Abstracts accepted for presentation at the Association of Veterinary Anaesthetists' meeting on September 19th and 20th 2024, in London, UK (listed in alphabetical order by first author's last name)

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

Abstracts

Canine

1. **Palatine approach to the maxillary nerve: a novel method investigation**

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The maxillary nerve may be blocked to improve analgesia in plethora of procedures. This study was designed to compare the popular infraorbital approach to the maxillary nerve with a novel technique. Heads were obtained from dog cadavers. On each head, the maxillary nerve was approached bilaterally, using one of two intra-oral techniques on each side: the palatine (P) and infraorbital (IO). Needles (23G x1″) were inserted into the palatine and infraorbital foramen for the P and IO approaches, respectively, and forwarded for approximately 15 mm. Dye/contrast (1:1) injections and Computerised Tomography of each head were followed by anatomical dissection and isolation of the maxillary nerves'-stained portions. Procedural failure rate was defined as stain extending < 20 mm along the nerve. Descriptive statistics, analysis of proportions and comparison of means were used for data analysis. $p < 0.05$ was considered statistically significant.

The palatine foramen is located at the level of the first molar.
Ten heads were used. There was no difference between lengths of stained nerve between P (0 (0-1) mm) and IO (3.5 (1.1 – 4.7) mm) ($p = 0.07$). However, procedural failure rate was greater for the P than for the IO technique (80% and 20%, respectively; $p = 0.025$). For both techniques, imaging revealed contrast spread along the nerve path after 70% of the injections, with a pattern that was linear in 86% of the cases and cloud in the remaining 14% ($p = 1$). Contamination of nasal turbinates and nasal passages with contrast medium was observed in 50% of P and 30% of IO injections ($p = 0.650$).
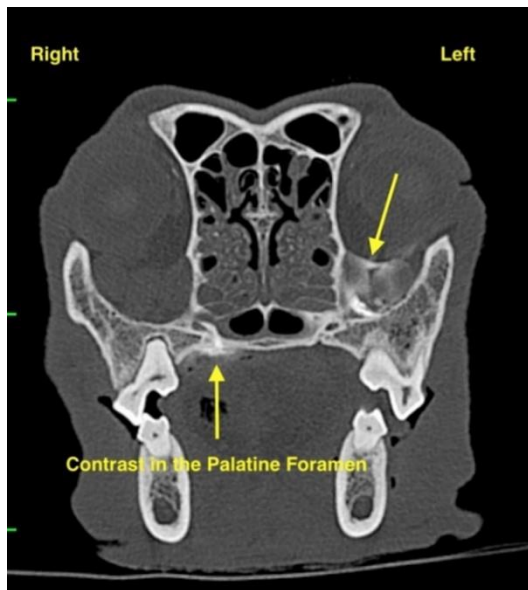
Contrast along the maxillary nerve path. Left: successful infra-orbital injection. Right: Contamination of the mucosa following palatine injection.

Based on this study's findings, the palatine approach cannot be recommended as a suitable alternative to the infraorbital technique.

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De Gennaro C, Vettorato E, Corletto F. (2022) Evaluation of bilateral maxillary nerve block in dogs undergoing surgery for brachycephalic obstructive airway syndrome. Can Vet J. Jan;63(1):67-73.

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2. **Effect of medetomidine with or without vatinoxan on some ocular variables in healthy dogs**

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Alpha-2 agonists, often used in uncooperative dogs for ophthalmologic exams, can decrease tear production and intraocular pressure (IOP). This study investigates the ocular effects of medetomidine with vatinoxan in healthy dogs.

This study enrolled healthy dogs undergoing teeth scaling. Dogs were randomly assigned to two equal groups. Group M received medetomidine (10 µg kg^{-1}), while Group MV received medetomidine (10 µg kg^{-1}) and vatinoxan (200 µg kg^{-1}) into the quadriceps muscle. An ophthalmic examination of both eyes was conducted, measuring tear production and IOP using the Schirmer tear test (STT-1) and rebound tonometry, respectively. STT-1 and IOP measurements were taken before, and at 10 and 20 minutes after injection. Sedation score (Grint et al. 2009) was noted every 5 minutes, and heart rate recorded before and 20 minutes after injection. Group differences were analysed using a Student's t-test or Wilcoxon test. A linear mixed model assessed STT-1 and IOP over time. Statistical significance $p < 0.05$.

Twelve dogs, weighing 4.5 to 40 kg, were recruited. All animals had centrally positioned eyes except one in Group MV, which had a partially ventral position necessitating lateral IOP measurement. Tear production significantly decreased in both groups after sedation from 12 ± 3 to 8 ± 3 and 5 ± 3 mm

minute^{-1} at 10 and 20 minutes (p < 0.001). IOP did not differ between groups, remaining unchanged until 20 minutes, when it significantly decreased to 12 ± 3 mmHg. After 10 minutes, sedation was deeper with significantly higher scores in Group MV (p = 0.022). Heart rates did not differ between groups at 20 minutes, averaging 66 ± 11 beats minute^{-1}.

Medetomidine with or without vatinoxan may reduce tear production and IOP. Eye ointment should be applied, and IOP measured within 10 minutes. However, vatinoxan may improve medetomidine sedation, facilitating ophthalmic examination.

References
Grint NJ, Burford J, Dugdale AH. (2009) Does pethidine affect the cardiovascular and sedative effects of dexmedetomidine in dogs? J Small Anim Pract. 50, 62–66.

3. Polymorphism in the α_{2A}-adrenoceptor gene in dogs

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In humans, genes coding for the α_2-adrenoceptors are polymorphic resulting in variations in the pharmacodynamic response to α_2-agonists. Our aim was to assess the presence of polymorphisms in the gene encoding the α_{2A}-adrenoceptor in dogs.

Dogs which presented to the veterinary school hospital for elective surgical procedures were enrolled. Ethical approval was obtained and informed consent was provided by the owners. The waste blood from pre-anaesthetic blood samples was retained for DNA extraction and genetic analyses. The α_{2A}-adrenoceptor was amplified using the polymerase chain reaction (PCR) in two parts and sequenced with Sanger sequencing. The prevalence of polymorphisms was determined.

A total of 72 dogs of 43 breeds, 15 crossbreds and one of an unknown breed were included in the study. Median body weight (range) was 15.6 (2.4–50.3) kg, with 32 males and 40 females. Samples from five dogs could not be amplified. Only three polymorphic sites in the gene were present, one synonymous transition as a heterozygote in the coding region in two dogs, one transition as a heterozygote in the non-coding region in one dog, and one homozygous 22 base pair deletion in the non-coding region in one dog. The overall nucleotide diversity was only 0.00004.

In this group of dogs of various breeds, no polymorphisms affecting the protein structure of the α_{2A}-adrenoceptor were detected. However, a very GC-rich section of the gene could not be analysed. Further work is needed to determine whether this part of the gene may alter the response to administration of α_2-adrenoceptor agonists in dogs.

4. Clinical effects of two doses of magnesium sulphate as adjuvant to ropivacaine for sciatic and saphenous nerve blocks in dogs undergoing tibial plateau leveling osteotomy

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Several studies in humans suggest that perineural magnesium sulphate enhances the analgesic effects of local anaesthesics for peripheral nerve blocks (PNBs) (Zeng et al. 2021). However, no studies have investigated its effects for PNBs in dogs.

Dogs undergoing tibial plateau leveling osteotomy (TPLO) were premedicated with IM acepromazine and methadone. Anaesthesia was induced with propofol and maintained with isoflurane in oxygen. Dogs randomly received perineural magnesium sulphate (2 mg kg^{-1}) and ropivacaine (M2 group, n = 10), magnesium sulphate (5 mg kg^{-1}) and ropivacaine (M5 group, n = 10), or ropivacaine alone (C group, n = 10), for ultrasound-guided sciatic and saphenous PNBs. Fentanyl was administered in case of intraoperative nociception. Pain was blindly assessed preoperatively and at different time points up

to 24 hours after extubation, using the Short-Form Glasgow Composite Measure Pain Scale (SF-GCMPS). Methadone was administered if SF-GCPS ≥ 5/20 or 6/24 (Reid et al. 2007). The duration of the motor blockade was also recorded. Data were analysed using Kruskal-Wallis and two-way repeated-measures mixed effect ANOVA with Geisser-Greenhouse correction.

No significant differences were found between groups regarding the number of intraoperative fentanyl boluses. Postoperative SF-GCMPS significantly decreased in groups M2, M5, and C compared to preoperative scores. Group M5 had a significantly lower SF-GCMPS score than group C at the time of extubation [1 (1-3) and 2 (1-2), respectively]. Rescue methadone was given to 2/10 dogs at 1 and 1.5 hours post-extubation in group M2, 3/10 dogs at 1.5 hours post-extubation in group M5, and 2/10 dogs at 4 hours post-extubation in group C. No significant differences regarding the duration of motor blockade were detected between groups.

The addition of perineural magnesium sulphate to ropivacaine did not improve the quality of perioperative analgesia and did not prolong the motor blockade in dogs undergoing PNBs for TPLO surgery.

References
Zeng J, Chen Q, Yu C, et al. (2021) The use of magnesium sulfate and peripheral nerve blocks: an updated meta-analysis and systematic review. Clin J Pain. 37(8), 629-637.
Reid J, Nolan AM, Hughes JM, et al. (2007) Development of the short-form Glasgow composite measure pain scale (CMPS-SF) and derivation of an analgesic intervention score. Anim Welf 16, 97-104.

5. **Comparing the cardiovascular and sedative effects of medetomidine and vatinoxan hydrochloride with dexmedetomidine in dogs undergoing official hip radiography**

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A prospective, randomized, blinded clinical study was performed to compare the cardiovascular effects and the quality of sedation of two sedation protocols used for official hip radiography in healthy dogs.

A total of 18 client-owned dogs planned for official hip radiography were randomly allocated to one of two groups: ZEN, combined medetomidine and vatinoxan hydrochloride IM (body surface area calculated dose) + butorphanol 0.2 mg kg^{-1} IV; or DEX, dexmedetomidine 5 µg kg^{-1} IV + butorphanol 0.2 mg kg^{-1} IV. Both treatment groups received additional midazolam 0.2 mg kg^{-1} IV immediately before radiographic examination. Onset of sedation (before midazolam administration) was noted, and the quality of sedation was scored (0 - 13) using a modified score system from Kuusela et al. (2000) both before and after midazolam administration. Cardiovascular parameters were measured before sedation and at 3 time points following sedation. Statistical analysis was performed to compare both groups (Mann-Whitney U Tests) and the effect of treatment over time (Friedman's two way ANOVA). Statistical significance was set at $p < 0.05$.

Median heart rate was significantly lower in DEX, 44 (32 - 60 beats minute^{-1}) compared to ZEN, 66 (32 – 84 beats minute^{-1}) after administration of midazolam. Mean arterial blood pressure decreased significantly over time in ZEN, but not in DEX, however, remained within physiological ranges in both groups. Median overall sedation score was 8 (7 - 13) for DEX compared to 10 (5 - 13) for ZEN, which was not significantly different.

The ZEN protocol is a valuable alternative for the DEX protocol for sedation of healthy dogs for official hip radiography.

References
Kuusela E, Raekallio M, Anttila M, et al. (2000) Clinical effects and pharmacokinetics of medetomidine and its enantiomers in dogs. J Vet Pharmacol Ther. 23, 15–20.

6. **The use of a thoracic epidural catheter intra- and postoperatively for an opioid-**

sparing analgesia in a dog undergoing sternotomy

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We describe the use of a thoracic epidural catheter for intra and postoperative opioid-sparing analgesia (OSA) (Beloeil 2019) in a one-year old, 11 kg, female Spaniel dog anesthetized for removal of intrathoracic grass seeds.

The initially planned ultrasound-guided percutaneous removal was converted to sternotomy and lung lobectomies after 120 minutes of partially unsuccessful procedure. Premedication included IV methadone before induction with ketamine and propofol. Anesthesia was maintained with isoflurane in oxygen at an end-tidal concentration (Et_{iso}) of 1.3% and ketamine and lidocaine continuous rate infusions (CRIs) for analgesia (Table 1). Forty-five minutes before surgery, an epidural catheter was placed at the level of the thirteenth vertebra through a Tuohy needle inserted at the lumbosacral space under radiographic control (Son *&al*. 2019), and bupivacaine 0.5% (0.5 mL) administered. Intraoperatively, Et_{iso} was adjusted based on anesthesia depth and cardiorespiratory variables and equilibrated at 0.8% in 40 minutes. The initially considered supplemental IV opioids were not needed during the 240 minutes of surgery. Epidural analgesia (EA) was repeated before extubation, combining 0.5% bupivacaine (0.5 mL) and morphine (0.1 mg kg^{-1}). The CRIs were stopped 10 hours after extubation. Further postoperative analgesia associated meloxicam once daily with EA every 12 hours at decremental doses (Table 1). Pain scores (PS) were performed every 4 hours (4A-VET canine acute pain scale) and the threshold for systemic rescue analgesia set at 6 ([0-18]) was never reached (Table 1).

With an estimated 4-hour duration of action of IV methadone in dogs (Ingvast-Larsson *&al.* 2010), we hypothesize a successful intraoperative OSA management (Beloeil 2019) followed by postoperative analgesia mainly managed with thoracic EA despite the invasive nature of the procedure. No complication was reported during hospitalization until the one-month follow-up.

	Day 0				Day 1						Day 2						Day 3						Day 4			Day 5	Day 6	Day 7
Time (hours)	0	4	8	9	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84	92	100	108	132	156
Period	Intraoperative				Early post-operative						Postoperative																	
Events	Pre-medication	Epidural catheter	End surgery	Extubation																								
Systemic analgesia — Methadone (mg kg⁻¹)	0.2			0.1																								
Ketamine (mg kg⁻¹ h⁻¹)	0.6	0.6	0.3	0.3	0.3	0.3																						
Lidocaine (mg kg⁻¹ h⁻¹)	3	2.4	1.8	1.8	1.8	1.2																						
Meloxicam (mg kg⁻¹)							0.1						0.1						0.1					0.1		0.1	0.1	0.1
Epidural analgesia T13 — Bupivacaine (mg kg⁻¹)		0.25	0.2				0.1			0.1			0.07			0.05												
Morphine (mg kg⁻¹)			0.1				0.1			0.1			0.05			0.05			0.1									
Total volume (mL)		0.5	0.6				0.6			0.6			0.5			0.5			0.5									
Pain score [0-18]	5	/	/	/	4	5	4	3	1	1	2	0	1	0	0	2	1	0	0	0	1	1	0	2	2	0	0	1

Table 1. Analgesia and pain scores following an epidural catheter placement for a sternotomy in a dog

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7. Evaluation of laryngeal function using a novel AI model to test new antidotes for fentanyl-induced laryngospasm

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Fentanyl can induce vocal cord closure (VCC), not completely reversible by naloxone (Miner et al., 2021). Evaluating drug effects on laryngeal function requires high temporal resolution due to rapid changes. An artificial intelligence (AI) model enables accuracy.

In 16 male Sprague Dawley rats weighing mean (SD) 421 (27) grams a femoral venous catheter was placed under isoflurane anaesthesia before conversion to intravenous anaesthesia with α-chloralose 50-60 mg kg^{-1}. A video endoscope was placed orally to visualise the larynx, and 30 seconds (s) baseline recording was initiated before 25 μg kg^{-1} fentanyl was injected IV over 10 s. The larynx was video-recorded for a duration of 216 or 516 s depending upon airway patency and respiration. To assess each frame of these videos an AI model was developed to define the glottic opening as either open, closed or undefined. A closed glottis over 1 s was defined as VCC. The model was trained on 22,000 annotated images. To evaluate the accuracy of the AI model, 80 frames were extracted by a random number generator. Each frame was assessed manually by a blinded observer and scored as open, closed or undefined. Sensitivity and specificity for the AI model were calculated to determine the model's accuracy in predicting the true state of the glottic opening.

Fentanyl induced VCC in all rats within 14 s with a median (range) duration of 21 (1-136) s. The AI model was able to predict the glottic opening with high accuracy, achieving a sensitivity of 97.5% and a specificity of 92.8%. Of the 80 images, 11 were categorised as undefined with 100% agreement between the manual method and AI model.

In conclusion, this AI model allows for an accurate assessment of the state of the glottic opening, making it a valuable tool to test novel antidotes.

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Miner, N. B., Schutzer, W. E., Zarnegarnia, Y., Janowsky, A. & Torralva, R. (2021). Fentanyl causes naloxone-resistant vocal cord closure: A platform for testing opioid overdose treatments. Drug Alcohol Depend, 227: 108974. doi: 10.1016/j.drugalcdep.2021.108974.

