min. Increasing PEEP progressively increased physiologic (VDPhys) and anatomic (VDAnat) dead spaces at all time points, with no significant difference in alveolar dead space (VDAlv).

Ventilation of healthy cats with PEEPmaxCrs improved CRS and CL with mild increase in VDPhys and VDAnat but no significant increase in VDAlv. None of the PEEP levels prevented the deterioration of CRS and CL after two hours of ventilation.

The effect of venous admixture on correction of Enghoff's towards Bohr's dead space fractions in anesthetized dogs: preliminary results

Couto Bueno ML¹, Soares JHN¹, Hopper K¹, Motta-Ribeiro GC², Jandre FC^{2,3}

¹ Department of Surgical and Radiological Sciences, School of Veterinary Medicine, University of California Davis, USA

² Laboratory of Pulmonary and Cardiovascular Engineering, Biomedical Engineering Program/COPPE, Federal University of Rio de Janeiro, Brazil

³ Biomedical Instrumentation Laboratory, Biomedical Engineering Program/COPPE, Federal University of Rio de Janeiro, Brazil

Enghoff's dead space fraction ($V_{DEnghoff}/V_T$) is easier to assess than Bohr's (V_{DBohr}/V_T). However, the first is significantly affected by venous admixture. Using data from anesthetized dogs ventilated with $F_{iO_2} > 0.94$, we evaluated if a linear regression including P_{aO_2}/F_{iO_2} , as a measure of venous admixture may be used to estimate V_{DBohr}/V_T from $V_{DEnghoff}/V_T$.

Forty-five adult dogs of different breeds (4.5 to 71.6 kg) anesthetized for various procedures that required mechanical ventilation and arterial catheterization were included in this study. During stable ventilation and cardiovascular function, volumetric capnography and P_{aCO_2} were collected to calculate V_{DBohr}/V_T and $V_{DEnghoff}/V_T$. Data was analyzed with stepwise least-squares linear regression of V_{DBohr}/V_T using $V_{DEnghoff}/V_T$ with or without P_{aO_2}/F_{iO_2} .

Fifteen dogs were excluded due to capnogram artifacts. Median P_{aO_2}/F_{iO_2} was 538 (122 to 628 mmHg), V_{DBohr}/V_T was 0.51 ± 0.10 , and $V_{DEnghoff}/V_T$ was 0.59 ± 0.10 . The coefficient of determination was 0.71 for the model $V_{DBohr}/V_T = a \times V_{DEnghoff}/V_T + b$, and 0.83 for the model $V_{DBohr}/V_T = a \times V_{DEnghoff}/V_T + b \times P_{aO_2}/F_{iO_2} + c$ (a, b, and c are constants of the models). The difference in Akaike Information Criteria was 12.7 favoring the model including P_{aO_2}/F_{iO_2} .

The addition of P_{aO_2}/F_{iO_2} significantly improved the regression model of V_{DBohr}/V_T from $V_{DEnghoff}/V_T$ and suggests that such parameter may be a good proxy for venous admixture when correcting $V_{DEnghoff}/V_T$ calculated at different levels of shunt. The continuation of data collection for this study will further clarify this relationship and its possible clinical implications in anesthetized dogs.

Reliability of respiratory compliance assessed by two spirometry monitors used in dogs and cats: the effect of resistance

Ben-Aderet D¹, Soares JHN², Couto Bueno ML²

¹ William Pritchard Veterinary Medical Teaching Hospital, School of Veterinary Medicine, University of California Davis, USA

² Department of Surgical and Radiological Sciences, School of Veterinary Medicine, University of California Davis, USA

Accuracy of respiratory compliance (Crs) may be affected by respiratory resistance (Rrs). This study investigated the reliability of Crs assessed by ECAIOV modules (Datex-Ohmeda, CECAIOV) and NM3 monitors (Philips Healthcare, CNM3) using a test lung simulating cats and dogs with normal and increased Rrs. Resistance was increased by adding resistors between breathing system and test lung. For each Rrs level, the lung was ventilated with VT of 50 and 300 mL, Crs ranging from 1 to 10, and 5 to 80 mL cmH₂O⁻¹ for the cat and dog settings, respectively. Static compliance (Cstat) was calculated at the end of each trial. Bland-Altman plots and concordance correlation coefficient (ρ_c) were used to evaluate agreement between Cstat and Crs, and four-quadrant plots for trend ability analysis.

For the cat settings, ρ_c was 0.8899 and 0.8776 with a bias of -12.6 and -15.6 %, limits of agreement from -48.9 to 23.7% and -38 to 6.7% for CECAIOV and CNM3, respectively. For dog settings, ρ_c was 0.9271 and 0.9385 with a bias of -10.7 and -1.3 %, limits of agreement from -46.8 to 25.5% and -38 to 6.7% for CECAIOV and CNM3, respectively. The trend ability of CECAIOV and CNM3 for both settings was good (concordance rate > 97.8%). At normal Rrs, CECAIOV and CNM3 presented acceptable agreement for both settings, but unacceptable agreement as Rrs increased. Trend ability was maintained independently of Rrs.

When variations in Rrs occur, Crs assessed by these two monitors is not reliable. However, their trend ability remained good.

Incidence of post-anaesthetic complications and their risk factors in 199 dogs undergoing surgery for brachycephalic obstructive airway syndrome (boas)

Filipas M, Self I, Owen L, Adami C

Department of Veterinary Medicine, University of Cambridge, UK

The aims of this study were to determine the incidence of post-anaesthetic aspiration pneumonia and requirement for temporary tracheostomy in dogs undergoing BOAS surgery, and their risk factors. It was hypothesised that lower functional BOAS grade, lower body condition score (BCS) and postoperative sedation would be associated with a lower risk of complications.

Data retrieved from 199 records (2019 to 2021) were analysed. Binary logistic univariate regression, followed by multiple logistic regression, was used to identify associations between independent covariates and two dependent variables (postoperative aspiration pneumonia and tracheostomy). The quality of model-fit was assessed using the Likelihood Ratio test. $P < 0.05$ was considered statistically significant.

Survival to discharge was 98.5%; one dog died from cardiac arrest and two were euthanised owing to clinical deterioration and diagnosis of laryngeal neoplasia, respectively. Binary logistic regression showed an association between postoperative aspiration pneumonia, which developed in 6% of the dogs, and BCS and ASA status; however, when these covariates were evaluated in the multiple logistic regression model, significance was not maintained (Likelihood Ratio Test $p = 0.029$). Risk factors for tracheostomy, which was performed in 5% of the dogs, were pre-operative and post-operative aspiration pneumonia ($p = 0.014$) and high BOAS grade ($p = 0.045$; Likelihood Ratio Test $p < 0.001$). Postoperative sedation was not correlated with the development of post-anaesthetic complications.

In this study population, the incidence of post-anaesthetic complications was lower than previously reported. Higher BOAS grade and aspiration pneumonia may be regarded as risk factors for postoperative tracheostomy.

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Machine learning – based analysis of intraoperative hypotension risk from two epidural dosing strategies in dogs undergoing abdominal surgery

Millán Parreño C¹, Giles DM², Corletto F¹

¹ Dick White Referrals, Cambridgeshire, UK

² UCL Queen Square Institute of Neurology, University College London, UK

Post – epidural hypotension risk was investigated, comparing volume calculation based on occipital – coccygeal distance (OCD) or body weight (BW) with machine learning – based analyses.

Two cohorts of dogs undergoing abdominal surgery, where lumbosacral epidural was performed, were retrospectively selected according to epidural dosing strategy: OCD ($n = 110$, using the nomogram (Otero et al. 2010) or BW ($n = 100$). These two were the main inclusion criteria. One case was excluded due to acepromazine premedication. Data recorded: premedication, sex, age, body weight, type of surgery, oesophageal temperature, mean arterial blood pressure (MABP), anaesthesia maintenance agent, inhalant agent's minimum alveolar concentration (MAC), ASA status, intraoperative fentanyl, and epidural volume. Predictors of post epidural hypotension were identified using multivariable logistic regression and counterfactual modelling.

Hypotension (MABP < 60 mmHg) was reported in 49.1% vs 33.0% of OCD and BW patients, respectively ($p = 0.018$). Logistic regression identified the following associations with increased intraoperative hypotension risk: females, hypothermia, lower MABP pre – epidural, lower MAC, and premedication with methadone alone. Non – linear modelling, capable of detecting more complex associations, additionally identified OCD – derived dosage as the most influential risk factor.

Counterfactual simulation – model application under a causal framework – showed that, if all OCD patients instead received epidural volume according to BW, hypotension would have been prevented in 56% of the observed hypotensive patients (vs 21% of normotensive patients becoming hypotensive).

This study suggests the existence of modifiable risk factors linked to post – epidural hypotension, including inclusion of dexmedetomidine in premedication and epidural dosing strategy.