8. A retrospective single-centre study of dogs undergoing general anaesthesia for radiotherapy treatment

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This retrospective, single-centre study aimed to establish the types and incidence of complications in dogs undergoing anaesthesia for radiotherapy and identify associated risk factors.

A retrospective analysis of clinical records of dogs undergoing general anaesthesia for radiotherapy treatment at the University of Glasgow between January 2017 and January 2020 was performed. The anaesthetic protocol and incidence of complications were recorded. Complications were defined based on physiological parameters and comments on the clinical record. Factors potentially associated with the incidence of complications were identified using univariable logistic regression ($p \leq 0.1$), and used to create a mixed multivariable regression model, with patient identity as a random effect. In the multivariable model $p < 0.05$ was considered significant.

Overall 129 dogs undergoing 131 courses of radiotherapy, totalling 1289 anaesthetic events, met the inclusion criteria. The final model included 1284 anaesthetic events, owing to missing data. Complications occurred in 1030 anaesthetic events (79.9%), with respiratory complications the most common ($n = 467$, 36.2%). In the multivariable model, increasing treatment number (Odds Ratio [OR 0.941], 95% confidence interval [CI] 0.907 - 0.976) and increasing age (OR 0.931, 95% CI 0.869 - 0.998) were associated with decreased odds of complications. Factors associated with increased odds

of complications included intermittent positive pressure ventilation (OR 1.515, 95% CI 1.103 - 2.081), administration of intravenous fluid therapy (OR 2.909, 95% CI 1.083 - 7.810), and opioid premedication (OR 1.595, 95% CI 1.047 - 2.431). Entire females had reduced odds of complications compared to castrated males (OR 0.448, 95% CI 0.214 - 0.940).

Anaesthetic complications occurred frequently in dogs undergoing radiotherapy. The clinical impact was difficult to determine in this retrospective single-centre study. The incidence decreased over the course of treatments and with increasing patient age. Further investigation of risk factors is warranted, ideally with a prospective multi-centre study.

9. Total intravenous anesthesia in a dog with Tetralogy of Fallot undergoing cystotomy

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Tetralogy of Fallot (ToF) is a congenital cardiac disease characterized by pulmonary valvular or subvalvular stenosis, dextroposition of the aorta, ventricular septal defect and ventricular hypertrophy secondary to right ventricular outflow tract obstruction. The anesthetic management of a dog with ToF has been described using partial intravenous anesthesia (Ferrari et al., 2022; Veen et al., 2022). We aim to present a total intravenous anesthesia (TIVA) protocol for the management of an eight-year-old Welsh Corgi presented for cystotomy due to a solitary urolith.

Premedication consisted of methadone 1 mg kg^{-1} IM and alfaxalone 1 mg kg^{-1} IM. The left cephalic and saphenous veins were catheterized for the administration of fluids and drugs throughout the procedure. Electrocardiogram was monitored during the induction of general anesthesia (GA), that was performed with etomidate 1 mg kg^{-1} and midazolam 0.25 mg kg^{-1} IV. Patient's trachea was intubated, and GA was maintained with 100% oxygen and the IV infusion of alfaxalone (0.05-0.2 mg kg^{-1} minute^{-1}), remifentanil (0.1-0.7 mg kg^{-1} minute^{-1}) and dexmedetomidine CRI 0.5 mcg kg^{-1} hour^{-1}. An arterial catheter (22G catheter) was placed on the right dorsal pedal artery for invasive blood pressure (IBP) measurement, and 4-point transverse abdominal plane block was performed with bupivacaine 0.125% with a total volume of 8 mL.

Mild bradycardia was observed after induction and glycopyrrolate 5 mcg kg^{-1} was administered IV. GA was stable throughout surgery (60 minutes) with a total anesthesia time of 90 minutes without anesthetic complications. The dexmedetomidine infusion was not discontinued during recovery and ECG and IBP were monitored during the recovery. Extubation was achieved without complications 60 minutes after discontinuing alfaxalone and remifentanil IV infusions.

The use of TIVA could maintain cardiovascular stability in canine patients with ToF undergoing non-cardiac surgery, however, anesthetic recovery was prolonged.

References

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Veen, I., Szatmári, V., De Vries, A., De Grauw, J., 2022. Anaesthetic management of a dog with tetralogy of Fallot undergoing placement of a modified Blalock-Taussig shunt. Vet Record Case Reports 10, e256.

10. Respiratory compliance in anaesthetised and intubated brachycephalic dogs with and without brachycephalic obstructive airway syndrome (BOAS)

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The impact of BOAS on respiratory mechanics is unclear and may alter ventilation strategies under anaesthesia.

This prospective observational study recruited client-owned brachycephalic dogs (ASA grade 1-3), which were clinically assessed as either respiratory functional Grade 0 (non-BOAS, $n = 30$) or Grade 1-3 (BOAS, $n = 26$) (adapted from Riggs et al., 2019). Patients were anaesthetised according to a standardised protocol for advanced imaging and dental procedures. Patients were orotracheally intubated, connected to a breathing system and pressure-controlled ventilation (peak inspiratory pressure 7-12 cm H_2O, using a Penlon Nuffield ventilator) was initiated around 30 minutes post-induction. In addition to routine anaesthetic monitoring, airway compliance was recorded at predetermined time points in sternal, right and left lateral recumbency. Thorax dimensions were assessed with a tape measure. Body surface area (BSA) was calculated. For statistical analysis, lung compliance and thorax measurements were compared between BOAS and non-BOAS dogs with Mann-Whitney U test. Correlations between variables were assessed with a Spearman rank order correlation coefficient (SCC). $P < 0.05$ was considered statistically significant.

Non-BOAS dogs showed significantly higher lung compliance BSA^{-1} compared to affected dogs in sternal (41.5 (31.3-51.8) vs. 32.9 (24.4 – 39.1), respectively, $P = 0.028$), right lateral (36.1 (25.7 – 46.3) vs. 27.0 (22.7 – 35.5); $P = 0.026$) and left lateral (33.6 (22.6 – 45.4) vs. 24.6 (18.3 – 32.2); $P = 0.020$) recumbencies. The compliance BSA^{-1} was higher in sternal compared to lateral recumbencies for all dogs. BOAS dogs had a significantly shorter distance between thoracic inlet and last rib compared to non-BOAS dogs (20 ± 4 vs. 23 ± 6 cm, respectively; $P = 0.043$). Compliance measured in sternal recumbency showed positive correlation with endotracheal tube size (SCC: 0.34; $P = 0.007$). Reduced compliance in BOAS-affected dogs should be considered when ventilating anaesthetised brachycephalic dogs.

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Riggs, J., Liu, N., Sutton, D. R., Sargan, D., & Ladlow, J. F. (2019). Validation of exercise testing and laryngeal auscultation for grading brachycephalic obstructive airway syndrome in pugs, French bulldogs, and English bulldogs by using whole-body barometric plethysmography. *Veterinary Surgery*, *48*(4), 488–496. https://doi.org/10.1111/vsu.13159

11. Comparison of fentanyl and alfentanil in combination with atropine for premedication of dogs undergoing radiotherapy

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Quick anaesthetic induction and recovery are desirable when anaesthesia is to be delivered repeatedly[1]. The minimal cardiovascular effects produced by opioids make them advantageous premedication agents, although dysphoria may occur at recovery[2].

The objective of this study was to evaluate the effects of two opioid-based premedication protocols on propofol dose and quality of induction and recovery in dogs anaesthetised for radiotherapy. Twenty-two dogs were randomly assigned to receive one of two intravenous premedication protocols on their first radiotherapy session, and the other one on their second treatment. Premedication consisted of atropine (10 µg kg^{-1}) mixed with equipotent doses[3] of either alfentanil (10 µg kg^{-1}, group AA) or fentanyl (2.5 µg kg^{-1}, group FA), followed two minutes later by propofol induction and 3% sevoflurane maintenance. Cardiorespiratory variables and observation of vocalizations, paddling, and nystagmus were recorded after premedication and during recovery. Time elapsed from discontinuation of sevoflurane to tracheal extubation, sternal position and walking were also recorded (in minutes).

The proportion of dogs vocalizing, paddling, and demonstrating nystagmus was not different between groups at any time point. In both groups, heart rate decreased after premedication (82 ± 27 and 93 ± 27 beats $minute^{-1}$ in groups AA and FA, respectively) compared to baseline (117 ± 23 and 112 ± 26 beats $minute^{-1}$ in groups AA and FA, respectively; $p < 0.001$). Required propofol dose did not differ between groups (3.8 ± 1.7 and 4.3 ± 1.3 mg kg^{-1} in groups AA and FA, respectively). Time to

extubation was shorter in group AA (5.3 ± 2.1 minutes) compared to group FA (6.2 ± 2.3 minutes; $p = 0.049$), while time to sternal recumbency and walking did not differ between groups.

The two premedication protocols produced comparable effects and were both found suitable for dogs undergoing repeated radiotherapy treatment.

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12. Pericapsular knee desensitization. An anatomical study in canine cadavers

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This study developed and compared ultrasound-guided and blind techniques for targeting the median (MAN), posterior (PAN), and lateral (LAN) articular nerves responsible for dogs' knee joint innervation.

The anatomical and ultrasonographic landmarks for targeting the MAN, PAN, and LAN in three canine pelvic limbs were identified. Ultrasound-guided and blind injections targeting the MAN, PAN, and LAN were performed with 0.025 and 0.05 mL kg^{-1} of a dye solution in ten cadavers donated for research purposes. The leg side receiving ultrasound-guided or blind injections was randomly assigned. Success rates (successful staining of the articular nerves confirmed upon dissection) were analyzed using Fisher's exact test, with a significance level of 0.05. The primary anatomical and ultrasonographic landmarks for targeting the MAN, PAN, and LAN were the fascial plane containing the descending genicular artery, the cranial aspect of the popliteal artery, and the caudal margin of the fibularis longus muscle on the caudolateral aspect of the fibula head, respectively. The anatomical landmarks for the blind injections were the depression between the vastus medialis and semimembranosus muscles, the caudal aspect of the knee joint (1-1.5 cm depth), and the caudolateral margin of the fibula head for the MAN, PAN, and LAN, respectively.

Out of 30 articular nerves targeted/dissected in each technique, the overall success rate was 97.6% for the ultrasound-guided and 70% for the blind techniques ($p = 0.01$). The MAN was stained in 100% of ultrasound-guided injections and 50% of blind injections ($p = 0.03$). The PAN and LAN achieved staining in 100% and 80% of ultrasound-guided and blind injections, respectively.

The articular nerves supplying the knee capsule can be injected using either ultrasound or blind techniques, with ultrasound potentially yielding superior results. Further investigation is needed to evaluate the analgesic and motor-sparing effects of the pericapsular knee desensitization technique in live dogs.

13. A retrospective analysis of incidence of complications in animals undergoing balloon valvuloplasty for treatment of pulmonic stenosis comparing inhalational anaesthesia versus TIVA

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Haemodynamic complications are common during anaesthesia for balloon valvuloplasty in dogs. This study compares the complications between anaesthetic maintenance with inhalant versus intravenous agents.

This is a retrospective observational study of 48 dogs undergoing balloon valvuloplasty via a left jugular transvenous approach between April 2014 and March 2023. Patients were premedicated with 0.2mg/kg methadone then maintained on total intravenous anaesthesia (TIVA) with propofol (n= 15) or inhalational volatile agent (n=33). Groups were compared to assess cardiovascular parameters, invasive blood pressure values, incidence of arrhythmias and requirement for interventions to achieve haemodynamic stability. Blood pressure values, heart rate and duration of hypotension were compared using an unpaired t-test. A Chi-square test was used to analyse incidence of hypotension and arrhythmias, use of a lidocaine CRI and requirement for interventions. A p value of <0.05 was considered significant.

Incidence of hypotension was significantly lower in patients maintained on TIVA (40.00%) compared to inhalant (78.79%) (Figure 1). Duration of hypotension was also significantly lower with TIVA (15.3 ± 24.8 vs 57.6 ± 56.7 minutes). Systolic, mean and diastolic blood pressure was significantly higher in patients maintained on TIVA (106.6 ± 17.9, 73.3 ± 9.7 and 59.2 ± 8.2 mmHg respectively) compared to inhalant agents (96.0 ± 14.7, 64.6 ± 8.9 and 52.2 ± 7.9 mmHg respectively). A significantly higher incidence of recorded arrhythmias was seen in patients maintained on propofol TIVA (92.9%) compared to inhalant (55.9%), likely subject to non-reporting bias. There was no significant difference in heart rate between TIVA (88.1 ± 14.5bpm) and inhalant (88.4 ± 18.1bpm). No significant difference was seen between groups for the interventions or other drugs required.

This study suggests that maintenance with propofol TIVA during balloon valvuloplasty may be associated with a lower incidence and duration of hypotension, and possibly increased arrhythmias during anaesthesia.

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Figure 2

14. Comparison of oscillometric and Doppler ultrasound blood pressure measured from tongue in anesthetized Beagle dogs

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This study aimed to compare the oscillometric blood pressure (OBP) and Doppler ultrasound blood pressure (DBP) devices with invasive blood pressure (IBP) at two different cuff positions (tongue and thoracic limb) in anesthetized Beagle dogs.

Eight adult female Beagle dogs weighing 9.2 ± 1.4 kg were sedated intravenous acepromazine (0.01 mg kg^{-1}), anesthesia was induced with intravenous alfaxalone (2 mg kg^{-1}) and maintained with isoflurane (0.8–3.5%). The dorsal pedal artery was catheterized for IBP measurements. DBP evaluation of systolic blood pressure (BP), and OBP evaluation of systolic, mean and diastolic BP were performed at tongue and thoracic limb during hypertension (>140 mmHg), normotension (90–
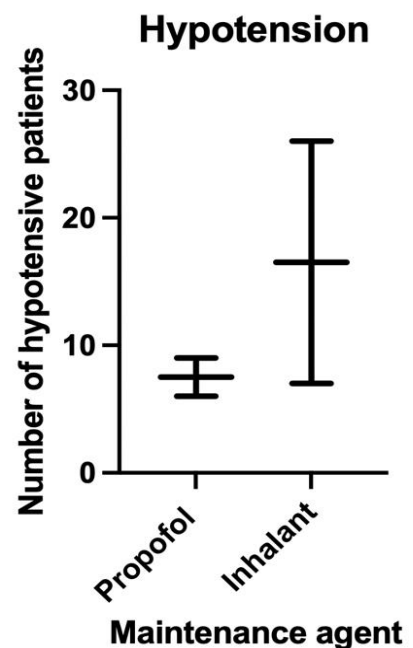
140 mmHg), and hypotension (<90 mmHg) based on systolic IBP. The BP ranges were induced by adjusting end-tidal isoflurane concentrations and/or dobutamine/norepinephrine administration. Agreement between IBP and DBP/OBP measurements (mean bias ± standard deviation) was analyzed using Bland-Altman analysis with the criteria for non-IBP in humans (<5 ± 8 mmHg) and small animals (≤10 ± 15 mmHg).

At both the tongue and thoracic limb positions, agreements between IBP and OBP for mean and diastolic BP met both veterinary and human standards across all BP ranges, but systolic BP only showed acceptable agreement to veterinary standard during hypotension (tongue, 2.8 ± 10.2 mmHg; thoracic limb, -8.3 ± 9.4 mmHg). Whereas agreement between IBP and DBP for systolic BP met the veterinary standard, not the human standrad, during normotension (tongue, 6.1 ± 6.2 mmHg; thoracic limb, 3.4 ± 8.5 mmHg) as well as hypotension (tongue, 7.9 ± 7.3 mmHg; thoracic limb, 3.9 ± 10.3 mmHg).

As an alternative to the thoracic limb, the tongue would be a clinically useful site for measuring perianesthetic OBP and DBP, providing relatively reliable estimates of mean/diastolic BP and systolic BP, respectively.

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15. Does the application of a pain-monitoring program modify pain scores and the use of analgesics in dogs?

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Although pain in hospitalized dogs is associated with suffering, increased morbidity and additional costs, evidence regarding the effects of routine pain monitoring on pain levels and management is lacking.

Interactive visual analogue scale (IVAS), short form Glasgow composite measure pain scale (SF-GCMPS), and Colorado State University canine acute pain scale (CSU-CAPS) were assessed by two raters, and analgesic use, co-morbidities, and demographic data were recorded in 86 hospitalized dogs. Following this initial evaluation, hospital staff were instructed on the importance of effective pain management and the use of CSU-CAPS which was then routinely implemented. Six-months later, pain was similarly assessed in a second group of 83 hospitalized dogs. Mann-Whitney and Chi Square tests were used to assess the effect of intervention and demographic variables on pain scores. Intra-test and rater reliability were assessed using Spearman's Rho. Linear regression and Kruskal-Wallis were used to evaluate associations between pain scores and other variables.