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The dose-response relationship between the patient state index and plasma propofol concentration in anesthetized dogs

Chang K¹, Sakai DM¹, Knych H², Reed RA³

¹ Department of Small Animal Medicine and Surgery, College of Veterinary Medicine, University of Georgia, USA

² K.L. Maddy Equine Analytical Pharmacology Laboratory, University of California Davis, USA

³ Department of Large Animal Medicine and Surgery, College of Veterinary Medicine, University of Georgia, USA

The patient state index (PSI) is an EEG-based monitor of consciousness that correlates with the propofol-induced anesthetic depth in humans. Dose-response relationships between measured plasma propofol concentrations (CPM) and PSI, HR, and MAP were investigated in dogs.

In a prospective experimental study, six healthy, intact adult male Beagles were sedated with acepromazine and methadone. Anesthesia was induced and maintained with a target-controlled infusion at 8, 6, 4, and 2 $\mu\text{g mL}^{-1}$ and held for ten minutes at each target. The CPM, PSI, HR, and MAP were obtained at baseline, five and ten minutes after reaching the plasma propofol targets, and 5 and 60 minutes following discontinuation of the propofol infusion. The presence of burst suppression in the raw EEG was recorded. The effects of CPM on PSI, HR, and MAP were analyzed with mixed-effect models. The PSI half-maximal inhibitory propofol concentration (IC₅₀) was estimated with nonlinear regression.

Baseline PSI was 90.2 \pm 1.8 and decreased as propofol concentrations increased ($p < 0.001$). The IC₅₀ (95% confidence interval) was 4.5 (3.6 to 5.4 $\mu\text{g mL}^{-1}$). No burst suppression was detected at any of the targeted propofol concentrations. Baseline HR was 66.7 \pm 10.4 beats minute⁻¹ and increased with higher CPM ($p = 0.048$). Baseline MAP was 94.5 \pm 12.0 mmHg and decreased with higher CPM ($p < 0.001$).

Increased propofol concentrations were associated with deeper anesthetic depth, lower MAP, and higher HR. There was no evidence of excessive anesthetic depth at the highest propofol CPM in the present study population.

Prospective survey of checkout procedures of veterinary anesthesia equipment in Alberta, Canada

Marchiori JJM¹, Prebble MJ², Pang DSJ³

¹ Department of Clinical Studies, University of Guelph, Canada

² Dispomed Ltd., Joliette, Canada

³ Veterinary Clinical and Diagnostic Sciences, Faculty of Veterinary Medicine, University of Calgary, Canada

In veterinary medicine, it is recommended that an anesthetic equipment checkout procedure be performed before anesthesia (Mosley. 2015). If equipment is not checked, risk of patient morbidity and mortality increases (Arbous et al. 2005). The goals of this prospective survey were to evaluate veterinary anesthetic machines in Alberta (Canada) for problems identifiable with use of a standardized anesthetic machine checkout procedure, and to document use of checkout procedures by clinics.

One-hundred anesthetic machines at 30 private veterinary clinics were evaluated consecutively by the same technician (as part of a service contract) using a standardized checkout procedure. There was a median of 3 machines (range, 1 –12) per clinic. Each item of the checkout procedure was assessed and scored as a “pass”, “fail” or “not applicable”. Clinic identifiers were anonymized before analysis. The number of items assessed varied according to machine configuration.

A secondary oxygen supply was available on 10% (10/100) of machines, no machines had an oxygen supply pressure alarm, 31% (27/87) had a leak identified in the rebreathing system, 17% (16/94) had a leak in the non-rebreathing system and 39% (39/100) of machines did not have a high pressure circuit alarm. During scavenging tests, 52% of non-rebreathing systems (39/75) and 32.1% (26/81) of rebreathing systems had pressure build up (> 10 cmH₂O). Two clinics (6.7%) maintained a record of machine checkout procedures.

These results highlight the frequency of easily identifiable anesthetic machine deficiencies and the value in performing a checkout procedure.

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Incidence of peri-anaesthetic complications in bovine animals: a retrospective study to identify risk factors

Micieli F^{1,2}, Mirra A², Marchionatti E³, Spadavecchia C²

¹ Department of Veterinary Medicine and Animal Productions, University of Napoli Federico II, Italy.

² Department of Clinical Veterinary Medicine, Anaesthesiology and Pain Therapy Section, Vetsuisse Faculty, University of Bern, Switzerland.

³ Department of Clinical Veterinary Medicine, Clinic for Ruminants, Vetsuisse Faculty, University of Bern, Switzerland

Evaluation of peri-anaesthetic complications is essential to improve quality and safety of anaesthesia (Itami et al. 2017). The aim of this study was to analyse peri-anaesthetic complications occurring in bovine animals undergoing general anaesthesia at a referral hospital.

Three hundred and eighteen bovine anaesthesia records collected between January 2016 and June 2021 were screened. Mortality rate, incidence of complications, risk factors and responsiveness to pharmacological treatment were analysed. The effect of the risk factors on complications, odds ratios and 95% confidence intervals were calculated with logistic regression and stepwise selection. Statistical significance was set at $p < 0.05$.

Anaesthesia related mortality rate due to complications occurring within 72 hours was 0.4%. Reported complications (and their incidence) were: hypotension (52.3%); hypertension (38.5%); PaO₂/FiO₂ ratio < 300 (17.2%); regurgitation (11%); difficult intubation (10%); hypothermia (5.7%); laryngospasm (5.6%); radial paralysis (0.9%) and hyperthermia (0.6%). The use of thiopental at induction was significantly associated with higher risk of difficult intubation. Hypotension was significantly associated with dorsal recumbency, while hypertension with increase in body weight, surgery time and intraoperative ketamine infusion. A PaO₂/FiO₂ < 300 was significantly associated with increase in age. For hypotension and hypertension, responsiveness to pharmacological treatment was 70% and 13%, respectively.

The high incidence of complications found in the current study indicates that there is room for improvement in bovine anaesthesia safety. Anaesthesia-related mortality rate was rather low, but prospective, multicentric studies are necessary to confirm these findings on a larger scale.

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Investigation of an ultrasound-guided erector spinae plane block in cows: a cadaveric study

d'Anselme O¹, Hartnack A², Suarez Sanchez Andrade J³, Alfaro Rojas C⁴, Ringer SK¹, de Carvalho Papa P⁴

¹ Department of Clinical Diagnostics and Services, Section of Anaesthesiology, Vetsuisse Faculty, University of Zurich, Switzerland

² Department of Farm animal, Vetsuisse Faculty, University of Zurich, Switzerland

³ Department of Clinical Diagnostics and Services, Large Animal Diagnostic Imaging, Vetsuisse Faculty, University of Zurich, Switzerland

⁴ Institute of Veterinary Anatomy, Vetsuisse Faculty, University of Zurich, Switzerland

The goal of the present study was to develop and investigate an ultrasound-guided erector spinae plane block (ESPB) in comparison to a blind proximal paravertebral nerve block (PPNB) in cow cadavers.

In 10 cadaver specimens, injections of methylene blue-lidocaine (1:1) were made at the level of T13, L1, and L2 vertebrae, on one side using an ESPB, and on the other side a PPNB. Five cadavers were injected with a high (40 mL per injection for PPNB, 20 mL for ESPB) and 5 with a low (20 and 15 mL, respectively) volume injectate. For the ESPB, the ultrasound probe was oriented craniocaudally and the ventral-cranial aspect of the articular processes (T13, L1, L2) was targeted for injection. Dye spread was evaluated by dissection.

The landmarks for ultrasound-guided injection were easily visualized, but injections were accidentally performed at T12, T13 and L1. Nevertheless, L2 was stained in 60% of ESPBs (table). Epidural spreading was observed with both techniques and volumes. Viscera puncture was reported in two PPNBs.

The ESPB resulted in similar nerve staining compared to the PPNB, using less volume of injectate. Even better staining is expected with a T13-L2 instead of a T12-L1 ESPB approach.

Table

	Rami dorsales			Rami ventrales		
	T13	L1	L2	T13	L1	L2
PPNB 40 mL	5/5	5/5	5/5	4/5	5/5	4/5
PPNB 20 mL	5/5	5/5	5/5	3/5	3/5	3/5
ESPB 20 mL	5/5	5/5	3/5	5/5	5/5	3/5
ESPB 15 mL	5/5	5/5	3/5	5/5	5/5	3/5

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Pharmacokinetics of bupivacaine injected within the internal abdominis rectus sheath in horses

Ishikawa Y¹, Sakai DM¹, Im JSY¹, Zhang S², Reed RA³, Quandt JE¹, Baldo CF⁴, Barletta M³

¹ Department of Small Animal Medicine and Surgery, College of Veterinary Medicine, University of Georgia, USA

² Institute of Bioinformatics, University of Georgia, USA

³ Department of Large Animal Medicine, College of Veterinary Medicine, University of Georgia, USA

⁴ Department of Veterinary Clinical Sciences, College of Veterinary Medicine, University of Minnesota, USA

The rectus abdominis sheath (RAS) block anesthetizes the abdominal midline (Fernandes et al. 2021), potentially providing analgesia for equine colic surgery.

In a prospective, experimental, randomized, masked, cross-over design, 1 mL kg⁻¹ of 0.9 % NaCl (placebo) or 0.2 % bupivacaine divided into four points was injected in six healthy horses sedated with xylazine (0.6 to 2.3 mg kg⁻¹). The right cranial RAS was located with a linear 15-6 MHz probe, and one-quarter of the treatment was injected with a 100 mm 18-gauge spinal needle using an in-plane technique. The administration was repeated in the left caudal, right cranial, and right caudal RAS. The mechanical nociceptive threshold (MNT) was the maximal force tolerated from a 1-mm blunt probe protruded remotely. The MNTs were measured in triplicate at the xiphoid-umbilicus midpoint at baseline and from 30 minutes to 8 hours after treatments.

The placebo and bupivacaine baseline MNT were 12.6 ± 1.6 N and 12.4 ± 2.4 N ($p = 0.717$). After treatments, the overall bupivacaine MNT was higher than the placebo ($p = 0.001$). Compared to baseline, placebo MNTs were 18.9 ± 5.8 N at 30 minutes ($p = 0.010$) and from 9.4 to 15.3 N after this time point ($p > 0.521$). The bupivacaine MNT was higher than baseline at all time points (21.1 to 24.9 N, $p < 0.001$).

The antinociception provided by bupivacaine indicates the potential use of RAS block in the analgesic management of surgical celiotomies in horses. Further investigations in anesthetized clinical cases are necessary.

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Identifying endotracheal tube positioning and lumen restriction using computed tomography: preliminary results

Lloyd F, Kropf J, Murison PJ

School of Biodiversity, One Health and Veterinary Medicine, University of Glasgow, Scotland

Endotracheal intubation is an essential practice in the anaesthesia of cats and dogs, but little is known about the problems that occur with endotracheal tubes (ETT). Computed tomography (CT) imaging can detect changes in endotracheal tube positioning and luminal diameter (Pincioli et al. 2013; Mietto et al. 2014).

Visual assessment for mispositioning and narrowing of ETTs using 'Clear Canvas' software was conducted on CT images of the head, neck and/or thorax from 816 anaesthetised cats and dogs from one University hospital (2017-2019 inclusive). The cross-sectional area of the ETT lumen was measured digitally and location and cause of narrowing recorded. The ETT was defined as 'too caudal' when extending beyond the first rib and 'too rostral' when protruding beyond the incisors (which could increase deadspace).

Narrowing was present in 168/816 (20.5%) of cases, with 6/168 (3.6%) intraluminal (attributable to material within ETT lumen) and 162/168 (96.4%) extraluminal. Narrowing occurred within the oral cavity in 137/162 (84.6% of extraluminal narrowing), with causes identified as the use of a radiotherapy mouth gag (63/137, 39%), ETT tie (33/162, 20%), teeth (29/162, 18%) or tongue (1/162, 0.6%) or unidentified cause in 35/162 (22%). Too caudal positioning of the ETT was identified in 131/515 cases where assessment was possible (25%). Too rostral positioning was present in 145/277 assessable cases (52%).

Narrowing of the ETT lumen was relatively common in this population. Care should be taken with the use of mouth gags, position of teeth and using ties to secure ETTs in particular.

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Comparison of hemodynamic effects of propofol or alfaxalone during induction of anaesthesia in dogs: a preliminary study

Lardone E¹, Sarotti D², Rabozzi R³, Franci P¹

¹ Department of Veterinary Science, University of Turin, Italy

² Centro Veterinario Fossanese, Fossano, Italy

³ Anicura Policlinico Veterinario Roma Sud, Rome, Italy

To compare the hemodynamic effects of propofol and alfaxalone for induction of anaesthesia.

Dogs were premedicated with acepromazine (0.015 mg kg⁻¹ IM) and methadone (0.15 mg kg⁻¹ IM) randomly and received propofol 5 mg kg⁻¹ over 30 seconds followed by 25 mg kg⁻¹hour⁻¹ IV (Group-P, *n*=9) or alfaxalone 2 mg kg⁻¹ over 30 seconds followed by 10 mg kg⁻¹ hour⁻¹ IV (Group-A, *n*=9) for anaesthesia induction. Heart rate, invasive arterial pressures, and the velocity time integral (VTI) of the left ventricular outflow tract obtained by transthoracic echocardiography were recorded before induction and every 15 seconds for 3 minutes. Minute distance (VTI*HR) was calculated (Cattai et al. 2018; Blanco 2020). A Friedman test was used to assess the variances within groups and Kruskal-Wallis test between groups. Significance was set at *p* < 0.05.

All dogs were intubated between 60 and 120 seconds. Transient hypotension (MAP < 60 mmHg) was detected in 3/9 (33%) and 1/9 (11%) subjects respectively in group-P and group-A (*p* > 0.05). Group-P showed the following significant variations compared to baseline: HR increased between 45-105 and decreased between 165-180 seconds, MAP decreased between 30-75 and between 135-180 seconds, VTI*HR decreased between 135-180 seconds. Group-A showed the follows significant variations compared to baseline: HR increased between 45-135 and VTI*HR between 30-120 seconds, MAP decreased at 60 and between 135-180 seconds (all *p* < 0.001). Between groups there were no differences.

In healthy dogs premedicated with acepromazine and methadone induction of anaesthesia with alfaxalone and propofol showed similar hemodynamic profile.

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Anaesthetic management for surgical treatment of severe pulmonic stenosis under cardiopulmonary bypass in four French Bulldogs

Rovatti I, Scarso S, Montinaro V, Santilli RA, Perego M, Scarabelli S

Anicura Clinica Veterinaria Malpensa, Samarate, Italy

Pulmonic stenosis (PS) is one of the most common cardiovascular malformations in dogs (Oliveira et al. 2011). Surgical repair of severe PS under cardiopulmonary bypass (CPB) is a newly feasible procedure; anaesthetic management can be challenging.

Four French Bulldogs underwent patch grafting for PS under CPB; sildenafil (1.5 mg kg^{-1}) orally, chlorphenamine (0.5 mg kg^{-1}) IM and maropitant (1 mg kg^{-1}) SC were administered before premedication with methadone (0.3 mg kg^{-1}) and dexmedetomidine (3 mg kg^{-1}) IM. Dexamethasone (1 mg kg^{-1}) and pantoprazole (1 mg kg^{-1}) were administered IV before induction of general anaesthesia achieved with propofol (1 mg kg^{-1}) and midazolam (0.3 mg kg^{-1}) IV. General anaesthesia, during the off-pump period, was maintained with isoflurane in 100% oxygen whereas during CPB a total-intravenous anaesthesia technique with propofol and ketamine and/or fentanyl was used. Mechanical ventilation was initiated and adjusted to maintain $\text{FECO}_2 < 45 \text{ mmHg}$; during CPB, a fR of 4 breaths min^{-1} and VT of 10 ml kg^{-1} were set. Monitoring included HR, invasive blood pressure, temperature, spirometry, end-tidal isoflurane, arterial and venous blood gases.

In all dogs, episodes of hypotension ($\text{MAP} < 60 \text{ mmHg}$) were encountered and treated with noradrenaline and dobutamine IV; in one case only, hypotension was experienced during CPB. All dogs recovered uneventfully.

This case series describes the anaesthetic management for surgical repair of PS under CPB, supporting that open-heart surgeries are feasible procedures in dogs. Further studies are warranted to clarify the impact of the anaesthetic management and the ventilation strategies on post-operative complications and outcome.

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Retrospective evaluation of the intraoperative effects of phenoxybenzamine pre-treatment in dogs with pheochromocytoma

Willette C¹, Bini G¹, Traverson M², Liptak J³, Hollenbeck D⁴, Wustefeld-Janssens B⁴, Maxwell E⁵, de Mello Souza CH⁵, Selmic L¹

¹ College of Veterinary Medicine, The Ohio State University, USA

² College of Veterinary Medicine, North Carolina State University, USA

³ Capital City Small Animal Mobile Surgery, USA

⁴ College of Veterinary Medicine, Texas A & M University, USA

⁵ College of Veterinary Medicine, University of Florida, USA

Phenoxybenzamine is a systemic alpha-antagonist used to treat hypertension, often as pre-treatment in dogs undergoing adrenalectomy for suspected pheochromocytoma. Data regarding perioperative mortality and intraoperative effects in dogs are limited (Herrera et al. 2008).

This is a retrospective, multicenter case-control study comparing 65 records: 34 dogs with phenoxybenzamine pre-treatment (median 0.46 mg kg⁻¹, range 0.08-2 mg kg⁻¹) (group PT) and 31 dogs without (group N). Our objective was to evaluate phenoxybenzamine pre-treatment effects on intraoperative variables and anesthetic interventions in dogs undergoing adrenalectomy for pheochromocytoma. Statistical analysis included Shapiro-Wilks to test normality, and two-way ANOVA and Mann-Whitney U to evaluate normally and non-normally distributed data, respectively (p < 0.05).