Median pain scores [quartiles] after intervention indicated less pain than before (post *versus* pre) IVAS (6.5 [3-21.3] *versus* 15.5 [7-31.3]; $p < 0.001$), SF-GCMPS (3.0 [1.0-5.0] *versus* 5.0 [2.0-7.1]; $p = 0.004$) and CSU-CAPS (0 [0-1] *versus* 0.67 [0.33-1.33]; $p < 0.001$). SF-GCMPS correlations with CSU-CAPS (0.459) and IVAS (0.379) were lower than CSU-CAPS with IVAS (0.813). Analgesic administration was not significantly different following intervention. No significant association was found between pain scores and other variables.

This study found lower pain scores in hospitalized dogs after implementation of a pain monitoring program, without an observed change in analgesic administration.

16. Comparison of cardiac output index in dogs before and after mitral valve repair as determined using pulse pressure recording analytical methods

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Surgical repair is an effective treatment for mitral regurgitation in dogs (Uechi et al., 2012). Cardiac output immediately increases upon repair in humans (Patzelt et al., 2017), there are currently no studies in dogs.

This retrospective observational study included dogs undergoing mitral valve repair under cardiopulmonary bypass between October 2023 – June 2024. Arterial waveform analysis determined cardiac index (CI) and systemic vascular resistance index (SVRI), this technique has acceptable concordance with thermodilution in anaesthetised dogs (Briganti et al., 2018). Data was collected over pre- and post-repair time periods: start of invasive blood pressure monitoring to heparin administration, and venous cannula removal to end of monitoring. Data was tested for normality using the Kolmogorov-Smirnov test. Influence of disease severity was investigated by calculating change in CI after repair and comparing dogs of different disease stages.

A significant increase in CI after mitral valve repair was seen in 9/20 (45%) dogs and a significant decrease in SVRI in 17/20 (85%). Results stratified by disease stage are outlined in the table.

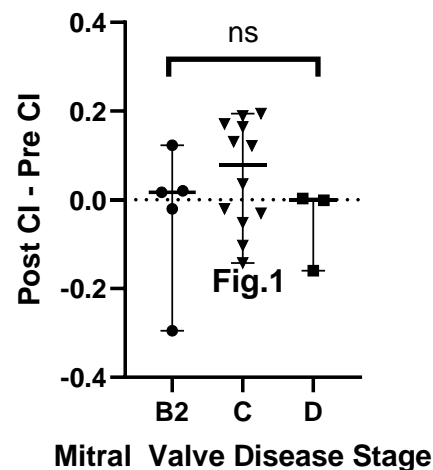| Mitral Valve Disease Stage	Total number of dogs	Cardiac Index Number (%) Statistically Significant Increase	Systemic Vascular Resistance Index Number (%) Statistically Significant Decrease	Details of significant intraoperative complications
B2	5	3 (60%)	2 (40%)	Aortic rupture (n = 1) Haemorrhage (n = 1)
C	12	6 (50%)	12 (100%)	Haemorrhage (n = 1)
D	3	0 (0%)	3 (100%)	

The one-way ANOVA, Fig. 1, demonstrates no significant difference in the change in median CI between dogs with different stages of mitral valve disease.

The majority of dogs, 85%, included showed a significantly decreased SVRI after mitral valve repair, 45% demonstrated a significantly increased CI. Further research should investigate a potential correlation between degree of CI increase and a positive outcome.

Change in Median Cardiac Index (CI) After Repair

Fig.1

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17. The effect of lidocaine splash block followed by suspensory ligament massage in female dogs undergoing ovariohysterectomy. A prospective study

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Lidocaine has been shown to have various analgesic effects in dogs undergoing ovariohysterectomy. Our study assessed the efficacy of lidocaine irrigation on suspensory ligament, followed by ligament massage, to achieve sufficient intraoperative analgesia.

Thirty-eight female dogs were included in this prospective, double-blinded clinical study and randomly allocated to two groups (n = 19 each). Group L received a splash block of lidocaine, and Group C received saline. Premedication consisted of dexmedetomidine (5 µg kg^{-1}) and buprenorphine (20 µg kg^{-1}) IM in both groups. Anaesthesia was induced with propofol (1 mg kg^{-1} to effect) and maintained with isoflurane. After induction, meloxicam (0.2 mg kg^{-1}) was administered SC. The HR, f_R, MAP, and end – tidal isoflurane concentration [FE´ISO] were continuously recorded. FE´ISO was required to reach 1.2% and remained steady for 10 minutes before any surgical manipulation. A splash block with either 0.5 ml of 2% lidocaine or an equivalent volume of saline was applied to the suspensory ligament, followed by ligament massage for 60 seconds, and another 60 seconds of waiting before handling the left ovary. Rescue analgesia (fentanyl at 2 µg kg^{-1}) was administered if an increase of 30% or more was detected in HR, f_R, and MAP, compared to their values before ovarian manipulation. The same procedure was applied to the right ovary. All dogs recovered uneventfully. Data were analysed using a mixed model for repeated measures ANOVA and Pearson's Chi-Square test.

A statistically significant difference in the incidence of rescue analgesia was observed between the groups ($p < 0.0005$), with 17/19 dogs in group C and 2/19 in group L requiring rescue analgesia. After ovarian manipulation, mean values of HR, f_R, and MAP were significantly higher in Group C.

The combination of lidocaine splash block followed by massaging of the suspensory ligaments achieved adequate intraoperative analgesia.

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18. Description of an ultrasound-guided maxillary nerve block in dogs: a cadaveric study and case series

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This study assessed an ultrasound-guided in-plane technique for maxillary nerve blockade in dogs, a method previously only described in Equidae (O'Neill et al., 2014; Stauffer et al., 2017; Hagag & Tawfiek, 2018).

The ethical approval was obtained (CEEAUCV2402). Twelve thawed canine cadavers were positioned in lateral recumbency, with each hemimaxilla receiving 0.1 ml of yellow-latex-based dye diluted 1:1 in saline. A 5-8 MHz microconvex ultrasound probe was placed transversally on the head to visualize the pterygopalatine fossa. The probe was positioned ventral to the zygomatic arch, cranial to the mandible and moved until the fascia separating the zygomatic gland from the medial pterygoid muscle was identified. A 22G, 50 mm insulated needle was inserted caudomedially to pierce the fascia and inject the dye. Successful injection was confirmed by staining of the fascia upon dissection. The procedure was then applied clinically to six dogs undergoing surgical procedures. Nine blocks were carried out with 0.5% bupivacaine (0.06-0.2 ml kg^{-1}). The pulse of the maxillary artery served as a landmark for accurate injection. Success was defined as the absence of pain reaction after the upper lip was pinched compared with lower lip once the animal had recovered from anaesthesia. Descriptive statistics were used. Weight was presented as median (range) and success as % and n/n.

Anatomical landmarks were consistently identifiable across cadavers. Weight was 12.6 (2.8-30.5) kg. The overall success rate of the block was 58% (14/24), with one instance where dye was not found. In the clinical cases, the weight was 16.3 (4.4-31.5) kg. The upper lip pinch reflex was absent in all dogs (100%, 9/9).

This ultrasound-guided technique seems to facilitate precise targeting of the maxillary nerve. The visualization of the maxillary artery pulse in live patients could be used as a guide to perform the block.

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19. Comparison of two ultrasound-guided versus anatomical landmarks techniques for inferior alveolar nerve block in dogs

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The inferior alveolar nerve block (IANB) has been described in horses and sheep using an ultrasound-guided (US-G) technique (Johnson et at., 2019; El-Sherif et al., 2024). This study aimed to describe two US-G techniques for IANB in dogs and compare their success to an anatomical landmark-guided technique (O'Morrow 2010).

Forty intact hemimandibles from twenty thawed canine cadavers were used. There were split into three groups: US-G in-plane (IG), US-G out-of-plane (OG), and anatomical landmark-guided (AG). The side (left/right) and the technique (IG/OG/AG) were randomly assigned. For the US-G techniques, the cadavers were positioned in dorsal recumbency. A microconvex 5-8 MHz ultrasound transducer was positioned transversely over the caudal third of the medial aspect of the mandibular body to identify the mandibular foramen. In the IG approach, a 50-mm (22G) insulated needle was advanced ventrodorsally with the bevel toward the bone surface. In the OG approach, the needle was inserted medioventrally and caudocranially. A total of 0.1 mL of a yellow latex-based dye (diluted 1:1 in saline solution) was injected. Success was defined as staining of the inferior alveolar nerve near the foramen upon dissection. Dye spread into the mandibular canal and the lingual nerve were also assessed.

Results were presented as descriptive statistics. The weight of the cadavers was 11.85 (2.8-30.5) kg. the success rate among the groups were compared using a Chi-squared test. AG had the highest success rate (14/16), followed by IG (10/12) and OG (7/12). No significant differences were observed

between groups. Staining within the mandibular canal was only observed with OG (1/12), and in all successful injections, the lingual nerve was stained.

According to our results, the US-G techniques described neither improve success rated nor prevent dye staining in the lingual nerve. Therefore, no advantages were found using the US-G techniques.

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20. **The effect of a subsequent dose of dexmedetomidine or other sedatives following an initial dose of dexmedetomidine on sedation and quality of recovery in dogs. Part I**

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According to the literature, the increase of dexmedetomidine dosage extends the duration of sedation, but not the degree of sedation. This study aimed to evaluate the quality of sedation and recovery after two consecutive doses of dexmedetomidine or subsequent administration of other common anaesthetics following the initial dose of dexmedetomidine.

This was a prospective, crossover, blinded, randomised study. Six adult laboratory Beagles participated in seven treatments, depending on the drug combination administered. The initial dose of dexmedetomidine (5 µg kg^{-1}) was followed by the administration of either a second dose of dexmedetomidine (2.5 µg kg^{-1}), butorphanol (0.2 mg kg^{-1}), buprenorphine (0.02 mg kg^{-1}), tramadol (2 mg kg^{-1}), ketamine (2 mg kg^{-1}), midazolam (0.1 mg kg^{-1}) or saline 0.9% (0.5 ml). The quality of sedation was assessed using the Grint sedation scale. Recovery quality was assessed, using two recovery scales, following atipamezole administration in all treatments. A quantile regression model and multilevel parametric survival models were used for statistical analysis.

No significant increase was observed after the subsequent dose of dexmedetomidine regarding the median sedation score (10 (7-15)) and duration of sedation (60.0 ± 4.6 minutes) compared to saline (6.5 (4-8) and 55.0 ± 3.3 minutes respectively). The subsequent administration of opioids produced enhanced sedation in comparison to saline (all $p < 0.035$). The subsequent administration of midazolam and ketamine significantly reduced the duration of sedation (48.3 ± 7.1 and 46.3 ± 6.3 minutes respectively). The median sedation score was significantly lower, after ketamine administration (5 (1-6)), compared to all treatments (scores ≥ 6.5 (4-8)), while recovery quality was inferior and adverse effects were observed.

Repeated administration of dexmedetomidine did not enhance sedation quality or duration. In contrast, the sedative effect of dexmedetomidine was enhanced by addition of opioids. Administration of midazolam or ketamine adversely affected initial sedation and recovery quality.

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21. The effect of a subsequent dose of dexmedetomidine or other sedatives following an initial dose of dexmedetomidine on electrolytes, acid-base, creatinine, and troponin in dogs. Part II

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Sedative drug administration can impact the physical status of veterinary patients. Our study evaluated the effect of subsequent administration of various sedatives following an initial, but insufficient dexmedetomidine dosage.

This prospective, cross-over, blind, experimental study included six healthy adult Beagles. All dogs received an initial dose of dexmedetomidine (5 μg kg^{-1}), IM. When maximum sedation was observed, a subsequent, IM dose of either 2.5 μg kg^{-1} dexmedetomidine, 0.5 ml NS 0.9%, 2 mg kg^{-1} tramadol, 0.2 mg kg^{-1} butorphanol, 0.02 mg kg^{-1} buprenorphine, 2 mg kg^{-1} ketamine or 0.1 mg kg^{-1} midazolam was administered. To evaluate the treatments' effects, repeated HR, f_R, glucose, cardiac troponin I (cTnI), and creatinine measurements, along with repeated arterial blood gas analyses were performed. For data analysis the Wilcoxon signed-rank test and paired t-tests were employed.

Results revealed no significant changes in median creatinine, PaO_2, $PaCO_2$, mean pH and cTnI values, following all treatments administrations. Instead, median HR significantly decreased in all treatments (all median $\leq$ 40 (33-45) beats minute^{-1}), except in the dexmedetomidine-ketamine treatment (90.3 (64-120) beats minute^{-1}). Median f_R decreased significantly after the initial dose of dexmedetomidine (17.5 (9-30) breaths minute^{-1}) and after the combination of dexmedetomidine with opioids (all median $\leq$ 13 (9-18) breaths minute^{-1}). Median f_R significantly increased after the dexmedetomidine-ketamine combination (37 (30-42) breaths minute^{-1}). Mean glucose concentration increased significantly following the dexmedetomidine administration (111.5 $\pm$ 9.7 mg dL^{-1}), while the increase was not significant after the combination of dexmedetomidine with opioids or midazolam.

Despite changes in HR and f_R values, the administered drugs did not compromise animal physical or biochemical status, considering that oxygenation, acid-base balance were not affected and myocardial injury was not detected, as cTnI remained within normal values. Nonetheless, the hyperglycaemic effect of dexmedetomidine was potentially mitigated by the administration of opioids and midazolam.

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22. Epidural anaesthesia with temperature-responsive hydrogel and bupivacaine combination in dogs: a comprehensive study

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This study aimed to compare the effect of epidural anesthesia using 0.5% bupivacaine alone (control) versus bupivacaine combined with temperature-responsive hydrogel (TRH treatment), a phase transformation drug delivery system (injectable liquid at $\leq$8°C and gel at $\geq$22°C).

In three parts of epidural distribution, antinociception, and bupivacaine plasma concentration, the two treatments were crossover in five healthy adult Beagle dogs (13.8 $\pm$ 1.5 kg). For each part, lumbosacral (LS) epidural anesthesia was performed twice using each treatment solution (0.2 mL kg$^-$

[1]) with 2-week intervals under isoflurane anesthesia. In part 1, epidurography was performed from LS to the L1 vertebra using magnetic resonance imaging. In part 2, antinociception was assessed at the metatarsal pad using algometry every hour after recovery from general anesthesia. In part 3, peak bupivacaine plasma concentrations were assessed through serial measurements. After each experimental procedures, behaviors including posture, gait and urination were monitored for one day. Between the two treatments, the distribution homogeneity and spinal compression of epidural solution, antinociceptive duration, and plasma concentrations were compared using the Wilcoxon signed-rank test.

Compared to control, TRH treatment show more uniform epidural distribution but greater spinal cord compression at every vertebral level from L7 to L1 (all $p < 0.008$ except for L6), with the largest compressed ratio being 43.4%. In addition, TRH increased the antinociceptive duration (7.0 ± 1.0 hours > 3.3 ± 0.6 hours, $p = 0.004$), and decreased the peak plasma concentration (479.8 ± 42.5 ng mL^{-1} < 1100.2 ± 16.5 ng mL^{-1}, $p < 0.007$). No behavioral abnormalities were observed after the epidural's effects subsided.

The use of TRH can enhance the effect of epidural anesthesia by promoting even distribution, lowering plasma concentration, and extending duration. Although the spinal cord compression ratio remained below the documented threshold for irreversible damage (62%) in dogs, caution is required.

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23. Low-dose dexmedetomidine as an adjuvant to regional anaesthesia of the oral cavity with levobupivacaine has no effect on serum cortisol and blood glucose concentrations in dogs

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The hypothesis was that low-dose dexmedetomidine (DEX) as an adjunctive analgesic to regional anaesthesia of the oral cavity with levobupivacaine (LBUP) reduces the perioperative stress response in terms of serum cortisol and blood glucose concentrations in dogs anaesthetised with isoflurane for dental procedure.

All dogs were premedicated with methadone 0.2 mg kg^{-1} IV. Levobupivacaine 0.5% was administered to desensitise all four quadrants of the oral cavity in all dogs (0.11 mL kg$^{-2/3}$ for the infraorbital (IO) block and 0.18 mL kg$^{-2/3}$ for the inferior alveolar (IA) block). In addition to LBUP, the dogs received placebo intravenously (IV) or DEX IV or perineurally at one block (IO or IA). They were randomly assigned to four groups of ten dogs each: LBUP + DEX IV, LBUP + DEX IO, LBUP + DEX IA and LBUP + PLC IV. The dose of DEX was 0.5 µg kg^{-1}. Serum cortisol and blood glucose concentrations were determined before administration of the oral blocks and at the end of the procedure. Values are reported as median (interquartile range). Differences between groups were analysed using a one-way ANOVA (for normally distributed data) or a Kruskal-Wallis test (for non-normally distributed data). If differences were found, corresponding post-hoc analyses were performed. Statistical significance was set at $p < 0.05$.