Results are presented in Table 1.

In dogs undergoing adrenalectomy for suspected pheochromocytoma, phenoxybenzamine pre-treatment produced a higher range of systolic arterial pressures and number of hypertensive episodes, without producing significant intra-operative benefits.

Table 1 Mean (SD) or median (IQR)* of intraoperative variables in dogs undergoing adrenalectomy.

Intraoperative Variable	Group N	Group PT	p-value
Maximum SAP	169.1 (49.1)	185.8 (44.6)	0.15
Maximum MAP	125.8 (31.6)	129 (32.9)	0.69
Minimum SAP	71.5 (17.7)	68.7 (18.5)	0.52
Minimum MAP	53 (9.3)	51.2 (10.6)	0.46
Delta SAP*	90.0 (60.0)	116 (66.0)	0.04
Delta MAP*	72.8 (30.4)	77.8 (33.9)	0.53
Duration of hypotension (minutes)*	20.0 (30.0)	30.0 (45.0)	0.1
Number of hypotensive episodes*	2.0 (2.0)	2.0 (4.0)	0.17
Duration of hypertension (minutes)*	20.0 (10.0)	15.0 (15.0)	0.58
Number of hypertensive episodes*	0.0 (0)	1.0 (2.0)	0.0076
Sinus tachycardia duration (minutes)*	17.5 (20.0)	55.0 (65.0)	0.12

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Effect of buprenorphine on the minimum alveolar concentration of isoflurane in cats

Pypendop BH, Barter LS

Department of Surgical and Radiological Sciences, School of Veterinary Medicine, University of California, Davis, USA

The effect of continuous administration of buprenorphine on MAC have not been reported.

Six adult healthy cats were anesthetized with isoflurane in oxygen. Catheters were placed in a jugular and a medial saphenous vein for blood sampling and drug administration. Body temperature was maintained within 38.5 – 39.5°C. Buprenorphine was administered using a target-controlled infusion to maintain 8 concentrations ranging from 0.5 to 64 ng mL⁻¹, using pharmacokinetic data obtained during isoflurane anesthesia. Four concentrations were selected randomly and administered in an ascending order. The remaining concentrations were administered in an ascending order at least 2 weeks later. Isoflurane MAC was determined in duplicate using the bracketing method and tail clamping at baseline (separate experiment) and each buprenorphine concentration. Blood was sampled after the last MAC determination at each buprenorphine concentration for plasma buprenorphine concentration measurement using liquid chromatography/mass spectrometry.

Total anesthesia time was 371 ± 67 minutes. Baseline MAC was 1.94 ± 0.23 %. Plasma buprenorphine concentrations of 0.32 ± 0.21, 0.37 ± 0.1, 1.05 ± 0.50, 2.53 ± 0.85, 6.41 ± 1.57, 13.17 ± 3.00, 30.33 ± 6.20 and 62.79 ± 9.95 ng mL⁻¹ reduced MAC by 9 ± 7, 9 ± 10, 10 ± 8, 19 ± 13, 10 ± 10, 10 ± 9 and 5 ± 9 %, respectively. Individual maximum % MAC reduction (buprenorphine ng mL⁻¹) was 18 (3.17), 34 (4.75), 12 (5.59), 2 (0.25), 34 (8.15) and 27 (0.33). The effect of buprenorphine on MAC was variable, with no clear dependence on plasma concentration.

The study was funded by the Center for Companion Animal Health, School of Veterinary Medicine, University of California, Davis

The study was approved by the Institutional Animal Care and Use Committee (protocol 22440)

Ultrasound-guided sciatic nerve block in two alpacas (*Vicugna pacos*) as part of an opioid-free anaesthesia plan for hind-limb fractures

Ruíz-López P¹, Felisberto R², Schauvliege S¹

¹ Department of Large Animal Surgery, Anaesthesia and Orthopaedics, Faculty of Veterinary Medicine, University of Ghent, Merelbeke, Belgium

² Southern Counties Veterinary Specialists, Ringwood, UK

An ultrasound-guided sciatic nerve block was performed as part of a balanced anaesthetic protocol in two alpacas (ASA II, 72 and 110 kg) undergoing surgical repair of a fracture of the distal hind limb. In case 1 this was a displaced, complete, closed, non-articular, oblique fracture of the mid-metatarsus III/IV, in case 2 a closed, acute, comminute, complete, displaced fracture of the mid-diaphysis of the left tibia.

Endotracheal intubation was performed 10 minutes after medetomidine 30 µg kg⁻¹ and ketamine 5 mg kg⁻¹ IM administration. Anaesthesia was maintained with sevoflurane in 60-65% oxygen. The sciatic nerve was visualised with a 12 MHz linear ultrasound probe at the level of the mid-thigh as an elliptical hypoechoic structure surrounded by a hyperechoic rim, medially to the biceps femoris muscle and laterally to the adductor muscles. A 19-gauge spinal needle was inserted caudo-cranially, in plane with the probe. Bupivacaine 0.5% (0.07 ml kg⁻¹ (Case1) and 0.09 ml kg⁻¹ (Case2)) was injected around the nerve. Correct positioning of the local anaesthetic was assessed by its spread around the nerve. Both animals received meloxicam 0.5 mg kg⁻¹ IV and ceftiofur 2.2 mg kg⁻¹ IM.

End-tidal sevoflurane was maintained between 1.9-2.2% (Case1) and 1.8-2.0% (Case2). Cardiorespiratory variables remained stable throughout surgery. General anaesthesia lasted 205 (Case1) and 255 (Case2) minutes. Endotracheal extubation was performed 12 (Case1) and 6 (Case2) minutes after discontinuing sevoflurane.

In the two cases described, the ultrasound-guided sciatic nerve block promoted opioid free intra-operative analgesia during surgical fracture repair of distal hindlimb.

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Evaluation of the effects of laser therapy on the recovery period in dogs undergoing thoracolumbar hemilaminectomy: a pilot study

Sanchis-Mora S¹, Corpe ML², Cowderoy E², De Decker S²

¹ Southfields Veterinary Specialist, Basildon, UK

² Clinical Science and Services, Royal Veterinary College, Hatfield, UK

Low level laser therapy (LLLT) is suggested to have anti-inflammatory, wound healing, and analgesic properties (Wardlaw et al. 2018). This study aimed to assess the effects of LLLT on wound healing and postoperative pain as additional treatment in dogs undergoing hemilaminectomy for thoracolumbar intervertebral disc extrusion (TLIVDE).

Nine dogs with TLIVDE undergoing hemilaminectomy were randomly allocated into group LLLT ($n = 5$) or SHAM ($n = 4$). Postoperative pain management was under clinician discretion for all dogs (Zidan 2020). The LLLT occurred 24-, 48-, 72- and 96-hours post-surgery. Pain was measured using Glasgow Composite Pain Scale (GCPS) and mechanical thresholds with an electronic Von Frey by a blinded operator the afternoon after surgery (baseline) and 2 hours after each LLLT. Wound healing was assessed using a 3D wound camera and processed to obtain the % of reduction in wound size. Success in wound reduction area was considered if there was 50% reduction from baseline to discharge. Generalised Estimated Equations and Chi square test were used.

Wound reduction success was significantly higher in LLLT (80%) than in SHAM (0%). There was no significant difference between LLLT and SHAM for GCPMS scores or mechanical thresholds. Group size $n = 12$ for a future study was estimated to obtain a mean difference in GCPS scores of 1.5 ± 0.9

Laser therapy appears to positively affect wound reduction in the early post-operative period in canine hemilaminectomy patients. Further research with a greater sample size is required to investigate the effect of LLLT on pain.

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Experience of veterinary practitioner and owners following referral to a dedicated veterinary pain clinic for medical management of degenerative lumbosacral stenosis

Sanchis-Mora S¹, Ruffell MJ², De Decker S²

¹ Southfields Veterinary Specialist, Basildon, UK

² Clinical Science and Services, Royal Veterinary College, Hatfield, UK

Human pain clinics are well-established services providing individualised and multimodal treatment (Crombie et al.1994; Kosson et al. 2019). This descriptive study aimed to determine the awareness and experience of veterinary practitioners and owners after visiting a pain clinic for treatment of canine degenerative lumbosacral stenosis (DLSS).

Data were collected from 18 dogs treated for DLSS (De Risio 2000) over a 5-year period at a dedicated veterinary pain clinic. All dogs received at least one epidural injection of steroids. Further injections and introduction of additional treatments were based on clinical response. Telephone interviews with practitioners and owners consisted of 12 and 38 questions, respectively. Questions were formulated to be answered as yes/no or with a scale from 0 to 10.

Of the 18 practitioners, 14 participated. Of these, 12 reported clinical improvement based on clinical notes, 10 were aware of the pain clinic prior to referral and 13 considered referral to the pain clinic in future.