No significant differences in cortisol concentration were observed in any of the groups. Glucose concentration was only significantly higher in LBUP + DEX IA at the end of the procedure compared to baseline.

The hypothesis could not be confirmed. The reduction of perioperative stress response in all groups of dogs could be attributed to the use of LBUP and not DEX as there was no significant difference between LBUP + DEX IV and LBUP + PLC IV groups.

24. Comparison of the sedative and cardiovascular effects of medetomidine and medetomidine-vatinoxan, combined with butorphanol, in pediatric dogs undergoing brainstem auditory-evoked response testing

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Medetomidine is a common sedative drug in dogs, and it can be combined with vatinoxan to reduce its cardiovascular effects (Kallio-Kujala et al. 2018). However, safety and efficacy of either medetomidine or medetomidine-vatinoxan has not been evaluated in puppies.
Healthy puppies aged between 6 – 8 weeks scheduled for elective brainstem auditory-evoked response (BAER) testing were recruited for the study. Puppies were randomised within each litter to receive either intramuscular medetomidine 10 µg kg^{-1} and butorphanol 0.2 mg kg^{-1}(group MB), or medetomidine 10 µg kg^{-1}, vatinoxan 0.2 mg kg^{-1} and butorphanol 0.2 mg kg^{-1}(group MVB). Heart rate (HR) and non-invasive MAP were measured at baseline (BL) and 5-minute interval after sedation. Paired samples Student t-test was used to compare means.
All the puppies (n = 32 were sufficiently sedated for BAER testing within 5 minutes after injection. At BL, HR was 178 ± 14 and 172 ± 20 bpm (p = 0.335), and MAP was 104 ± 25 and 104 ± 18 mmHg (p = 0.973) in group MB and MVB, respectively. Between 5 – 15 minutes, HR was significantly higher in group MVB (142 ± 28, 154 ± 27 and 157 ± 17 bpm) than in group MB (109 ± 15, 113 ± 14 and 119 ± 13 bpm) ($p < 0.001$). Whereas MAP was significantly lower in group MBV (99 ± 8, 82 ± 7 and 77 ± 7 mmHg) than in group MB (111 ± 12, 97 ± 9 and 91 ± 7 mmHg) ($p < 0.001$). No hypotension (MAP < 65 mmHg) was detected in any animal. All the puppies recovered from sedation uneventfully.
Medetomidine-butorphanol, with or without vatinoxan, is safe and effective sedative combination for puppies. The combination of medetomidine-butorphanol and vatinoxan maintains heart rate closer to baseline value.

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25. Usefulness of perfusion index derived parameters in dogs undergoing interventional cardiology

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The study aimed to investigate changes in perfusion index (PI) and plethysmographic variability index (PVI) in dogs undergoing interventional cardiology. After the resolution of the cardiac condition, we hypothesized abrupt changes in PI and PVI, which would correlate with recognized indices of peripheral perfusion.
Twenty-two dogs presenting for interventional cardiology (pacemaker implantation, balloon valvuloplasty, patent ductus arteriosus occlusion, and radiofrequency catheter ablation of accessory pathways) were included. Cardiovascular parameters, including PI, PVI and MAP were monitored every 5 minutes intraoperatively. The PI and PVI were digitally displayed (Masimo Radical 7; version

v1.16.3i, Masimo Corp, CA, USA) using a clip-type pulse oximeter probe. The values obtained 5 minutes before (PI-pre, PVI-pre) and 5 minutes after (PI-post, PVI-post) the cardiac intervention were compared. Arterial blood gas samples were analyzed every 30 minutes and immediately after cardiac intervention. Blood lactate (LAC) and base excess (BE) were utilized as indicators of peripheral perfusion and correlation with cardiovascular parameters was investigated. Data were normalized, checked for outliers, and compared using one-way ANOVA and Tukey post-hoc multiple comparison tests. Linear correlation between parametric continuous variables was assessed using Pearson's correlation coefficient. A value of $p < 0.05$ was considered statistically significant.

No statistically significant difference was found between PI-pre and PI-post and between PVI-pre and PVI-post. A moderate correlation was found between PI-post and MAP-post ($r = 0.46$, $p = 0.01$) and PI-post and pH-post ($r = 0.43$, $p = 0.02$). Moderate negative correlation was found between PI-post and PVI-post ($r = -0.46$, $p = 0.01$). PI-post weakly correlated with BE-post ($r = -0.09$, $p = 0.65$) and LAC-post ($r = 0.09$, $p = 0.65$).

The results suggest that PI values obtained with Masimo pulse oximeter cannot be considered clinically useful early indicators of changes in peripheral perfusion in dogs undergoing interventional cardiology.

26. Efficacy of enflicoxib in the control of postoperative pain and inflammation in dogs undergoing orthopaedic surgery

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A single enflicoxib administration can control pain and inflammation for one week which would improve animal welfare and treatment compliance compared to daily treatments.

Twenty-eight dogs were randomized to receive a single 8 mg kg^{-1} oral dose of enflicoxib (n = 14) 24 hours before surgery, or meloxicam (n = 14) at 0.2 mg kg^{-1} SC at induction and orally at 0.1 mg kg^{-1} daily for seven days. Pain and inflammation were assessed at different timepoints after surgery using the Short Form of the Glasgow Composite Measure Pain Scale (SF-GCMPS) and Visual Analog Scales (VAS) to assess pain at rest, under palpation and level of inflammation. SF-GCPS scores were calculated as area under the curve (AUC) for the initial 24 hours. Comparisons between groups were performed by use of ANOVA test and Mann-Whitney U test at each time point. A non-inferiority margin ± 3 (Δ) Pacheco et al. (2020) and Ross et al. (2022) was defined for SF-GCPS and analysed by two-sided Student's t tests.

No statistically significant differences were observed between treatments for the SF-GCPS and VASs scores overall and at each timepoint. Non-inferiority was stablished in the GCPS-SF total scores and AUC (Figure 1).

A single enflicoxib dose 24 hours before orthopaedic surgery is non-inferior to daily meloxicam in the control of post operative pain and inflammation.
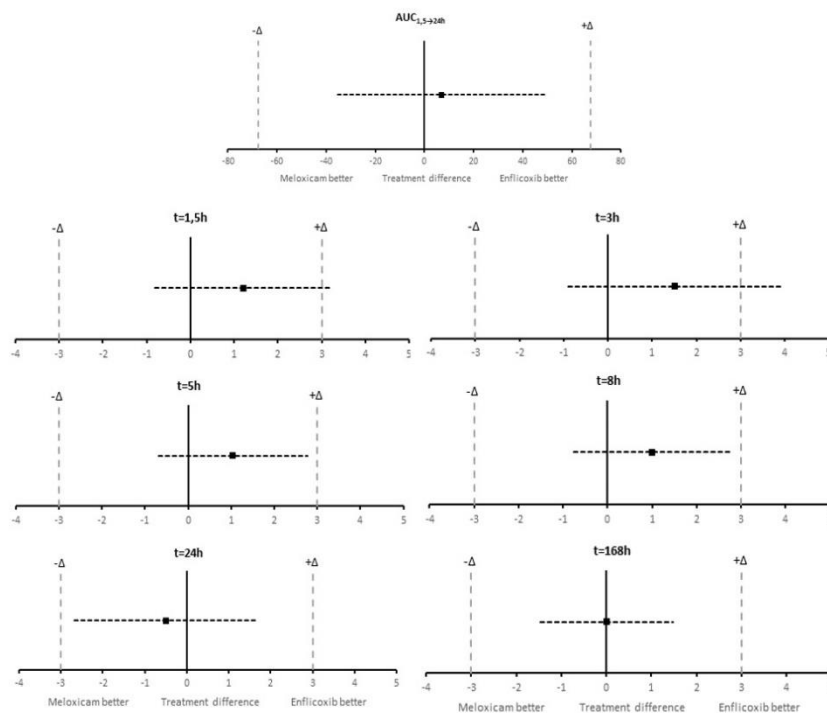

Figure 1: Mean and 95 % confidence interval for the difference of the Glasgow Composite Pain Scale (GCPS-SF) Area Under the Curve (AUC) for the initial 24 hours period and the GCPS-SF average total scores at each time point between treatments. Broken, vertical lines on the graphs show the non-inferiority margin

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27. Anaesthetic complications in cervical disc extrusion surgeries in dogs: a retrospective study

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To evaluate anaesthetic complications in surgeries for cervical disc extrusion in dogs, considering the location of the lesion.
This retrospective observational study was performed at Puchol Veterinary Hospital between 2017 and 2024. Data recorded included age, sex, breed, weight, cervical lesion location, and surgeon. Evaluated variables included hypothermia, hypercapnia, hypotension, haemorrhage, haemoglobin desaturation, nociceptive response, bradycardia, regurgitation, emergence delirium in recovery, and corneal ulceration. Analysis was performed using Microsoft Excel (2019) and R software (version 4.1.1) with descriptive statistics and nonparametric tests to determine relationships between the variables and anaesthesia complications. Statistical significance was considered if $p \leq 0.05$.

Eighty-four records were analysed, with mixed-breed dogs (12/84; 14.29%) and Beagle (12/84; 14.29%) being the most represented. The mean (±SD) age was 8.46 (±2.47) years, and the mean (±SD) weight was 13.72 (±8.64) kg. Bleeding occurred in 22/84 (26.19%) animals, being more frequent in the Beagle breed (6/22; 27.27%; p = 0.037). Hypercapnia was observed in 61/84 dogs (72.62%) and was more frequent in males (35/61; 57.38%; p = 0.033). Nociception was diagnosed in 35/84 patients, with no significant prevalence observed in individual-specific variables. Surgeries were performed by orthopaedic surgeons (60/84; 71.43%) and neurologists (24/84; 28.57%), with higher complication rates in surgeries performed by orthopaedists: hypercapnia (36/61; 63.93%; p = 0.014), bleeding (20/22; 90.91%; p = 0.020), and nociception (29/35; 82.86%; p = 0.052). While bradycardia was more common at C4-C5 (3/6), it was not statistically significant. Bleeding was found to be statistically significant different between the locations evaluated (p = 0.033), being more frequent in C4-C5 (6/22; 27.27%) and C6-C7 (6/22; 27.27%).

Anaesthetic complications in cervical disc extrusion surgeries in dogs were significantly associated with lesion location. Specific complications such as haemorrhage and hypercapnia correlate with certain breeds, genders, and surgeon specialty.

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28. **The sedative effect of intravenous butorphanol in dogs with intracranial lesions or indicators of intracranial hypertension**

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Opioids are commonly used in veterinary medicine as pre-anaesthetic medication, with only mild sedative effects in healthy patients. We hypothesized that butorphanol 0.2 mg kg^{-1} administered intravenously (IV) would result in statistically significantly higher sedation scores and quicker onset of recumbency in dogs with intracranial space occupying lesions (MRI-iSOL) and MRI- determined indicators of intracranial hypertension (MRI-ICH), compared to those without.

A total of 53 dogs presenting for brain MRI were included in this prospective, observational study. Each dog was sedated with 0.2 mg kg^{-1} butorphanol IV and the quality of sedation, and onset of recumbency was scored before drug administration and every 5 minutes following IV butorphanol administration for 15 minutes using a modified sedation scale from Grint et al. 2009. Dogs could receive a maximum sedation score of 18, and onset of recumbency was achieved when a dog lay down without the ability to stand. Each MRI was assessed for the presence or absence of MRI-iSOL and MRI-ICH using T2-weighted sequences.

Using the Wilcoxon rank sum test, dogs with MRI-iSOL had significantly higher median sedation scores compared to dogs without 15 minutes after butorphanol administration (T15) (sedation scores 12 and 5 respectively). Dogs also had significantly higher median sedation scores with MRI-ICH compared to those without at T15 (sedation scores 12 and 5 respectively). A greater proportion of dogs with MRI-ICH (n = 10; 90%) achieved recumbency, than those without MRI-ICH using Chi squared test, (n = 20; 46.5%).

When intracranial disease is suspected, the administration of butorphanol as a pre-medicant could be used to predict the presence of MRI-iSOL and MRI-ICH. If a dog has a sedation score > 10 within 15 minutes of butorphanol administration, the animal should be treated with an anaesthesia protocol adapted to the presence of ICH.

29. **Ultrasound comparison of the degree of pulmonary atelectasis in mechanically ventilated dogs with and without positive end-expiratory pressure – Pilot study**

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This study aimed to describe the lung ultrasonography (LUS) findings present in dogs during general anaesthesia and the recovery period and to study the effect of positive end-expiratory pressure (PEEP) on the development of atelectasis.

A non-randomized clinical pilot study was conducted in dogs undergoing anaesthesia for magnetic resonance imaging (MRI) in dorsal recumbency (DR). Of the 15 dogs included in the study, 6 were ventilated with a PEEP of 4 cmH$_2$O throughout the anaesthetic period and 9 were ventilated without PEEP. LUS was performed after induction of anaesthesia (DR), at the end of the MRI scan (DR), and 15 minutes after arriving in the recovery room (sternal recumbency). For each time point, 8 lung quadrants were evaluated. A semiquantitative LUS score adapted from human medicine was used to assess the degree of atelectasis, with higher scores indicating greater loss of lung aeration (Monastesse et al. 2017). LUS scores between groups were compared using the Mann-Whitney U test ($p < 0.05$). Ultrasound findings suggestive of atelectasis were observed in both groups. These included the presence of 3 or more B-lines per lung quadrant, small subpleural consolidations, and multiple subpleural consolidations separated by an irregular pleural line. LUS abnormalities were observed in 3 dogs (20%) after induction of anaesthesia, 7 dogs (47%) at the end of the MRI scan and 1 dog (8%) during the recovery period. The highest score recorded throughout the study was 8 out of 24. There was no significant difference between the LUS scores of dogs ventilated with and without PEEP. LUS may be useful to detect atelectasis and monitor lung aeration during general anaesthesia and the recovery period in dogs. Ventilation with 4 cmH$_2$O of PEEP did not reduce atelectasis formation.

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30. Differences between transdiaphragmatic pressure of dogs suffering from cervical or thoracolumbar myelopathy anesthetized with isoflurane

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The aim of this study was to evaluate the differences in diaphragmatic contractility by assessing transdiaphragmatic pressure (Pdi), between dogs with cervical myelopathy (CM) and thoracolumbar myelopathy (TLM) under isoflurane anesthesia.

This prospective cohort clinical study included dogs status ASA II diagnosed with either CM or TLM anesthetized for diagnostics or surgical purposes between September 2021 to July 2023. Patients were premedicated with dexmedetomidine 180 μg m^{-2} followed by propofol 1 mg kg^{-1} IV to effect until intubation and maintained with isoflurane in 100% O$_2$. Diaphragmatic contractility was assessed through Pdi measurements using the Pressure Monitoring System Buzzer-II, Michael Roehrich, Austria. Two balloon catheters were placed in the stomach (Pgast) and the mid third of the oesophagus (Poes) respectively, and the maximum Pdi (Pdi = Pgast-Poes) were recorded at 10 (Pdi10), 20 (Pdi20) and 30 (Pdi30) minutes.

A total of 50 ($n = 50$) client owned dogs were included in the study from September 2021 to July 2023, divided into two equal groups: CM group ($n = 25$) and TLM group ($n = 25$). In group TLM, Pdi10 was 9.3854 mmHg ± 6.05387 and CM Pdi10 was 7.2497 mmHg ± 4.60554 ($p = 0.167$). In group TLM, Pdi20 was 10.2375 mmHg ± 5.81997 and CM Pdi20 was 7.9906 mmHg ± 5.16133 ($p = 0.155$). In group TLM, Pdi30 was 9.2456 mmHg ± 5.54297 and CM Pdi30 was 8.1299 mmHg ±

5.52719 ($p = 0.479$). In summary, no statistically significant differences were found between groups at any of the time points recorded.

Our findings suggest that diaphragmatic contractility is similar in dogs with both CM and TLM under isoflurane anesthesia.

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31. Low dose dexmedetomidine in dogs undergoing ECG-gated cardiac Computed Tomography: a case series

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Few publications evaluated cardiac computed tomographies (CCT) in cardiopathic dogs undergoing general anaesthesia (Scollan et al. 2015; To et al. 2019), and only one focused on the anaesthetic protocol (Moretti et al. 2024).

This retrospective case series aims to assess the feasibility of an anaesthetic protocol including low dose dexmedetomidine. Anaesthetic records of dogs referred between February 2021 and May 2024 for cardiac tamponade undergoing ECG-gated CCT with contrast medium administration were reviewed. Peri-anaesthetic parameters were analysed using descriptive statistics. Data are reported as mean value ($\pm$ SD) and range.

A total of fifteen client-owned dogs (7 males, 8 females; ASA III, body weight 25 ± 17.5 kg and age 8.6 ± 3.2 years) of different breeds presented with mild (n = 10/15) or moderate (n = 5/15) pericardial effusion, which was drained before anaesthesia. Dogs were premedicated with dexmedetomidine (0.5 -1 µg kg^{-1}) and butorphanol (0.1 - 0.3 mg kg^{-1}) IM; sedation was described as mild (n = 6) and moderate (n = 9). General anaesthesia was induced with intravenous propofol to effect (2 - 4.5 mg kg^{-1}) and maintained with isoflurane delivered in medical air and oxygen. Volume controlled ventilation with tidal volume set at 7-15 ml kg^{-1} was used. During anesthesia, HR, f_R, non-invasive arterial blood pressure (oscillometric method), SpO_2, FE'CO_2, and end-tidal isoflurane concentration were monitored.

During anaesthesia ranges of cardiovascular variables were as follows: HR 37-141 beats minute^{-1}, MAP 58 - 117 mmHg. No arrhythmias were recorded; mild hypotension was reported in two patients. Anaesthesia lasted for 43 ($\pm$ 12.5) minutes and extubation time was 7 ($\pm$ 4.7) minutes after breathing system disconnection. No mortality was recorded within 48 hours.

Low dose dexmedetomidine seemed to provide good haemodynamic stability in dogs with heart disease.

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32. Development and validation of 3D printed epidural nerve block simulation model in dogs

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The aim of this study is to develop and validate a three-dimensional (3D) printed simulation model of epidural anesthesia as an alternative to live dogs or cadavers for training novice.

A 3D model including lumbosacral vertebrae, and the iliac crest was created from computed tomography data from a 27.1 kg German Shepherd, positioned in the sternal recumbency with its pelvic limbs extended cranially. The skin and soft tissue were replicated using a silicon pad covering 20% gelatin gel. A hole was made in the ventral face of the bone model and a base with a cylindrical structure was attached to it. The aluminum foil inside the cylinder, covered with a disposable drape mimicking the ligament flavum for 'pop sensation', connects to a nerve stimulator using a nerve stimulation needle. Changes in the beep sound from the device verify successful needle insertion into the target space. To validate the model ten veterinarians with experience in epidural anesthesia were asked to anonymous online survey the model using a 5-point Likert-scale (1, strongly disagree; 2, disagree; 3, neutral; 4, agree; 5, strongly agree) about its ease of use, visual realism, anatomical accuracy, needle insertion, pop sensation, nerve stimulator, and suitability for education.

All validations scored a median 4 (agree) or higher, except for visual realism (median 3.5). Compared to using cadavers or live dogs, 80% (n = 8) of evaluators agreed (n = 4) or strongly agreed (n = 4) that using the simulation model could be beneficial for education/training.

The 3D printed epidural nerve block simulation model developed through this study was validated by veterinarians and demonstrated its potential as an easy-to-use, anatomically accurate, and ethical alternative for epidural nerve block training. Further studies are required to validate its educational effectiveness for novice, compared to training using cadavers or live dogs.

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33. Nociceptive electrical stimulation increases mean arterial blood pressure without an evident electroencephalographic response in dogs anesthetized with sevoflurane

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Patient State Index (PSI) and burst suppression are electroencephalogram (EEG) indices used to quantify anesthetic depth. This study evaluated HR, MAP, and PSI shifts with noxious stimulation (NS) at three end-tidal sevoflurane (ETSEVO) concentrations.

Five male, intact Beagles were anesthetized with sevoflurane and constant rate infusions of fentanyl, maropitant, and rocuronium. With the ETSEVO set at a median of 3.64% (95% CI: 1.93, 3.87%), determined from a previous experiment, the averages of HR, direct dorsal metatarsal MAP, and PSI (0 to 100) acquired via adhesive electrodes without (time 0 to 6 minutes) and with intermittent electrical NS (time 6 to 12 minutes) were recorded. The NS (two 10-millisecond and two 5-second stimuli, 5 seconds apart, 50 V, 50 Hz) was applied at 6, 8, and 10 minutes. Instances of burst suppression were recorded. These methods were repeated twice by lowering the initial ETSEVO by 23% and 46%. The effects of ETSEVO, NS, and ETSEVO with NS interaction were analyzed with generalized linear mixed-effect models. The effective dose of sevoflurane (ED50) to induce burst suppression was analyzed with a binomial logistic regression.

The median (95% CI) HR, MAP, and PSI at the highest ETSEVO without NS were 90 (64, 112) beats/min, 50 (41, 91) mmHg, and 2 (0, 45). There was no effect of the interaction of ETSEVO with NS. Higher ETSEVO decreased MAP and PSI ($p < 0.001$), but not HR. The NS increased MAP by 29% ($p < 0.001$), but not HR and PSI. The ED50 for burst suppression was 3.15% (2.75, 3.75%).

An autonomic response, measured by increased MAP during NS, was observed without evident changes in EEG variables. This occurred in cases of deep anesthetic plane, as indicated by burst suppression. Cardiovascular responses to noxious stimuli do not correlate with anesthetic depth measured by EEG.

34. Cardiovascular effects of intramuscular medetomidine-vatinoxan premedication in comparison to dexmedetomidine in dogs induced with propofol and anesthetized with sevoflurane

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Medetomidine-vatinoxan is a novel sedative-analgesic drug indicated for procedural sedation in dogs. The aim of this study was to compare the cardiovascular effects of intramuscularly administered medetomidine-vatinoxan to dexmedetomidine when used as preanesthetic.

In this cross-over experimental study six pre-instrumented (digital radiotelemetry transmitter and aortic flow probe) Beagles received medetomidine 0.75 mg m^{-2} and vatinoxan 15 mg m^{-2} (Zenalpha), or dexmedetomidine 0.375 mg m^{-2} intramuscularly. Anesthesia was induced with propofol approximately 20 minutes post-treatment and maintained with sevoflurane until 80 minutes. Heart rate (HR), direct mean arterial pressure (IBP), cardiac (CI) and systemic vascular resistance indices (SVRI) were recorded at baseline and every 5 minutes until 170 minutes. Each of the variables were analyzed via a mixed linear model repeated measures analysis with $p < 0.05$ considered significant. During anesthesia HR was significantly higher with Zenalpha than with dexmedetomidine from 35 to 50 minutes (at 40 minutes 112 ± 16 (mean $\pm$ SD) $versus$ 75 ± 20 bpm, respectively), and CI from 30 to 40 minutes (at 40 minutes 2.7 ± 0.3 $versus$ 1.6 ± 0.4 L min^{-1} m^{-2}, respectively). During recovery HR was significantly higher with Zenalpha than with dexmedetomidine from 110 to 170 minutes (at 170 minutes 106 ± 18 $versus$ 59 ± 9 bpm, respectively), and CI at 110, 120, and from 145 to 170 minutes (at 170 minutes 3.4 ± 0.8 $versus$ 2.0 ± 0.6 L min^{-1} m^{-2}, respectively). IBP and SVRI were significantly lower with Zenalpha compared to dexmedetomidine from 10 to 160 and 170 minutes, respectively (lowest group IBP 66 ± 4 mmHg with Zenalpha at 60 minutes).

It should be taken into consideration in clinical decision making that in comparison to dexmedetomidine heart rate can be expected to be higher and blood pressure lower during anesthesia and recovery in dogs premedicated with Zenalpha.

35. Clinical effects of vatinoxan co-administered with medetomidine and methadone in healthy dogs undergoing isoflurane anaesthesia

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Vatinoxan mitigates the cardiovascular effects of medetomidine but may cause hypotension during general anaesthesia and may alter plasma concentrations of co-administered analgesics (Kallio-Kujala et al., 2022). This study examines cardiovascular variables and methadone plasma levels in anesthetized dogs premedicated intramuscularly with vatinoxan, medetomidine, and methadone.

This study enrolled 16 healthy dogs, weighing 2.5 to 46 kg, undergoing elective midline ovariectomy. The animals received medetomidine (0.15 mg m^{-2}) and methadone (0.2 mg kg^{-1}) premedication with vatinoxan (3 mg m^{-2}; group MVM) or without vatinoxan (group MM). Anaesthesia was induced with propofol 20 minutes after the injection and maintained with isoflurane in oxygen. Clinical variables, including HR, non-invasive MAP, and end-tidal concentration of isoflurane (EtISO), were recorded at maximal traction of both ovarian pedicles and at skin suture. Methadone plasma concentration (cM) was measured at 15 (T15) and 90 (T90) minutes after premedication. Propofol dose and cM were compared between groups with a Student's t-test, and a linear mixed model was used to analyse the effect of time and group on clinical variables.

Propofol dose did not differ between groups. Time and group did not show any statistically significant effects on haemodynamic and respiratory variables. During anaesthesia, mean HR was 76 ± 21 and 91 ± 22 beats minute^{-1} and mean MAP was 88 ± 14 and 94 ± 16 mmHg in group MM and MVM, respectively. In both groups EtISO ranged between 0.6 and 1.8 %. A statistically significant difference between groups was found in cM only at T90 with a lower value in group MVM than MM (13.2 ± 3.0 vs 17.2 ± 3.4 ng ml^{-1}; $p = 0.024$).

The co-administration of vatinoxan in dogs premedicated with methadone and medetomidine may affect the plasma concentration of the opioid, although cardiovascular variables do not appear to present clinically relevant variations.

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36. Sedative effects of methadone combined with medetomidine alone, or with medetomidine and vatinoxan in dogs

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Vatinoxan, a peripheral alpha-2 antagonist, mitigates medetomidine's cardiovascular effects. This study compared sedation quality and cardiovascular variables in healthy dogs given methadone and medetomidine, with or without vatinoxan.

This study enrolled healthy dogs, undergoing elective midline ovariectomy. The animals were randomly assigned to two groups: one group received IM methadone (0.2 mg kg^{-1}) with medetomidine (0.15 mg m^{-2}) (group MM), and the other group received the same combination plus vatinoxan (3 mg m^{-2}) (group MVM). Sedation was evaluated using a 21-point scale (Grint et al. 2009) at 5, 10, and 15 minutes post-administration, with scores 3 to 6 considered mild sedation. HR was measured before sedation and at 15 minutes, and systemic arterial blood pressure was measured using oscillometry. Group differences were analysed using a Student's t-test or Wilcoxon test. A linear mixed model was used to analyse HR and MAP over time. Statistical significance was set at $p < 0.05$

Sixteen dogs weighing 2.5 to 46 kg were enrolled. Compared to group MM, group MVM had a statistically higher weight ($p = 0.014$) and body surface area ($p = 0.012$). Medetomidine dose was not significantly different between dogs ($p = 0.760$), and was 5.8 ± 3.1 and 5.5 ± 0.9 µg kg^{-1} in MM and MVM groups, respectively. The sedation was mild in 2 MVM dogs; the other animals were scored $\geq$ 8. IV catheter was inserted in all animals. HR decreased significantly ($p < 0.001$) in both groups, with an overall median (range) of 68 (42-100) bpm. MAP remained above 70 mmHg.

Both protocols may provide similar sedation for IV catheter insertion with cardiovascular stability. However, dogs receiving medetomidine and vatinoxan exhibited more variability in sedation compared to those receiving medetomidine alone, suggesting the need for higher doses of the combination to achieve consistent sedation levels.

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37. Cardiorespiratory effects of adding adrenaline to arthroscopic irrigation fluid on improvement of clarity of visual field in dogs

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Adrenaline is used as local haemostatic in human arthroscopy, due to its peripheral vasoconstriction (Kuo et al. 2018), which enhance image quality with minimal risk of hypertension or tachycardia (Abdelrahman et al. 2021).

Clinical prospective and randomized study involved 39 dogs undergoing diagnostic (n = 19) and therapeutic (n = 20) arthroscopies. Premedication included 0.01 mg/kg medetomidine and 0.2 mg/kg methadone IM. Induction was achieved after preoxygenation with 1 mg/kg ketamine and propofol to effect IV and maintained with isoflurane (FiO_2 0.4). All dogs received locoregional blocks with bupivacaine 0.25%. During the first two minutes of initiating the arthroscopy Ringer Lactate (RL) was used, then the irrigation fluid was switched according to group assignments. The therapeutic-adrenaline (TA) and diagnostic-adrenaline (DA) groups received RL with adrenaline (0.33 mg/L), whereas the therapeutic-control (TC) and diagnostic-control (DC) groups received RL without supplementation. Parameters including HR, SAP, MAP, DAP, cardiac output (CO), stroke volume (SV), systemic vascular resistance (SVR) and maximum pressure variation over time (dP/dtmax) (using the PRAM method, MostCare®) were recorded 2 minutes before ($T_{baseline}$) and 20 minutes after (T_{20}) starting the arthroscopy. The surgeon, who was blinded to the trial, assessed the image visibility quality using a visual analogue scale (VAS). Data analysis was performed using SPSS®. Non-parametric variables were analyzed with Kruskal-Wallis test and parametric variables with one-way ANOVA. A p-value ≤ 0.05 was considered statistically significant.

No significant differences were observed between groups in T_{basal} and T_{20} for HR (p = 0.85, p = 0.72), SAP, MAP (p = 0.95, p = 0.82), DAP, CO, SV, SVR (p = 0.241, p = 0.241), dP/dtmax, and VAS (p = 0.568).

The use of adrenaline at 0.33 mg/L as a hemostatic agent in arthroscopic irrigation fluid does not induce significant cardiovascular alterations in dogs, nor does it enhance image quality.

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Canine and feline

38. Analgesic practices for acute pain management by veterinarians in Africa

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The study aim was to understand the perceptions and analgesic practices for acute pain management by veterinarians in Africa. This was to help design and target future continuing education initiatives to improve the welfare of small animals in the African continent.

A survey was developed based on the current literature on the topic. The survey was made available online in English and French for 4 months to small animal veterinarians in Africa. Small animal veterinary associations in Africa where the predominant languages are English or French, as well as global veterinary organizations and the industry, were contacted to help disseminating the survey. A convenience sample was used so as not to limit to the number of participants. Social media posts were prepared in collaboration with the World Small Animal Veterinary Association which were distributed using different platforms. All categorical data were presented as counts and percentages. Binary variables were created for peri-operative non-steroidal anti-inflammatory drug (NSAID) use,

opioid use, local anesthetic techniques, pain assessment tools, and limited drug availability in the country (yes or no). All statistical analyses were performed using the open-source software RStudio version 2022.07.1-554.

There were 242 respondents. One hundred and seventy-two respondents identified cost as the primary factor limiting drug availability in their country. The most readily available opioids, NSAIDs, and local anesthetics were morphine, meloxicam, and lidocaine, respectively. The majority of respondents did not utilize pain assessment tools to evaluate peri-operative pain in cats (n=169) and dogs (n=170). Among those who did use these tools, the Feline Grimace Scale (n=27) and the Glasgow Composite Measure Pain Scale (n=30) were the most commonly employed.

Despite wide advertising a low number of responses were obtained. Cost limited drug availability which has wide implications for managing pain in dogs and cats in Africa.

Feline

39. Nerve conduction in cats: a pilot study to determine most appropriate use of opioid

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Nerve conduction reference studies in cats are old, using anaesthetics that are now banned (Redding and Ingram, 1984, Malik and Ho, 1989, Pillai, 1992). In cases with suspected neuromuscular pathologies, it is important to reliably assess the nerve integrity to correctly diagnose the cause of symptoms.

Healthy cats ($n = 6$) according to clinical, neurological and blood exams were fasted for 8-10 hours before induction of anaesthesia with propofol (1-4 mg kg-1) and maintenance with volatile isoflurane. The choice of opioid was randomised, and evaluators blinded to the treatment: fentanyl (0.003 mg kg^{-1}; $n = 2$), hydromorphone (0.05 mg kg^{-1}; $n = 2$) or methadone (0.2 mg kg^{-1}) IV. Cats were monitored and temperature maintained above 37.5°C. Motor and sensory functions of the tibial, ulnar, peroneal and radial nerves were assessed using surface and intradermal electrodes. Amplitude and velocity were compared between opioids using ANOVA or Student's t-test with the JMP Pro 17.0.0 software ($\alpha = 0.05$).