Of the 18 owners, 13 took part. Of these, 10 felt that their expectations for attending the pain clinic were met. Twelve understood the aims of the treatment and 11 felt that their pet was undergoing individualised treatment. Owners' ratings (10-0) varied from 10 (11 owners) to 5 (1 owner) for the care to themselves and the approachability of the anaesthesiologists. Twelve owners would recommend the pain clinic to others.

Initial results about veterinary pain clinics and the treatments offered are promising and might provide a valuable source of therapy for pets with DLSS.

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Simulated clinical evaluation of the University of Surrey MAdTCI™, a manually adjusted system for target controlled infusion of propofol in dogs

Langton SD, Walters AL, Wilcox DR

School of Veterinary Medicine, University of Surrey, Guildford, UK

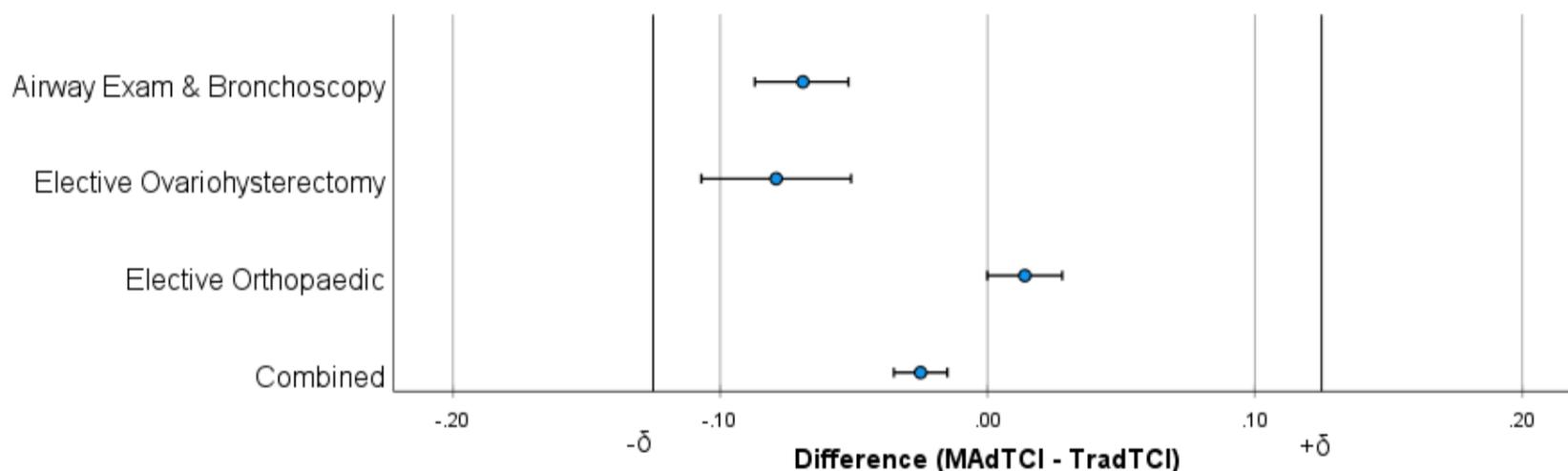
The study aimed to determine if a manually adjusted system for target controlled infusion (MAdTCI) of propofol in dogs performed similarly to a traditional target controlled infusion (TradTCI) in simulated clinical cases.

The MAdTCI consists of a spreadsheet based on the manual slide rule system described by Bruhn et al. (2003) adapted for use in dogs (Langton 2019). Plasma targets and timings were created for three cases (Elective Ovariohysterectomy, Airway Examination & Bronchoscopy and Elective Orthopaedic surgery). Pharmacokinetic simulations were conducted for each case with dogs of body mass 10-50 kg, in 10 kg increments, using both MAdTCI and TradTCI. Simulated plasma concentration was recorded every 10 seconds, with deviation from target calculated as simulated concentration minus target concentration. The two one sided test procedure was used to test for equivalence with respect to deviation from target. The equivalence margin (δ) was defined as $0.125 \mu\text{g mL}^{-1}$, giving a $\pm \delta$ interval of $0.25 \mu\text{g mL}^{-1}$, half of the smallest increment that plasma target may be adjusted during TradTCI.

Mean \pm 90% confidence interval for difference in deviation from target between MAdTCI and TradTCI (Figure 1) was within the equivalence zone for each case and for all cases combined.

In the pharmacokinetic simulation of these cases the performance of the MAdTCI with respect to deviation from target was equivalent with TradTCI, the established technique.

Figure 1 – Mean \pm 90% Confidence Interval (CI) for difference in deviation from target ($\mu\text{g mL}^{-1}$). The equivalence zone is defined as $\pm \delta$.



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Comparison of peri-operative behaviour and gastrointestinal motility in rabbits receiving a brachial plexus block or lidocaine CRI for orthopaedic surgery

Mead SA¹, Allen MJ², Hassouna Elsayed SA², Self IA¹, Bird AR¹, Gittel CS¹

¹ Queen's Veterinary School Hospital, University of Cambridge, UK

² Surgical Discovery Centre, University of Cambridge, UK

This prospective, randomized study describes a nerve stimulator-guided brachial plexus blockade (BPB) in rabbits undergoing orthopaedic surgery and compares the BPB to systemic lidocaine.

After IM medetomidine (100 µg kg⁻¹), fentanyl (5 µg kg⁻¹) and midazolam (0.5 mg kg⁻¹), anaesthesia was induced (propofol IV) and maintained with isoflurane. Nine rabbits received a BPB with lidocaine (2%; 0.3 mL kg⁻¹), and eight received lidocaine constant rate infusion (CRI) (2 mg kg⁻¹ IV, followed by 100 µg kg⁻¹ minute⁻¹). Fentanyl (5 µg kg⁻¹ IV) was used as rescue analgesia. Carprofen (4 mg kg⁻¹ IV) was administered at the end of surgery. Post-operative pain was assessed with the Rabbit Grimace Scale (RGS) and a composite pain scale (CPS) (Benato et al. 2021). Buprenorphine (0.05 mg kg⁻¹ SC) was administered if RGS was > 5/10 or latest at T120. Rabbits were filmed during T0-120 to record distance travelled and behaviours. Food intake and faecal output were measured. Groups were compared using Mann Whitney-U and Spearman Rank tests (significant if p < 0.05).

BPB had lower RGS scores than CRI at T90 (median 3 (range 1-7) vs 4 (4-6), p = 0.041) and 120 (3 (1-5) vs 4 (3-5), p = 0.026) and required fewer intraoperative fentanyl boluses (0 (0) vs 2 (1-3)). There were no differences in food intake or faecal production over 18 hours, and no differences in distance travelled, or behaviours examined during T0-120. Both groups had similar CPS and buprenorphine requirements.

BPB seems superior for intraoperative analgesia. Postoperatively both groups were comparable.

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The impact of the use of local anaesthetic nerve blocks on the incidence of post-operative regurgitation in brachycephalic dogs following orthopaedic surgery

Krekis A¹, Klöppel H², Downing F¹

¹ Davies Veterinary Specialists, Higham Gobion, Hitchin, UK

² Frontier GmbH, Hergolding, Germany

Regurgitation and gastro-oesophageal reflux (GOR) are commonly reported complications in dogs in the perioperative period, with brachycephalic dogs and dogs undergoing orthopaedic surgery being at higher risk than others (Downing and Gibson 2018, Lamata et al. 2012). In humans undergoing orthopaedic surgery, locoregional anaesthesia reduces complications, including post-operative nausea and vomiting (PONV) (Jin et al. 2020). Potentially, similar benefits may be seen in brachycephalic dogs by reducing pain, stress and opioid requirements post-operatively. This study aimed to identify whether brachycephalic dogs receiving femoral and sciatic nerve blocks had a lower incidence of regurgitation postoperatively following orthopaedic surgery than those that did not.

This is a single-centre retrospective study. Medical records were searched between 2017-2019; forty-seven brachycephalic dogs undergoing routine pelvic limb surgery were included in the study. Dogs were assigned to two discrete groups: dogs receiving pelvic limb nerve blocks ($n = 26$) and those that did not ($n = 21$). A positive result was recorded if an animal regurgitated in the post-operative period in hospital. Fisher's exact test was used to test for significance.

The group receiving nerve blocks had a lower incidence of regurgitation at 15% (4/26), than the group that did not (38% [8/21]); however, this was not statistically significant ($p=0.07$).

Local anaesthesia remains a gold standard for pain relief in the peri-operative period. This study suggests that their use in brachycephalic patients may reduce the incidence of regurgitation postoperatively. Further studies and greater case numbers are needed to confirm whether this finding is significant.

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Risk of burnout and depression: A survey of Veterinary Anaesthesia specialists-in-training during the COVID-19 pandemic

Monticelli P¹, Seymour C², Adami C³

¹ Dick White Referrals, London Road, Cambridgeshire, UK

² Pride Veterinary Centre, Derby, UK

³ Department of Veterinary Medicine, University of Cambridge, Cambridge, UK

This study was designed to investigate risk, risk factors, and effects on patient care and safety, of burnout and depression in Veterinary Anaesthesia residents.