The use of intradermal electrodes enabled a greater number of nerves to be evaluated. Opioids influenced the conduction amplitude in the tibial motor nerve and ulnar sensory nerve ($p < 0.010$): Fentanyl was associated with a lower mean amplitude (17.5 ± 0.57 mV) for tibial nerves compared with hydromorphone (23.4 ± 1.70; $p = 0.005$) or methadone (25.6 ± 0.49 mV; $p = 0.012$). Fentanyl induced a lower loss of temperature ($p = 0.047$), allowing 94% of the nerves (7/8 motor and 8/8 sensory) to be assessed, compared with only 31% assessed for hydromorphone (50% motor) and 44% for methadone (50% motor), before reaching the minimum threshold (37.5 °C).

Considering the importance of temperature maintenance for obtaining reliable nerve conduction data, the use of fentanyl is recommended. However, further cases will be needed to validate this pilot study.

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40. Peri-anaesthetic complications in cats undergoing magnetic resonance imaging of the brain. A retrospective, single-centre study

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Fatalities have been reported in anaesthetised small animals (Brodbelt et al., 2007; Hicks et al., 2013). This retrospective, single centre study investigated anaesthetic complications in cats undergoing brain magnetic resonance imaging (MRI).

Records of all cats undergoing brain MRI in a referral veterinary hospital between June 2020 and January 2023 were reviewed. Forty-three cats met the inclusion criteria. Collected data included signalment, clinical signs, physical and neurological examination, anaesthetic protocol, complications during general anaesthesia, classified as mild or severe, and known survival time. Selected data was

compared between cats with intracranial lesions and those without. Continuous data was analysed with Mann-Whitney non-parametric test, while Fisher exact test was used for categorical data. Values of $p < 0.05$ were considered significant.

Forty-one cats experienced a peri-anaesthetic complication, which were subclassified as mild (n = 39) and severe (n = 15), but it was possible to experience both. Cats with intracranial lesions were more likely to experience severe peri-anaesthetic complications ($p = < 0.001$, OR: 12.4, 95% CI: 2.7 - 56.7), to receive mannitol (n = 9, $p = < 0.001$, OR: 1.8, 95% CI: 1.2 - 2.7) and to have a delayed extubation, extubation taking place greater than 20 minutes after cessation of maintenance anaesthetic agent (n = 3, $p = < 0.014$, OR: 1.2, 95% CI: 1.0 - 1.6) compared to those without intracranial lesions. Cats with intracranial lesions were more likely to have an abnormal neurological examination on presentation than those without intracranial lesions ($p = < 0.001$, OR 42.1, 95% CI 8.8 - 228.6). Cats with abnormal mentation on neurological examination or intracranial lesions were more likely to experience peri-anaesthetic complications. Previously reported risk factors (tracheal intubation, fluid therapy) for anaesthetic mortality were not found to be associated with increased risk in this population. (Brodbelt et al., 2007).

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41. A case report of accidental coadministration of medetomidine, vatinoxan and ketamine in a cat

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Elective feline castration is a common procedure in veterinary education, often involving an anaesthetic protocol that includes an α2 agonist and ketamine.

An 8-month-old, domestic short-haired male cat was presented for elective orchiectomy. Preanaesthetic clinical examination was unremarkable. The anaesthetic protocol planned included medetomidine for premedication, tramadol, meloxicam, intratesticular lidocaine for analgesia, and ketamine for anaesthetic induction and maintenance.

What was considered medetomidine 30 μg kg^{-1} and tramadol 2 mg kg^{-1} were injected simultaneously IM. After 15 minutes, the cat was deeply sedated, and ketamine 8 mg kg^{-1} was administered IM. Within two minutes, the cat showed signs of excitement (head tilting, multiple attempts to escape, ataxia) and the HR increased up to 280 beats minute^{-1}. Upon reevaluation of the drug vials, it was realized that vatinoxan and medetomidine were inadvertently injected, instead of plain medetomidine. The surgery was postponed, and tachycardia persisted (HR 250) for approximately 20 minutes. Midazolam 0.2 mg kg^{-1} IV was administered to treat excitement. Approximately one hour after midazolam administration, HR had returned to normal, and the cat had fully recovered.

Given the documented synergistic effects of ketamine and dexmedetomidine on sedation (Biermann et al., 2012), in our case excitation could be attributed to vatinoxan, which caused medetomidine's increased clearance, therefore allowing emergence of ketamine's dissociative effects (Honkavaara et al., 2017). A prior study on sheep using a combination of medetomidine, vatinoxan, and ketamine did not report any excitement (Raekallio et al., 2018), however ketamine was administered in a lower dose. Tramadol's involvement in this case is unlikely, considering the consistent sedation that its combination with α2 agonists produces. Mitigation of bradycardia by vatinoxan and its combination with ketamine most likely resulted in tachycardia. In conclusion, coadministration of vatinoxan, medetomidine and ketamine in cats should be used cautiously due to potential adverse effects.

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42. **Incidence of eye ulcers in anaesthetised hospitalised cats**

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Eye ulceration and corneal abrasion represent unfortunate but relatively common consequences of anaesthesia, often leading to debilitating outcomes. In dogs, corneal injury incidence ranges from 1.9% to 18.6% despite ocular lubricant use, but data for cats is lacking (Dawson & Sanchez (2016)). Anaesthesia's adverse ocular effects include reduced tear production, lagophthalmos, loss of eyelid reflex, and compromised tear film stability (Kaye et al. (2019).

This prospective observational study enrolled cats undergoing anaesthesia and hospitalised for at least 24 hours at the Vetsuisse Faculty, University of Bern. Exclusion criteria are in Fig. 1. Data collected included demographics, ASA status, anaesthesia time, hypotension period, type and frequency of eye ointment, and postoperative hospitalisation location (wards, ICU, ICU oxygen cage). Data were collected over three months. Diagnosis was based on clinical symptoms like blepharospasm, miosis, and squinting, confirmed by ophthalmic examination. Descriptive statistics were used for most data, and inferential statistics were applied where appropriate. Continuous data were checked for normality using Shapiro-Wilk normality test, and graphically with quantile plot and histogram population distribution. Fisher's exact tests were performed in case of binary variables and a Kruskal Wallis test was performed in case of continuous data.

Of the 50 cats studied (Fig. 1), 12% (n = 6) developed corneal ulcers post-anaesthesia, diagnosed 1 ($\pm$ 0.837) day after GA. A significant association was found between staying in an ICU oxygen cage versus any other cage (p = 0.044). No significant association was found between ICU or other hospital department stays (p = 0.576). Similarly, no significant association was found for demographics, ASA status, anaesthesia time, hypotension period, eye ointment type and frequency of applications.

This study describes a 12% incidence of eye ulceration in anaesthetised hospitalised cats, with ICU oxygen cage hospitalisation emerging as a potential risk factor.
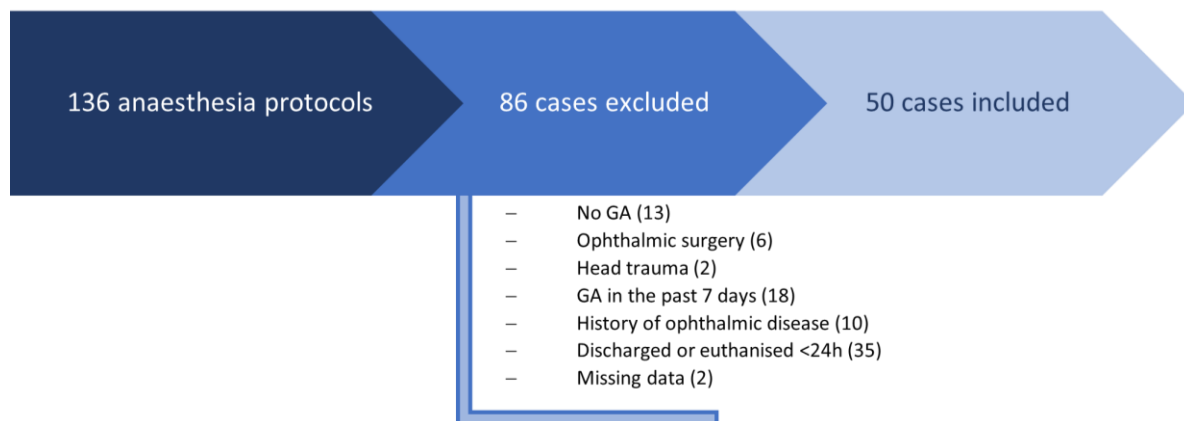
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136 anaesthesia protocols    →    86 cases excluded    →    50 cases included

        –   No GA (13)
        –   Ophthalmic surgery (6)
        –   Head trauma (2)
        –   GA in the past 7 days (18)
        –   History of ophthalmic disease (10)
        –   Discharged or euthanised <24h (35)
        –   Missing data (2)
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Figure 3 - Number of cats seen in the anesthesia department during the data collection period

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43. Comparison of the feline Glasgow Composite Measured Pain Scale (CMPS-f) in healthy cats at home and in a veterinary hospital: a prospective clinical study

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The main objective of this study was to compare the use of the feline Glasgow Composite Measured Pain Scale (CMPS-f) at home and in a veterinary hospital. The hypothesis was that pain-free cats would score higher with the CMPS-f in a stressful situation than when calm and relaxed.

Healthy, non-painful adult cats owned by clinical staff were examined in a prospective, clinical trial with two observers (owner and researcher). Cats were pain-scored by their owner at home (H), after arrival in the clinic (C1) and after a routine health check (C2). The researcher pain-scored the cats at C1 and C2 concurrently with the owner. Friedmann's test with Dunn's multiple comparison test were used for statistical analysis. The level of significance was set to α of 0.05.

Seventeen pain scores were obtained for analysis for each observation point (H, C1 and C2). Scores by the owner and the researcher at C2 were higher
compared with the scores at H ($p = 0.001$, $p < 0.0001$ respectively) and at C1 ($p = 0.0239$, $p = 0.0015$ respectively). The mean increase in CMPS-f scores from H to C2 and from C1 to C2 was 5.8 and 4.1, respectively. At C2, the CMPS-f intervention level ≥ 5/20 was reached in 11 out of 17 cats. No significant differences were present between the owner and researcher within one-time point.

Pain scores recorded after examinations in the clinic were significantly higher than those recorded at home. This suggests that stress may lead to a misinterpretation of the CMPS-f, potentially affecting the recognition of pain in cats during clinical assessments. Therefore, it is essential to conduct careful pain evaluations for hospitalised patients to ensure accurate assessments.

44. The effects of training on Feline Grimace Scale scoring for acute pain assessment in cats

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It is not known how training impacts Feline Grimace Scale (FGS) scoring among small animal veterinarians. The aim of the study was to determine the effects of training on the inter-rater reliability and agreement of the FGS scoring.

Seven small animal veterinarians scored 50 images of cats in varying degrees of pain before and after training using the FGS. Training was provided as a 1-hour online interactive discussion led by a board-certified anesthesiologist. Participant scores were compared to those of the anesthesiologist for ear position, orbital tightening, muzzle tension, whiskers change and head position. Inter-rater reliability was analyzed using the intraclass correlation coefficient (ICC) before and after training (ICC < 0.50 = poor reliability, 0.50 – 0.75 = moderate reliability, 0.75 – 0.90 = good reliability, and > 0.90 = excellent reliability). The Bland-Altman method was used to analyze the limits of agreement (LoA) and bias between participants and the anesthesiologist.

The inter-rater reliability for the total FGS ratio scores before and after FGS training were moderate (ICC = 0.75; 95% CI: 0.66 to 0.83) and good (ICC = 0.80; 95% CI: 0.73 to 0.87), respectively. Before training, LoA were -0.278 - 0.310 with a bias of 0.016. After training, LoA were -0.238 - 0.256 with a bias of 0.008. The bias was low (< 0.1) before and after training; LoA did not span the FGS analgesic threshold (0.39).

Training in FGS scoring improved inter-rater reliability and agreement among small animal veterinarians and the anesthesiologist during acute pain assessment.

45. Influence of drug induced nausea and euphoria/ dysphoria on Pain Scores in non-painful cats, a prospective, randomised, experimental trial

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The aim was to investigate if nausea and euphoria/ dysphoria can influence Pain Scores (PS) evaluated with the Feline Grimace Scale (FGS) and the Glasgow Composite Measure Pain Scale – feline (CPMS-F). The hypothesis was that nausea and dysphoria/euphoria would increase PS in non-painful cats.

In an experimental, controlled, randomised trial with cross-over design, seven healthy adult cats were evaluated by two investigators blinded to treatments: xylazine (XYL) 0.5 mg kg^{-1}, methadone (MET) 0.6 mg kg^{-1} and saline (SAL) with wash-out of one week. Assessments were performed at three consecutive baselines (BL) with 20 min in between and 10, 30 and 60 minutes after subcutaneous drug application. At each time point PS were determined *pre* and *post* thermal nociceptive stimulation (Topcat Metrology Ltd, TCM366). Thermal thresholds, signs of nausea, euphoria/dysphoria and sedation were recorded. Friedman's test was used to compare PS *pre* and *post* and to BL within groups. Alpha was 5%. Scores are presented as median [range].

All cats in MET showed euphoria starting at T10. In XYL, six cats showed signs of nausea or emesis by T10. In SAL, FGS was significantly higher at T60 *post* (6 [8]) compared to BL *pre* (2 [6]). In XYL, both FGS and CMPS-F were significantly higher at T10 *post* (7 [4]), 9 [5]), T30 *(pre:* 8[5], 9[7]; *post*: 8 [6], 10 [4]) and T60 *post* (8 [4], 9 [5]) compared to BL *pre* (1 [4], 1 [8]).

This study indicates that PS may be influenced by other types of discomfort like nausea.

46. The effect of passive leg raising manoeuvre on blood pressure in cats during surgery – pilot study

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Current veterinary research on passive leg raise (PLR) is limited and mainly involves hypotensive animals. This study aimed to evaluate PLR's impact on blood pressure in normotensive cats and correlations with age and weight, to improve care in both stable and potentially compromised patients. Twenty-five healthy female cats undergoing elective ovariohysterectomy were selected. Pre-surgical medication included Amoxicillin + Clavulanic Acid (8.75 mg/kg), Meloxicam (0.3 mg/kg), and Buprenorphine (0.02 mg/kg). Anaesthesia was induced using Propofol (4 mg kg^{-1}) and maintained with Isoflurane at 1%. Fluid therapy with 0.9% NaCl was administered at a rate of 2 ml kg^{-1}h^{-1}. The study had two stages (T1 and T2) where SAP, MAP and DAP were measured using a SunTech Vet20® device, validated by ECVIM and ACVIM. PLR was performed at a 30° angle using a sponge wedge under the legs. T1 – pre-PLR, obtained before manipulation of the first ovary. T2 - post-PLR, obtained before manipulation of the second ovary. A stabilization period of 5 minutes occurred between PLR and the measurements. Variables with normal distribution were analysed using paired t-tests, while Pearson's and Spearman's correlation tests were employed to assess the correlations.
The median age was 2.00 years [1.21-4.50] and the mean body weight was 4.23 ± 0.48 kg. There was a statistically significant decrease in SAP (p = 0,045) and DAP (p = 0,017) after PLR. A significant negative correlation was found between age and the values of DAP and MAP, aligning with age-related blood pressure trends in cats. Body weight showed weak correlation with MAP. These results, consistent with previous validated in human medicine (Delerme 2007, Pickett 2015) show PLR induces significant changes in blood pressure in normotensive cats, reinforcing the potential utility of PLR in a veterinary setting, especially in patients with a pathology capable of compromising hemodynamics.

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47. The effect of dopamine or noradrenaline on isoflurane-anesthetized cats undergoing dental procedures, premedicated either with acepromazine or dexmedetomidine: A retrospective study

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This retrospective study aimed to evaluate the effect of dopamine and noradrenaline on isoflurane-anesthetized cats undergoing dental procedures, premedicated with either acepromazine (ACP) or dexmedetomidine (DEX).
Medical records of 120 cats undergoing dental procedures from January 2023 to May 2024 were reviewed. Patients were premedicated with ACP 0.02 mg kg^{-1} and butorphanol 0.5 mg kg^{-1} IM (ACP$_{group}$) or DEX 20 μg kg^{-1} and tramadol 1 mg/kg IM (DEX$_{group}$). Hypotension (MAP < 60 mmHg via oscillometry) was treated with either dopamine (7 μg kg^{-1} min^{-1}) or noradrenaline (dose 0.1 μg kg^{-1} min^{-1}) with doses escalated until normotension. The dose of the sympathomimetic required to resolve hypotension and the corresponding time were analyzed using the Mann-Whitney test.
All 67 cats in the ACP$_{group}$ experienced hypotension and were treated with either dopamine (ACP$_{group}$-D, n=35) or noradrenaline (ACP$_{group}$-N, n=32). In the DEX$_{group}$, 14 out of 53 cats were hypotensive; of these, seven were treated with dopamine (DEX$_{group}$-D,n=7) and seven with noradrenaline (DEX$_{group}$-

N,n=7). The incidence of hypotension was significantly lower in the DEX_{group} (26.41%) compared to the ACP_{group} (100%) (p < 0.001). The median maximum dose of noradrenaline required to resolve hypotension was significantly less (p = 0.028) in the DEX_{group}-N (0.11 µg kg^{-1} min^{-1}) compared to the ACP_{group}-N (0.2 µg kg^{-1} min^{-1}). The mean time to effectively restore MAP was significantly shorter in the DEX_{group}-N (5 minutes) than in the DEX_{group}-D (18.57 minutes, p = 0.001), and in the ACP_{group}-N (7.2 minutes) compared to the ACP_{group}-D (17.14 minutes, p < 0.001).

Hypotension in isoflurane-anesthetized cats undergoing dental procedures premedicated with ACP or DEX can be resolved by administering either dopamine or noradrenaline, with the latter restoring MAP more rapidly in both groups.

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48. Comparison of airway resistance and wall shear stress between non- and bronchial pattern images in cats by computational simulation

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Cats with bronchial disease exhibit reduced lower airway diameters and increased mucus production (Trzil 2020). This study compared lower airway resistance and wall shear stress in cats with bronchial patterns versus normal thoracic computed tomography (CT) images using computational fluid dynamics (CFD).

Thoracic CT scan images of client-owned cats were divided into two groups: non-bronchial disease (NBD, n = 12) and bronchial disease (BD, n = 12). Previously diagnosticated by bronchoscopy and bronchoalveolar lavage. For each case, a three-dimensional geometry of the trachea and seven lobar bronchi was reconstructed. Each model was discretized with a tetrahedral mesh, and simulations were performed using Ansys CFX. Flows and inspiratory and expiratory times (Lin et al. 2014), were applied to each group. Additionally, NBD respiratory parameters were imposed on the BD group. Velocity, pressure, and wall shear stress were simulated throughout a complete respiratory cycle. Resistance (cmH2O L^{-1} minute^{-1}) was calculated as Δp (cmH2O) / flow (L minute^{-1}) for each case. An ANOVA test (SPSS® v29.0) was used to compare means, with p<0.05 considered statistically significant.

Cats weighed 4.40 ± 1.41 kg (NBD) and 4.85 ± 1.46 kg (BD). Simulations revealed different wall shear stress distributions at peak flow during inspiration (Figure 1). No statistical differences in resistance were observed during inspiration (p = 0.233) or expiration (p = 0.297). Wall shear stress was higher in the BD group when NBD flow and inspiratory/expiratory times were imposed (0.173 x 10^{-3} ± 0.110 x 10^{-3} kPa, p < 0.001), but not when BD respiratory parameters were applied (3 x 10^{-6} ± 1 x 10^{-6} kPa).

In conclusion, wall shear stress increased in the BD group at both flows, but not resistance. In humans, airway wall stiffening is correlated with increased wall shear stress (Xia et al. 2010).
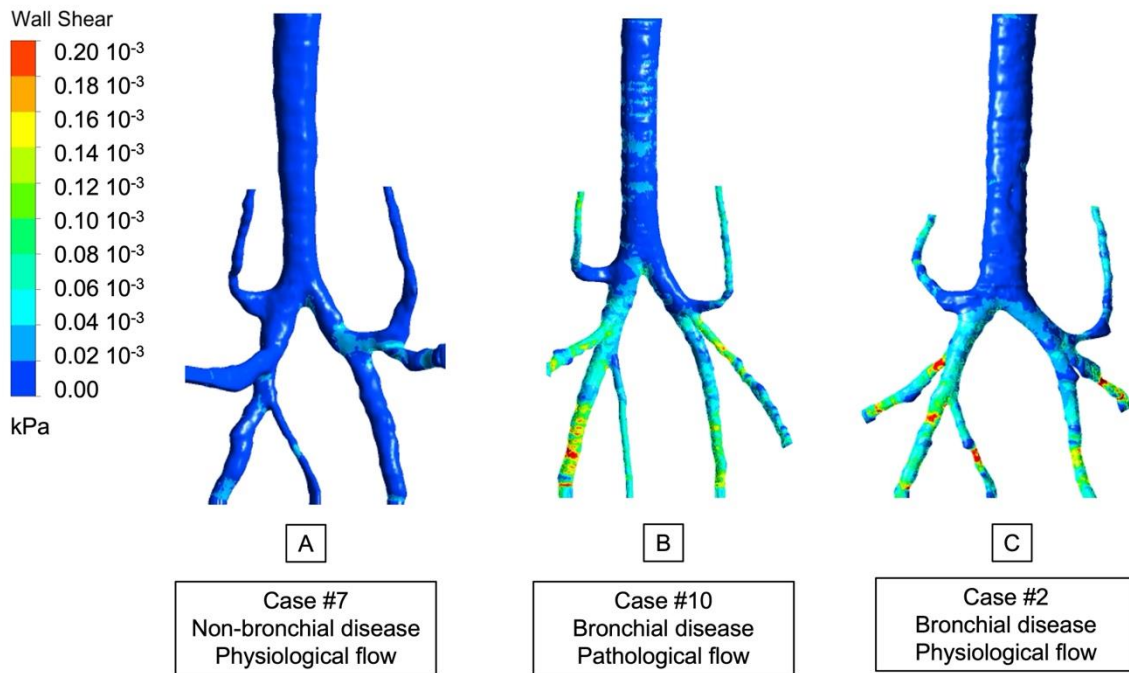
Figure 1: Wall Shear stress maps.

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Equine

49. Clinical use of Combined Horse Anaesthetic Risk Identification and Optimisation Tool (CHARIOT) in 50 horses

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The objective scoring tool Combined Horse Anaesthetic Risk Identification and Optimisation Tool (CHARIOT) (Hubbell et al. 2022) could be implemented in evaluation of equine patients before general anaesthesia (GA).
Fifty horses at the Royal (Dick) School of Veterinary Studies were assessed before GA using the American Society of Anaesthesiologists Physical Status Classification for equine (ASA-PS-Equine) and the CHARIOT, a 10-rubric scale based on characteristics associated with morbidity/mortality (higher score/higher risk). Each patient was evaluated separately by five predetermined evaluators (intern, ECVAA resident and diplomate, EBVS resident and diplomate) which were present before induction of GA. Inference statistical analysis was based on mixed-effects Poisson regression with score as outcome and evaluator's specialization and scoring systems as model's fixed effects. Random effects were set for the individual evaluator. Statistical differences were set if $p < 0.05$.
The model adjusted mean score values (95% CI: lower confidence limit, upper confidence limit) for ASA-PS-Equine and CHARIOT, respectively were: ECVAA residents 1.94 (1.71, 2.17), 13.59 (13.11, 14.06); ECVAA diplomates 1.98 (1.75, 2.20), 13.88 (13.44, 14.31); EBVS diplomates 1.81 (1.60, 2.02), 12.72 (12.31, 13.14), EBVS residents 1.88 (1.68, 2.09), 13.21 (12.84, 13.57) and interns 1.89 (1.67, 2.11), 13.26 (12.82, 13.70). Significant differences were identified between EBVS diplomates and both ECVAA diplomates ($p < 0.001$) and ECVAA residents ($p < 0.001$) with both scoring systems. The ECVAA diplomate-ECVAA resident pair scored similarly with no significant differences with both scoring systems. The same applied for the pair EBVS residents–interns. Differences in evaluator's scoring suggest variations in assessment practices and standards. The significant differences found in pairwise comparisons (intern/EBVS diplomate/resident and ECVAA diplomate/resident) highlight specific contrasts in scoring approaches between different EBVS specializations. Further prospective-multicentre studies recording outcomes will allow to eliminate the main limitation of our design as a comparison of ASA-PS-Equine and CHARIOT was not possible.

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50. Equine anaesthetists' perceptions of breed-related anaesthetic risks

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Previous studies have identified risk factors such as weight and temperament, which are breed-related, but evidence for breed influences remains largely anecdotal. The aim of this study is to investigate equine anaesthetists' perceptions of anaesthetic risk in common horse breeds and how these perceptions influence their clinical decision making.
Ethical pre-approval was obtained (SR2023- 0169). An internet-based survey using JISC online surveys was conducted, with invitations shared via ECVAA and ACVAA mail list servers and CEPEF-4 study representatives. Participation was voluntary and anonymous, with informed consent required. Data was collected, summarized and analysed using descriptive statistics.

A total of n =121 respondents completed the questionnaires, 53% of whom possessed over ten years of experience in equine anaesthesia, with 63% having anesthetized more than 500 horses. Of these, 77% of participants worked within a university setting. Warmbloods emerged as the most frequently anesthetized breed type, followed by draft breeds and racehorses. Breed was deemed a quite significant or very significant factor in anaesthesia management by 49% and 14% of the participants respectively. Additionally, in an open question setting, draft horses, racehorses, and Friesians were specifically mentioned as having an increased anaesthetic risk, regardless of the procedure, by 32%, 36%, and 9% of respondents respectively.

The survey results underscore the perceived importance of breed in equine anaesthesia risk assessment and management. A high proportion of anaesthetists identified specific breeds as having elevated anaesthetic risk. Despite this, there is a paucity of data regarding unique anaesthetic considerations for various equine breeds. This highlights a knowledge gap that needs addressing with large prospective studies looking into specific anaesthetic risks across different breed types.

51. The effects of dobutamine on hemodynamic and oxygenation parameters in standing and isoflurane-anesthetized horses

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Dobutamine (DOB) is a first-line therapy for hypotension in anesthetized horses. This study investigates the effects of escalating doses of DOB on hemodynamics and oxygenation parameters in standing versus isoflurane-anesthetized horses.

Six healthy adult horses (415 – 525 kilogram bodyweight) were studied in a randomized prospective cross-over design including standing and isoflurane-anesthetized experiments. HR, MAP, central venous pressure (CVP), pulmonary arterial pressure (PAP), and thermodilution cardiac output (CO) were measured, as well as mixed venous and arterial blood gases in anesthetized horses. Measurements were obtained at baseline and following fifteen minutes of escalating DOB continuous rate infusion at 0.5, 1, and 2 μg kg^{-1} $minute^{-1}$. Oxygen delivery (DO$_2$), oxygen extraction ratio (O$_2$ER), A-a gradient, fShunt, and PaO$_2$/F$_I$O$_2$ were calculated for anesthetized horses. Following a week of washout, each horse underwent the second experiment. After confirming normal distribution variables were compared to baseline and between groups using two-factorial ANOVA (alpha = 5%).

MAP, CVP, PAP, and CO increased significantly with increasing DOB infusions in both groups. At similar DOB infusion rates, MAP (increase of 24 – 31 mmHg, $p < 0.001$) and CO (increase of 16 – 28 liters, $p < 0.001$) were significantly higher in standing vs. anesthetized horses. For anesthetized horses DO2 significantly increased ($p < 0.01$) and O$_2$ER significantly decreased ($p < 0.001$) between every timepoint. DOB produced a significant increase in PaO$_2$/F$_I$O$_2$ (398 versus 491 mmHg, $p = 0.021$), and significant decreases in fShunt (15.6 versus 11.2, $p = 0.016$) and AaO$_2$ (205 versus 141 mmHg, $p = 0.031$).

DOB administration produces dose-dependent improvements in CO and perfusion parameters and improves indicators of peripheral oxygenation at higher doses in horses under isoflurane anesthesia. DOB dosages of 2 μg kg^{-1} $minute^{-1}$ are needed to reach standing baseline MAP and CO.

52. Acute changes in serum iron in anesthetized healthy horses

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A decrease in serum iron is used as a marker of systemic inflammation in horses (Borges et al. 2007). In healthy humans, decreases in serum iron following general anesthesia has been reported as a result of oxidative stress (Akin et al. 2015, Alarcon et al 1996). To date, changes in serum iron associated with anesthesia have not been evaluated in horses. The aim of this study was to determine whether

decreases in serum iron concentrations are observed in healthy horses during or following general anesthesia.

Twenty-four healthy adult horses were anesthetized with isoflurane for 120 minutes. Serum iron was measured prior to anesthesia (baseline; BL), after 60 mintues of anesthesia (T60), at the conclusion of anesthesia (T120), after recovery (TREC) and 24 hours after induction (T24). A repeated measures ANOVA with a post hoc Dunnett's test was used for comparison of each time point with baseline. A $p < 0.05$ was used for significance.

Serum iron concentrations were 152 ± 29 µg dL^{-1} for BL, 136 ± 25 µg dL^{-1} for T60, 133 ± 26 µg dL^{-1} for T120, 136 ± 26 µg dL^{-1} for TREC, and 63 ± 19 µg dL^{-1} for T24. Serum iron concentrations at all time points were significantly lower than BL (all $p < 0.01$).

Serum iron decreases acutely in healthy horses and remains decrease for at least 24 hours following general anesthesia. This may be due to oxidative stress rather than inflammation. Serum iron improvement associated with resolution of an inflammatory condition may be masked in horses that have recently undergone general anesthesia.

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53. Influence of general anesthesia on the equine lung microbiome

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In humans, changes in the pulmonary microbiome have been observed following general anesthesia (GA). This study aims to explore effects of GA on the equine lung microbiome to enhance the understanding of postoperative pulmonary complications.

Eight healthy horses were enrolled. Nasopharyngeal swabs and bronchoalveolar lavage fluid (BALF) were obtained 72 hours prior to as well as 2 hours after GA. Anesthetic protocol included sedation with xylazine followed by induction with midazolam and ketamine and maintenance with isoflurane at 1.3 Vol. % in oxygen for two hours. DNA was extracted from BALF and swabs, PCR-amplified for the bacterial 16S rDNA gene, and sequenced on an Illumina MiSeq platform. Sequencing data were analyzed using QIIME. Statistical analysis was performed using Linear Mixed-Effects Models (LMM) and Permutational Multivariate Analysis of Variance (PERMANOVA) in R.

The bacterial 16S rRNA gene analysis revealed that sample type significantly affects microbial diversity, in both alpha diversity metrics (observed species: $P < 0.001$; Shannon diversity: $P<0.05$) and beta diversity metrics (Weighted UniFrac: $P < 0.001$; Unweighted UniFrac: $P<0.05$). No significant differences were found between pre- and post-anesthetic obtained samples in any of the diversity metrics for the most abundant ($> 1 \%$) phyla, which were Firmicutes (53 %), Actinobacteria (14 %), Bacteroidetes (14 %), Proteobacteria (13 %), and Cyanobacteria (4 %). Certain low-abundant bacterial genera showed significant differences by sample type and between pre- vs post-anesthetic samples. These genera decreased in post-anesthetic samples of the BALF sample type, whereas they increased in post samples of the swab sample type.

The microbiome associated with both sample types may be considered low biomass with only a few bacteria affected by anesthetics. The changes to the microbiota, although small, were consistent across horses. Further investigation of the lung microbiome is required to determine the clinical relevance.

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54. Cadaver study of ultrasound-guided pudendal nerve block in six horses

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Equine pudendal nerve blocks provide analgesia for genito-anal surgery but are currently limited to blind electrolocation techniques with inherent risk. This study aims to describe a novel, ultrasound-guided pudendal nerve block in horse cadavers.

Fresh equine cadavers were used. Before injection, cadavers were positioned in dorsal or lateral recumbency and transcutaneous ultrasonographic identification of intrapelvic anatomy was performed in the perianal region with a curvilinear transducer. Methylene blue dye (15 mL) was injected under ultrasound-guidance using a 21-gauge 90 mm spinal needle; dissection occurred within 24 hours. Blockade was considered successful if > 2 cm of the pudendal nerve was stained (Gallacher *et al.*, 2016). Other structures stained by dye misplacement or spread were recorded.

Six cadavers were used, each allowing left and right-sided injection attempts (total 12 injections). Pudendal nerve staining was successful in 5/12 injections (41.7 %). Successful staining occurred bilaterally in one cadaver and unilaterally in three cadavers. Staining failed bilaterally in two cadavers. Ultrasonographic identification of the pudendal nerve was technically challenging and unreliable. Landmarks for needle position utilised identifiable anatomy, including: pubis; rectum; urethra; and hindlimb musculature lateral to the sacrosciatic ligament. Injection depth ranged 75 - 90 mm. In all successful injection attempts, dye was widely distributed across the medial sacrosciatic ligament surface, within a facial plane. Misplacement of dye into hindlimb musculature occurred in 1/12 injections, onto colon serosal surface in 4/12 injections and dye identification was not possible in 2/12 injections. Staining of the sciatic nerve or any other structure did not occur.

These results demonstrate that deposition of dye into a sacrosciatic ligament fascial plane and pudendal nerve staining is possible. Ultrasonography facilitated avoidance of critical intrapelvic structures. However, further refinement of the ultrasound-guided technique is necessary to improve staining success rate and reduce dye misplacement before application to clinical cases.