A link to access an online questionnaire, which included the Maslach Inventory-Human Services Survey (MBI-HSS; Lin et al. 2022), the Harvard National Depression Screening Day Scale (HANDS; Baer et al. 2000), and 28 questions developed to assess adherence to adequate clinical standards, was sent by email to 185 residents. The components of the MBI-HSS, namely emotional exhaustion (EE), depersonalisation (DP) and reduced personal accomplishment (RPA) were analysed separately. The Checklist for Reporting Results of Internet E-Surveys (CHERRIES) was used. Data were analysed with Chi-square test and two-step regression statistical modelling. Significance was set at $p < 0.05$.

Response rate was 48%, with 89/185 responses. Based on HANDS and MBI-HSS scores, high risk for both depression and burnout was found in 49% of the residents (44/89). These residents expressed greater concern of delivering inadequate patient care ($p < 0.001$), of decreased supervision quality during Covid-19 ($p = 0.038$), and of negative impact of the pandemic on their training program ($p = 0.002$) than residents at low-to-moderate risk. Clinical work ≥ 60 hours/week was a risk factor for depression ($p = 0.016$) and EE ($p = 0.022$), while female gender was a risk factors for EE only ($p = 0.018$).

An alarmingly high proportion of residents is at high risk of depression and burnout; the pandemic seems to have contributed to this.

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Ultrasound-guided brachial plexus block in a Miniature Shetland Pony: a case report

Pye E, Gozalo-Marcilla M, Duncan J

Royal (Dick) School of Veterinary Studies, University of Edinburgh, Roslin, Midlothian, UK

Ultrasound-guided (USG) brachial plexus (BP) blocks are commonly used in small animal practice to provide optimum analgesia, improving welfare. There is space for improvement in loco-regional techniques in equidae (Gozalo-Marcilla et al. 2021). We describe a BP block in a Miniature Shetland Pony.

A 9-year-old, 105 kg gelding Miniature Shetland Pony presented for arthrodesis of the right scapulohumeral joint. Pre-anaesthetic medication consisted of IV acepromazine 0.03 mg kg⁻¹, romifidine 0.08 mg kg⁻¹ and morphine 0.2 mg kg⁻¹. General anaesthesia was induced (ketamine 2.2 mg kg⁻¹ and diazepam 0.06 mg kg⁻¹) and maintained with sevoflurane in 100% oxygen (F_E Sevo 1.9 - 2.1) and a romifidine CRI 0.04 mg kg⁻¹ hour⁻¹. Once in left lateral recumbency, a linear transducer was placed medial to the right scapulohumeral joint in a parasagittal plane, with depth adjusted to 5 cm. Mixed echogenicity tissue corresponding to the BP was identified adjacent to the brachial vessels. A 21-gauge 100 mm insulated needle was inserted cranially, in plane with transducer, and advanced under continuous USG until the tip was adjacent to the BP. Bupivacaine 0.2 mg kg⁻¹ and mepivacaine 0.4 mg kg⁻¹ (volume 5 mL) were injected with minimal resistance, demonstrating hydrodissection of perineural tissues.

The plane of anaesthesia was stable throughout surgery (145 minutes), with no increase from baseline in monitored physiologic variables that suggest nociception. Recovery from anaesthesia was uneventful. Rescue analgesia was required 6 hours after the BP block.

Ultrasound-guided BP blocks can form part of a multimodal analgesic approach in ponies undergoing shoulder surgery.

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Accuracy and safety of placing neuraxial catheters in pigs: Preliminary results

García Casalta LG, Petrucci M, Casoni D

Department for BioMedical Research, Faculty of Medicine, University of Bern, Bern, Switzerland

Placing accurately and safely an epidural catheter might be difficult (Gamble et al. 2014). We aimed at evaluating the likelihood of safely achieving a targeted thoraco-lumbar location.

In 24 pigs (53.63 ± 6.1 kg) undergoing general anaesthesia for thoracotomy, lumbosacral puncture with an 18 G Tuohy needle was carried out by the same anaesthesiologist. Correct placement was defined by hanging drop and loss and lack of resistance. A 20 G catheter was then slid to T13-L1, after measuring landmarks' distance. If the needle's tip reached the sub-arachnoid space (CSF present), the catheter was placed spinally. For each insertion, the prediction of the anaesthesiologist regarding catheter's (epidural versus spinal) and tip's location was recorded. After euthanasia, the lumbar region was dissected until the tip of the catheter was visualized. Epidural and subarachnoid placements were compared with Fisher-Exact test.

The catheter was found 13/24 and 11/24 times epidurally and spinally respectively, with an accurate prediction of 83.33%. Catheter's tip was found in the targeted location 10 times, with an accurate prediction of 62.5%. In 4 cases (3 epidural and 1 subarachnoid placements) the catheter's tip turned caudally and in 1 (epidural) went outside the canal, through an intervertebral foramen. There was no significant difference in the likelihood of predicting correctly either catheter's or tip's location between epidural and sub-arachnoid placement. Hematomas or damages to the spinal cord were never macroscopically observed.

Lumbo-sacral puncture in pigs might easily result in sub-arachnoid catheter's placement. Catheter's position could be predicted more accurately than tip's position.

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Can descending pain pathway function be evaluated using a conditioning stimulus in awake dogs?

Brause S, Rupp V, Kästner SBR, Schütter AF

Clinic for Small Animals, University of Veterinary Medicine Hannover, Hannover Germany

This experimental study aimed to elaborate a method for functional testing of the endogenous descending inhibitory system for clinical use.

On four occasions, 12 healthy adult beagles were tested. An electrical stimulus (1ms train-of-five-square-wave pulse at 200 Hz) applied to the metatarsus, starting with 0.2 mA and increasing the current until a clear avoidance response occurred, was used as a test stimulus. After baseline determination, a mechanical conditioning stimulus was applied to the contralateral antebrachium using a commercially available pressure algometer (3 mm blunt tip) (Prod algometer limb actuators, Topcat Metrology), to generate a force of maximal 22 ± 1 N for 1 or 5 minutes. Electrical stimulation was reevaluated 0, 2, 5, 10, 15, 30, 45, and 60 minutes after conditioning.

The number of dogs showing an elevated electrical threshold compared to baseline and the magnitude of increase were analysed using the Wilcoxon signed-rank test ($\alpha = 5\%$).

In 90.9% of measurements ($n = 40$), increased thresholds up to 60% above baseline ($p < 0,0001$) could be detected, but there was high variability in magnitude and time of threshold increase.

It seems that descending inhibitory system could be activated. However, at present high variability limits clinical use. Further, despite the dogs appearing calm, an interference between stress response and results cannot be completely excluded. In the future, altered conditioning times and force need to be investigated.

Perioperative analgesic effects of an ultrasound-guided transversus abdominis plane block with bupivacaine in rabbits undergoing elective ovariohysterectomy: a pilot study

Garbin M, Violette D, Watanabe R, Summa N, Gagnon D, Cruz Benedetti IC

Faculty of Veterinary Medicine, Université de Montréal, Saint-Hyacinthe, QC, Canada

This prospective, blinded, randomized study aimed to evaluate the perioperative analgesic effects of a transversus abdominis plane block (TAPB) with bupivacaine administered to rabbits undergoing elective ovariohysterectomy.

Eight 9-month-old female New Zealand White rabbits were premedicated IM with dexmedetomidine, methadone, and ketamine. Anesthesia was induced with IV alfaxalone and maintained with isoflurane. Post-induction, meloxicam was administered SC. An ultrasound-guided bilateral 2-point (subcostal and lateral) TAPB was performed by injecting 1 mL kg⁻¹ of 0.25% bupivacaine (BUPI group, $n = 4$) or the same volume of saline solution in controls (CTR group, $n = 4$) about 20 minutes before surgery. A 20% increase in HR or MAP intraoperatively was treated with remifentanyl (1 µg kg⁻¹, IV). Before premedication and for 6 hours post-extubation, pain was assessed with the Rabbit Grimace Scale (RbtGS; Miller et al. 2022). For RbtGS > 4/10, methadone 0.3 mg kg⁻¹ was administered IV. Data were analyzed with a generalized linear mixed model and Kendall's T coefficient ($p < 0.05$).

Two rabbits in the CTR group and 2 rabbits in the BUPI group were administered 2 and 3 doses of remifentanyl, respectively. All rabbits required rescue analgesia postoperatively. Rabbits in the CTR and the BUPI group received 8 and 4 doses of methadone, respectively ($p = 0.47$). No correlation was observed between the intra- and postoperative rescue analgesia in either group.

Although the BUPI group required less postoperative analgesia, this was not statistically significant, therefore further clinical studies are warranted to evaluate the efficacy of TAPB in rabbits.

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Assessing diagnosis of pain in pigs according to behavioural changes by applying weightings based on machine learning algorithm

Trindade PHE¹, Araújo AL², Mello JFSR³, Luna SPL¹

¹ Department of Veterinary Surgery and Animal Reproduction, School of Veterinary Medicine and Animal Science, São Paulo State University, Brazil

² Federal Institute of Education Science and Technology of Paraíba (IFPB), Veterinary Medicine School, Sousa, Paraíba State, Brazil

³ Autonomous statistician, São Paulo, São Paulo State, Brazil

We investigated the effects of the inclusion of weightings from a machine learning-based algorithm on the discriminatory capacity of the Unesp-Botucatu pig acute pain scale (UPAPS) to detect pain in pigs according to the area under the curve (AUC) of sensitivity and specificity.

Pain scores of 45 pigs from the study validating UPAPS were used (Luna et al. 2020). Pigs were filmed before orchiectomy, 3-4h after orchiectomy (performed under local anaesthesia), 5h after orchiectomy (1 hour after flunixin and morphine IM), and 24h after surgery. Four experienced 'blind' evaluators randomly assessed the footages, indicated whether they would provide analgesia according only to their experience and scored UPAPS. Assessments were repeated after 30 days. A machine learning-based algorithm was conducted with random forest using the UPAPS behaviors (feature variables) to classify pigs who needed analgesia or not (target variable). The algorithm was created/trained with 70% of the randomly selected data, using four k-folds, two repeats, 1,001 trees, and two variables randomly sampled for each split. Pig remaining data was used to test and cross-validate the algorithm.

There was no difference in the AUC of the algorithm compared to the original UPAPS (0.97; $p > 0.05$). The five behaviors with the greatest power to diagnose pain were 'changes posture, protects the affected area', 'head down', 'sits with difficulty', 'wags tail', and 'shows little interest in the surroundings', suggesting no improvement in pain diagnosis with the algorithm.

In conclusion, although the algorithm indicated the importance of each behavior, there was no improvement in AUC.

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Ethical authorization

The study was approved by the Ethical Committee for the Use of Animals in Research of the School of Veterinary Medicine and Animal Science, Unesp, Botucatu, Brazil, under protocol number 102/2014 and follows the Brazilian Federal legislation of CONCEA (National Council for the Control of Animal Experimentation).

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Evaluation of postoperative analgesia after intraperitoneal and incisional administration of ropivacaine in dogs undergoing ovariohysterectomy

Kazmir-Lysak K¹, Steblaj B¹, Kutter APN¹, Restitutti F², Bettschart-Wolfensberger R¹, Henze IS¹

¹ Section of Anaesthesiology, Department of Clinical Diagnostics and Services, Vetsuisse Faculty, University of Zurich, Switzerland

² Department of Small Animal Medicine and Surgery, School of Veterinary Medicine, St. George's University, Grenada

Intraperitoneal administration of local anaesthetics can reduce postoperative pain after ovariohysterectomy in dogs (Carpenter et al. 2004). The objective of this study was to compare postoperative analgesia and opioid requirements following intraperitoneal and incisional ropivacaine versus 0.9 % NaCl.

Forty-three client-owned dogs were included in this randomized, blinded, clinical study. Dogs were administered acepromazine (0.03 - 0.05 mg kg⁻¹) and dexmedetomidine (0.01 mg kg⁻¹) intramuscularly. Anaesthesia was induced with propofol to effect and ketamine (1 mg kg⁻¹) intravenously and maintained with isoflurane in oxygen. Intraoperative analgesia included carprofen (4 mg kg⁻¹) subcutaneously and morphine (0.2 mg kg⁻¹) intravenously. Each dog received either a ropivacaine intraperitoneal and incisional splash (2 mg kg⁻¹ and 1 mg kg⁻¹, respectively), or an equal volume of 0.9 % NaCl. Buprenorphine (0.02 mg kg⁻¹) was administered intramuscularly once the uterus was removed. Sedation and pain were assessed at 0.5, 1, 2, 4, 6 and 8 hours after extubation, using a sedation scale (Grint et al. 2009), the Short Form of the Glasgow Composite Pain Scale (SF-GCPS) and a dynamic interactive visual analogue scale (DIVAS). Buprenorphine (0.01 mg kg⁻¹) was administered intravenously if dogs scored > 5/24 on SF-GCPS.

Ordinal mixed effects models showed no difference in pain scores between the groups. Fisher's exact test revealed no significant difference regarding postoperative buprenorphine requirements between group NaCl (3/22 dogs) and group ropivacaine (1/21 dogs). Additionally, lower sedation scores were associated with higher DIVAS scores.

In this multimodal analgesic protocol, ropivacaine provided no superior analgesia to 0.9 % NaCl.

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Evaluation of paravertebral single-site anaesthetic injection in experimental pigs undergoing forelimb amputation

Casoni D¹, Hirsiger S², Garcia Casalta LG¹, Petrucci M¹, Mirra A³

¹ Department for Biomedical Research, Faculty of Medicine, University of Bern, Switzerland

² Clinic for Plastic and Hand Surgery, Inselspital University Hospital, Bern, Switzerland

³ Department for Veterinary Clinical Sciences, Vetsuisse Faculty, University of Bern, Switzerland

Multimodal analgesia is required in pigs used as models of invasive surgeries. We aimed to investigate the feasibility and success of a paravertebral single-site injection, in pigs undergoing forelimb monolateral or bilateral amputation.

Twenty-three pigs for a total of 30 forelimb amputations received IM dexmedetomidine 20 µg kg⁻¹, ketamine 10 mg kg⁻¹ and methadone 0.2 mg kg⁻¹, followed by IV ketamine and propofol to allow tracheal intubation. General anaesthesia was maintained with isoflurane in oxygen and air. With the animal in lateral recumbency, transverse processes and vertebral bodies of C6 and C7 were ultrasonographically visualised. A needle connected to a nerve stimulator was inserted caudally to the transverse process of C6 and directed caudo-medially to puncture the deep cervical fascia and anaesthetise the two ventral branches emerging from C7. When carpal extension was obtained at 0.7 mA and lost at 0.3 mA, 0.2 mL kg⁻¹ ropivacaine 0.75% mixed with 0.2 mL patent blue V were injected. Staining was verified before amputation. The target was considered achieved when at least 1 cm of the ventral branches was stained, partially achieved when at least 1 cm of one ventral branch was stained, otherwise failure was declared.

Target was achieved in 12 amputations (40%), partially achieved in 12 (40%) and failed in 6 (20%). Out of the 6 failures, staining was found 4 times superficially to the deep fascia, while twice post-mortem in the epidural space.

At this volume, a single-site injection could be a complementary option to provide analgesia of forelimbs.

Effects of vatinoxan on heart rate, mean arterial pressure and respiratory rate in dogs premedicated with medetomidine and butorphanol followed by sevoflurane anaesthesia – a randomized clinical study

Salla K¹, Turunen H^{1,2}, Kallio-Kujala I¹, Pekkola V¹, Casoni D^{1,3}, Lepajoe J¹, Raekallio M¹, Vainio O¹

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

² Vetcare Ltd, Mäntsälä, Finland

³ Experimental Surgery Facility, Department for Biomedical Research, Faculty of Medicine, University of Bern, Bern, Switzerland

Administration of vatinoxan maintains HR and reduces MAP in medetomidine-butorphanol sedated dogs (Salla et al. 2014). We aim to investigate the effects of vatinoxan in medetomidine- butorphanol premedicated dogs during sevoflurane anaesthesia.

Dogs ($n = 28$) scheduled for surgical castration were randomly IV premedicated with medetomidine (0.125 mg m^{-2}) and butorphanol (0.2 mg kg^{-1}) (MB), or medetomidine (0.25 mg m^{-2}), butorphanol (0.2 mg kg^{-1}) and vatinoxan (5 mg m^{-2}) (MB-VATI). Anaesthesia was induced 15 minutes later with propofol and maintained with sevoflurane. Intratesticular lidocaine (2 mg kg^{-1}) and IV meloxicam (0.2 mg kg^{-1}) was administered for analgesia. End-tidal sevoflurane concentration ($\text{FE}'\text{Sevo}$), HR, f_R and MAP were recorded at selected timepoints. Data was analysed with mixed model of ANOVA. Results are given in the table.

Despite the higher dosage of medetomidine, vatinoxan alleviated the decrease in HR and MAP was lower in MB-VATI than in MB group.

Table

Variable	Group	BL	Surgery start	Surgery end
HR (beats minute ⁻¹)	MB	100 ± 23	61 ± 16*	58 ± 12*
	MB-VATI	108 ± 23	93 ± 23	73 ± 10
MAP (mmHg)	MB	111 ± 21	70 ± 14*	69 ± 10
	MB-VATI	110 ± 22	58 ± 12	62 ± 13
f_R (breaths minute ⁻¹)	MB	na	10 ± 6	15 ± 11
	MB-VATI	na	7 ± 2	14 ± 15
$\text{FE}'\text{Sevo}$ (%)	MB	na	1.5 ± 0.2	1.5 ± 0.2
	MB-VATI	na	1.4 ± 0.2	1.5 ± 0.2

*Significant difference between groups ($p < 0.05$); na = not assessed; BL = baseline

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Endotracheal intubation in pigs: which animal positioning is the best?

Mirra A^{1,2}, Spadavecchia C¹, Micieli F^{1,3}

¹ Section of Anaesthesiology and Pain Therapy, Department of Clinical Veterinary Medicine, Vetsuisse Faculty, University of Bern, Bern, Switzerland.

² Graduate School for Cellular and Biomedical Sciences, University of Bern, Bern, Switzerland.

³ Department of Veterinary Medicine and Animal Production, University of Naples "Federico II", Naples, Italy

Endotracheal intubation (ETI) is challenging in pigs. We aimed at comparing perception of ETI ease and performance time with the animal positioned in dorsal (DR) or sternal (SR) recumbency.

Thirty-three participants were grouped: undergraduates (veterinary students), graduates (veterinarians without specific anaesthesia training) and experts (veterinary anaesthesiologists). Each participant intubated one pig cadaver (28.9 ± 4.7 kg; euthanised for another study; total number = 16) in DR and SR. Attempts and time to correctly perform ETI, and answers to three Likert-scale questions (score from 0 = worst score to 5 = best score) were recorded. Effect of recumbencies within groups was tested with the Wilcoxon signed-rank test.

Results are presented in the table.

		Undergraduates (15)	Graduates (10)	Experts (8)
Attempts (number)	DR	3 (2, 6)	5 (1, 6.25)	1.5 (1, 2.75)
	SR	1 (1, 2)*	1 (1, 2)	1 (1, 1)
Time (seconds)	DR	154 (80, 439)	223 (93.2, 314.5)	41.5 (29, 81.5)
	SR	33 (19, 80)*	22 (14.5, 168.5)*	16.5 (9, 45.5)
Larynx visualization (score)	DR	2 (2, 4)	3 (2, 4)	4 (2.25, 5)
	SR	5 (5, 5)*	5 (4, 5)	5 (4, 5)
Endotracheal tube introduction (score)	DR	3 (2, 3)	3 (2, 4)	5 (3.5, 5)
	SR	4 (4, 5)*	4 (2, 5)	4 (3.25, 4.75)
Endotracheal tube advancement (score)	DR	4 (3, 4)	3.5 (2, 4)	4.5 (4, 5)
	SR	4 (3, 4)	4 (2, 5)	3 (2, 4)

*statistical difference between recumbencies (p <0.05)

Intubation in SR seems preferable, but only for inexperienced personnel.

Depth of anaesthesia assessment in experimental pigs: a scoping review

Mirra A^{1,2}, Gamez Maidanskaia E¹, Carmo LP^{3,4}, Levionnois O¹, Spadavecchia C¹.

¹ Section of Anaesthesiology and Pain Therapy, Department of Clinical Veterinary Medicine, Vetsuisse Faculty, University of Bern, Bern, Switzerland.

² Graduate School for Cellular and Biomedical Sciences, University of Bern, Bern, Switzerland.

³ Veterinary Public Health Institute, Department of Clinical Research and Public Health (DCR-VPH), Vetsuisse Faculty, University of Bern, Bern, Switzerland.

⁴ Norwegian Veterinary Institute, Ås, Norway.

Despite the large use of pigs in research, no gold standard depth of anaesthesia (DoA) indicator is available. We undertook a scoping review to investigate and summarize the evidence that sustains or contradicts the use of DoA indicators adopted in pigs.

Medline, Embase and CAB abstract were searched up to March 19th 2020. No time and language limitations were set. Only original articles reporting in vivo studies using pigs or minipigs under general anaesthesia were included. The DoA indicators found in the selected papers were divided in two categories: A, indicators investigated as methods to assess DoA; B, indicators used to assess DoA, whose outcomes were merely reported.

Out of 12304 papers, 92 were selected for final analysis.

Category A: 15 DoA indicators were found in 17 papers. Studies were conducted using inhalant anaesthetics in the majority of the cases (11/17), while 3/17 using propofol. The most investigated DoA indicators were: bispectral index (8/17), spectral edge frequency 95% (4/17) and median frequency (3/17). Contrasting results about the reliability of the DoA indicators were reported, making difficult to draw final conclusions.

Category B: 21 DoA indicators were found in 81 papers. The most reported DoA indicators were: motor response following a stimulus (31/81), bispectral index (16/81), DoA scales (16/81), and spectral edge frequency 95% (9/81).

Results highlight the current lack of scientifically valid and reliable indicators to ensure an adequate DoA in pigs. Further research should be conducted, especially targeting DoA induced by intravenous anaesthetic agents.

Lipopolysaccharid administration in equine 15 hours prior to isoflurane/lidocaine anaesthesia – description of perianaesthetic complications in lean and obese body condition

Gittel C^{1,2}, Vervuert I³, Blaue D³, Schedlbauer C³, Starzonek J³, Brehm W², Braun C⁴

¹ The Queen's Veterinary School Hospital, Cambridge University Veterinary School, Cambridge, UK

² Department for Horses, Leipzig University, Leipzig, Germany

³ Institute of Animal Nutrition, Nutrition Diseases and Dietetics, Leipzig University, Leipzig, Germany

⁴ Clinical Unit of Anaesthesiology and Perioperative Intensive-Care Medicine, Vetmeduni Vienna, Vienna, Austria

Obesity might alter individual responses to lipopolysaccharide (LPS) administration. Perianaesthetic complications in lean and obese equine after preanaesthetic induction of endotoxemia is described.

Twenty healthy lean geldings gained body weight over 2 years for the main project. On 3 occasions (1 year apart) laparotomy and subcutaneous tissue sampling was performed 15 hours after intravenous LPS administration (10 ng kg⁻¹ body weight). A common anaesthetic protocol was applied (isoflurane/lidocaine, mechanical ventilation, 100% oxygen) for 2.5 hours. Cardiorespiratory parameters and blood gases were monitored. Perianaesthetic morbidities in Y1, Y2 and Y3 are assessed via descriptive analysis.

Hypotension in 89% of the animals in Y1 (moderate-severe) necessitated implementation of a strict cardiovascular support protocol. Preanaesthetic crystalloids, earlier dobutamine administration and frequent colloids if unresponsive, decreased severity and incidence during obesity (82% and 76% in Y2 and Y3, respectively).

In Y1, one horse was euthanized due to inability to stand in recovery. One pony (Y3) showed a sudden loss of reflexes and decrease in blood pressure (by 32 mmHg) after 75 minutes of anaesthesia but recovered uneventful after treatment. Tachycardia occurred during lean and obese body condition (Y1 13/20, Y2 8/19, Y3 12/19). In obese equine, preanaesthetic packed cell volumes were increased (7/19) and Methemoglobinemia detectable (Y2 17/19, Y3 15/19). Lactic acidosis was observed in 2/20 (Y1), 3/19 (Y2) and 2/19 (Y3) animals.

One horse was hypoxemic throughout the years, severity increased.

Cardiovascular stability under anaesthesia is impaired in lean and obese endotoxic equine. The impact of obesity remains unclear based on our data.

Rectal temperature variation in dogs undergoing 3-Tesla MRI during general anaesthesia

Frauke P, Stefan K, Ingmar K, Michaele A

Small Animal Department, Faculty of Veterinary Medicine, University of Leipzig, Leipzig, Germany

While inadvertent hypothermia is common in small animals undergoing anaesthesia, high field MRI can potentially increase body temperature, which is also reported in children of comparable size as small animals.

In this prospective observational trial dogs scheduled for 3-Tesla MRI in anaesthesia between February and October 2020 in a veterinary teaching hospital were eligible for enrolment. Data recorded included breed, body mass, body condition score, age, quality of fur, rectal temperature before and after MRI, time in MRI room, scan area, application of contrast medium, choice of anaesthetic agents, blankets, and infusion therapy. Groups were compared using Mann-Whitney-U-test or Kruskal-Wallis-Test with $p < 0,05$ considered as significant.

Inclusion criteria were matched by 174 dogs. Body temperature before MRI was 38.2 ± 0.6 °C, mean temperature after MRI was 37.7 ± 0.8 °C, temperature difference was $- 0,6 \pm 0,6$ °C ranging from $- 2,3$ °C to $+ 0.9$ °C. Mean MRI duration was 50.2 ± 18.6 minutes.

Temperature loss greater 0.1 °C was observed in 123 (70.6 %) dogs, 29 (16.7 %) dogs kept their temperature within 0.1 °C constant and 22 (12.6 %) dogs gained more than 0.1 °C. Factors that were associated with higher temperature after MRI were higher bodyweight, thick fur and application of α -2-agonists and ketamine.

Temperature loss is most likely in dogs undergoing MRI in general anaesthesia. However, in larger dogs and in dogs with thick fur rise in body temperature is possible and more common than generally anticipated, while clinically irrelevant in most cases.