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55. The use of pedometers for objective scoring of recovery from general anaesthesia in horses

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Objectivity is lacking from most recovery quality scoring systems (RQSS) in equine anaesthesia and inter-observer agreement is low. Introducing objectivity into RQSS might increase agreement enabling multi-centre data collection and analysis.

Thirty-eight horses undergoing general anaesthesia were studied. Demographic and procedure data were recorded and analysed using descriptive statistics, including frequency calculation. Step-counts in recovering horses were recorded using pedometers fixed to each limb; median step count was used for analysis. Recoveries, which were non-interventional, were video-recorded until 5 minutes after

standing. All recordings were independently scored by 12 equine anaesthetists using a multi-dimensional RQSS (Donaldson et al., 2000). Scores were ranked according to the median RQSS score for each horse. Original and $\log_{10}$ transformed step-count data were plotted against rank, median recovery score and mean recovery score. Pearson regression was used to assess the relationship between these variables.

Data from 33 recoveries were analysed. The population (18 geldings, 9 mares, 6 stallions) had a mean ($\pm$ SD) age of 9.9 ± 5.13 years. The modal procedure was arthroscopy. Mean anaesthetic duration was 114.2 ± 48.5 minutes. Inter-observer recovery score agreement was not tested because graphical data representation revealed wide score variation for intermediate quality recoveries. Median pedometer step-counts (MSCs) ranging from $10 - 1204.5$ corresponded to median RQSS scores ranging from $10 - 77.5$. Regression analysis demonstrated statistically significant positive correlations between MSCs and mean, median and ranked recovery scores. The greatest Pearson coefficient ($r = 0.75$; $p = 0.01$) linked $\log_{10}$ MSCs with both median and rank recovery scores, and untransformed MSCs with rank recovery score.

Pedometer data from 33 horses recovering from general anaesthesia correlated significantly ($p = 0.01$) with median recovery scores from 12 observers. Pedometry provides a low-cost, reproducible, objective assessment of equine anaesthetic recovery, facilitating multi-centre data collection for future research.

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56. Return of spontaneous circulation after cardiopulmonary arrest in an adult horse recovering from anaesthesia

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A third of perioperative equine deaths result from cardiopulmonary arrest (CPA) or postoperative cardiovascular collapse (Deutsch and Taylor 2022). Minimal information exists on cardiopulmonary resuscitation (CPR) outcomes in adult horses (Chiavaccini 2022).

This report details successful CPR in a healthy 8-year-old Quarter horse gelding. After uneventful hind limb orthopaedic surgery under general anaesthesia (GA), the horse was hoisted into recovery. CPA was then identified, 3 minutes after discontinuation of mechanical ventilation and GA, by absence of cardiac sounds and pulse. Chest compressions were promptly started, using the knee-drop technique, at 40-53 compressions minute^{-1}. Intermittent positive pressure ventilation continued at 4-6 breaths minute^{-1} using 100% oxygen via demand valve. During the first CPR cycle, 0.002 mg kg^{-1} of adrenaline was administered intravenously, and a second dose two minutes later. During the fourth cycle capnography was used with an $EtCO_2$ range of 10-21 mmHg. During the fifth and final cycle, $EtCO_2$ spiked to 31 mmHg indicating return of spontaneous circulation (ROSC). After standing, the horse showed signs of distress and was not weight-bearing on his right forelimb. A grade 3/6 left side systolic heart murmur, tachycardia (56 beats minute^{-1}), and lactate elevation (3.57 mmol/L) were noticed. Two days post-CPA, the heart murmur was undetectable, and the horse was weight-bearing. Serum cardiac troponin I returned from markedly elevated (402 ng/L) five days after CPA to normal (2 ng/L) 13 days later. Surgical site infection led to euthanasia 42 days after surgery.

This case highlights successful ROSC in an adult horse with lower compression rates than recommended and is the first to report chest compressions quality and ROSC using capnography. The CPA cause remains unclear, but potential factors include hypoxaemia, hypotension, and decreased cardiac preload due to hoisting. Further research is needed to understand possible cardiovascular changes in preload caused by hoisting adult horses.

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57. Pre- and intraoperative risk factors related to intraoperative euthanasia in horses undergoing colic surgery

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Colic surgery is commonly performed in horses, and, despite recent progress, mortality rate remains relatively high. Recent data from the CEPEF-4 study revealed that 27% of the horses undergoing colic surgery are euthanized during the procedure. Risk factors related to intra-operative euthanasia are poorly described.

Horses undergoing colic surgery over a two-year period were included in this retrospective single centre study. Data were retrieved from the CEPEF platform which served for case recording and classification. Age, breed, sex, weight and haematocrit on admission, ASA status, surgeon, out-of-hours scheme, the presence or absence of intraoperative hypotension, hypoxaemia, hypercarbia, and the type of lesion (strangulated versus non-strangulated) and the location of the lesion (small versus large intestine) or organ rupture were analysed in their relationship to the outcome, classified as euthanasia during surgery, euthanasia in the first week of hospital stay or survival for 1 week after surgery. Continuous data were analysed by ANOVA after control of normal distribution, while parametric data were analysed by Chi-square test. The level of significance was set at $p < 0.05$.

From the 211 horses included in this study, 133 survived the first week after surgery (63.0%), 58 (27.5%) were euthanised during surgery, 17 (8.1%) were euthanised during the first week of hospital stay, and 3 (1.4%) horses died. Sex, age, breed, surgeon and out-of-hours scheme were not significantly related to the outcome, nor was the presence or absence of intraoperative hypotension, hypoxaemia or hypercarbia.

As shown previously, the haematocrit on admission, ASA status and type of lesion were significant predictors for intraoperative euthanasia. In contrast to previous results, out-of-hours scheme and intraoperative hypotension, hypercarbia and hypoxaemia were not correlated to intraoperative euthanasia in the present study.

58. The development of a V/Q model using electrical impedance tomography on anaesthetised horses

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Electrical impedance tomography (EIT) is reported for assessing ventilation in horses (Mosing *et al.*, 2017). In an equine model, this research aimed to 1) isolate impedance changes due to perfusion in EIT, 2) develop V/Q EIT variables, and 3) evaluate these variables' ability to detect V/Q changes during pharmacologically induced perfusion changes. This abstract presents preliminary findings.

A prospective, experimental study was performed in seven adult anaesthetised horses positioned in dorsal recumbency. Phenylephrine hydrochloride was infused intravenously to increase mean arterial blood pressure (mean increase 61% (95% CI 41 - 81)). Thoracic EIT, arterial and mixed venous blood gases were measured before and after phenylephrine hydrochloride infusion. Perfusion impedance signal was isolated using frequency filtering techniques. A V/Q map and impedance histograms were

generated after normalisation of perfusion impedance. EIT generated V/Q maps and histograms were subjectively compared with calculated shunt fraction and PaO_2.

Phenylephrine caused a mean (95% CI) increase in shunt fraction from 37.7 (32.4 - 43.0) to 43.3 (37.4 - 49.3) % (p = 0.04), and a reduction in the mean (95% CI) PaO_2 from 214 (137 – 291) to 118 (76 – 159) mmHg in 88% of horses (p = 0.01). The V/Q map and histograms were obtained from 7/7 horses, and changes were consistent with F-shunt and PaO_2 in 6/7 of these horses. An example of the EIT images, V/Q map and histograms from Horse 1 are provided in Figure 1.

EIT Images			Histogram	
V	Q	V/Q Map	V	Q
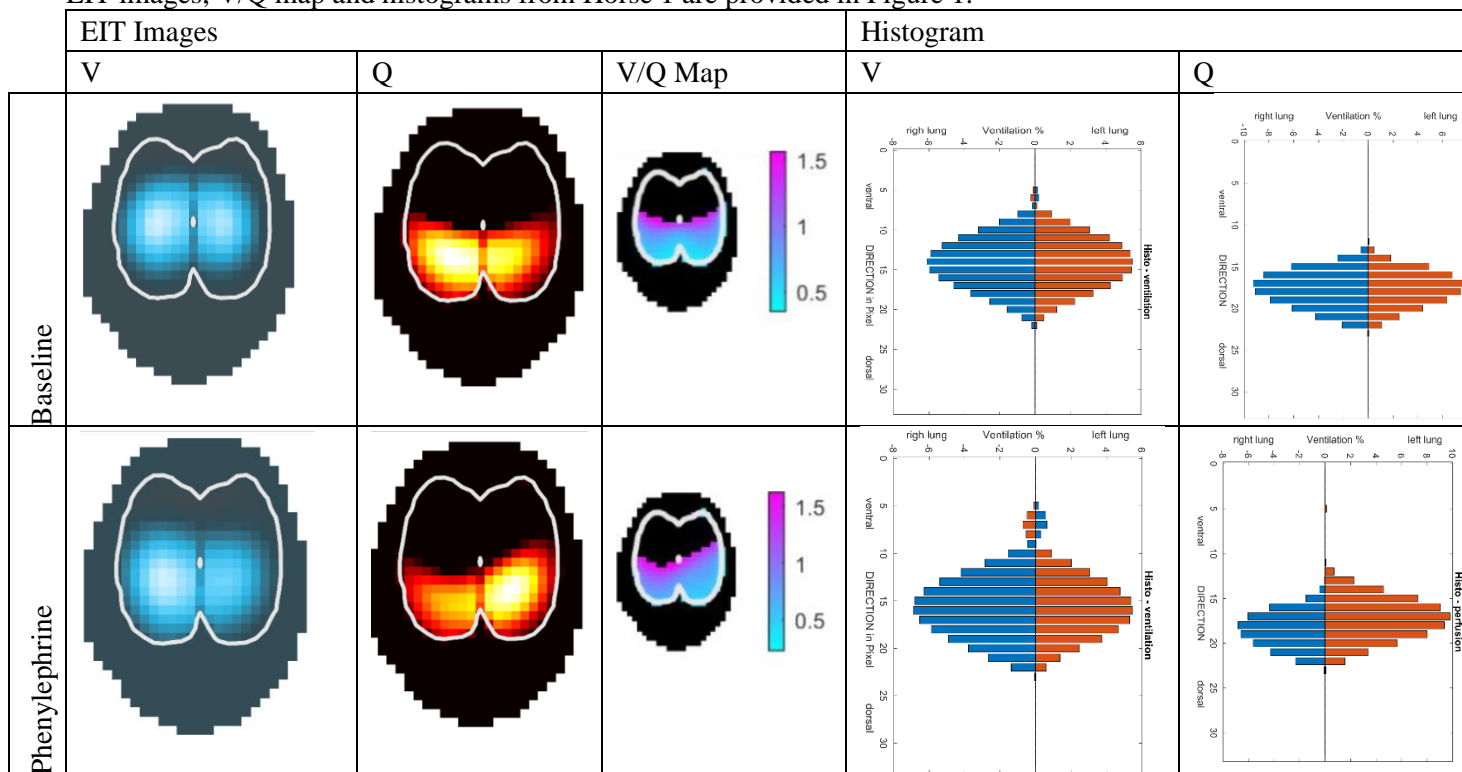
Preliminary results support use EIT to detect the pulmonary perfusion signal in anaesthetised horses. During administration of phenylephrine, changes in EIT variables of V/Q were consistent with standard variables - PaO_2 and F-shunt. These preliminary results support the potential for assessing V/Q with EIT.

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59. The use of an air-inflated pillow for assisted recovery after general anaesthesia in horses

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This study describes the use of Equilift®, an air-inflated pillow to assist horses during recovery from general anaesthesia.

Following data were collected of horses that were recovered with this system after elective surgery (with owner consent): age, bodyweight, procedure, anaesthetic protocol, time required for proper positioning in the Equilift®, time to extubation, time to standing, number of attempts to stand and

number of stimuli. Subjective data included the behavior during recumbency/first attempts and overall impression.

Twenty-eight adult horses (1-28 years old; mean weight 478 ± 118 kg) were enrolled. Most were admitted for open castration (16/28), other procedures were ulna fracture (1/28), wound debridement (4/28), cardiac procedures (2/28) and diagnostic imaging (CT or MRI; 5/28). Total intravenous anesthesia, a triple drip solution (ketamine, guaifenesin and romifidine), was used for maintenance in 50% of the horses, isoflurane in oxygen in the other 50%. Premedication consisted out of romifidine 80 µg kg^{-1} with morphine 0,1 mg kg^{-1} in 27 horses, medetomidine 7,5 µg kg^{-1} for one horse. 85% of the horses received sedation prior to the placement in the pillow, usually romifidine 20 µg kg^{-1}. Median time to place the horse in the system was 6 minutes (range 1-15 minutes). After anaesthesia, time to extubation and to standing was 16 ± 7 minutes and 41 ± 12 minutes respectively. Most of the horses (85,7%) showed a calm recovery with an average of 4 attempts before fully standing. Four horses showed signs of excitation and anxiety, where they either received a second dose of sedation (3 horses) or it was decided to stop the use of this recovery system (1 horse). The limitations observed with this technique are the size of the horse.

All horses recovered without injuries or other immediate postoperative complications. In conclusion, this recovery system shows promising results.

Ruminants

60. Pain-alleviating effects of xylazine alone and in combination with either levomethadone or ketamine in calves prior to thermocautery disbudding

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Thermocautery disbudding elicits severe acute pain in calves resulting in noticeable behavioral and physiological responses. Hence, effective pain alleviation is crucial to mitigate suffering and promote animal welfare. This study aimed to explore the effects of levomethadone and ketamine on post-disbudding pain and activity in calves compared to xylazine alone.

Twenty-eight dairy calves aged 21 ± 5 days and weight 61.2 ± 9.4 kg were randomly assigned to three treatment groups: Group XL, levomethadone (0.05 mg kg^{-1}) and xylazine (0.1 mg kg^{-1}); group XK, ketamine (1 mg kg^{-1}) and xylazine (0.1 mg kg^{-1}); and group X, xylazine (0.2 mg kg^{-1}) given intramuscularly 30 minutes before disbudding. Pain was subjectively assessed with a multidimensional pain score (0–21), and pressure pain threshold with algometry around the horn buds was measured at intervals. Calf activity was monitored using two accelerometers between midnight and 6 am on the nights before and after disbudding. Differences between groups were evaluated using the Kruskal-Wallis test followed by Bonferroni corrections, whereas paired T-tests were used to compare activities within the group.

Four hours post-disbudding, the pain score was significantly higher with XK compared to X and XL [14 (11–16) versus 10 (7–14) and 10 (8–12), $p = 0.045$ and 0.008, respectively]. Pressure pain thresholds were significantly higher with XL than with X and XK [17 (12–24) versus 8 (8–31) and 8 (8–15) Newtons, $p = 0.01$] 24 hours after disbudding. While no significant differences were observed in overall calf activity between treatment groups, resting duration was decreased (302 ± 20 versus 278 ± 18 min night^{-1}, $p = 0.02$) in group X post-disbudding.

In conclusion, the combination of levomethadone and xylazine appeared more effective in alleviating post-disbudding pain in calves than xylazine alone or xylazine combined with ketamine.

61. Feasibility of a simultaneous ultrasound (US) and peripheral nerve stimulation (PNS) guided interscalene brachial plexus injection in calves

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Studies assessing the efficacy and safety of brachial plexus blocks in ruminants are scarce. This experimental anatomical study assessed the feasibility of a simultaneous ultrasound and peripheral nerve stimulator (PNS)-guided interscalene brachial plexus injection in 6 calves.

Calves were divided into three experimental groups. Group 1 (n = 2): one aliquot of 0.3 mL kg^{-1} to be administered near the eighth cervical/first thoracic (C8-T1) nerve ventral branches. Groups 2 (n = 2) and 3 (n = 2): two aliquots of respectively 0.15 mL kg^{-1} and 0.3 mL kg^{-1}, one to be administered near C8-T1 and one near the sixth/seventh cervical (C6-C7) ventral branches. After sedation (xylazine 0.2 mg kg^{-1} intramuscularly), calves were positioned in lateral recumbency on a surgery table. Following aseptic preparation of the neck and shoulder region, a linear ultrasound probe was positioned at the shoulder level, transversely oriented to the longitudinal axis of the first rib. After visualisation of C8-T1 and C6-C7 nerves ventral branches, ketamine (2 mg kg^{-1} intravenously) was administered, and a

20 gauge insulated needle connected to a PNS was inserted in-plane until near the target nerves. A dye solution was injected once the motor response was absent below 0.4 mA stimulus. The procedure was repeated in the contralateral limb, and the calves were euthanised (pentobarbital 70 mg kg^{-1} intravenously). Dissection was performed to assess nerve staining.

The results are summarized in Figure 1.

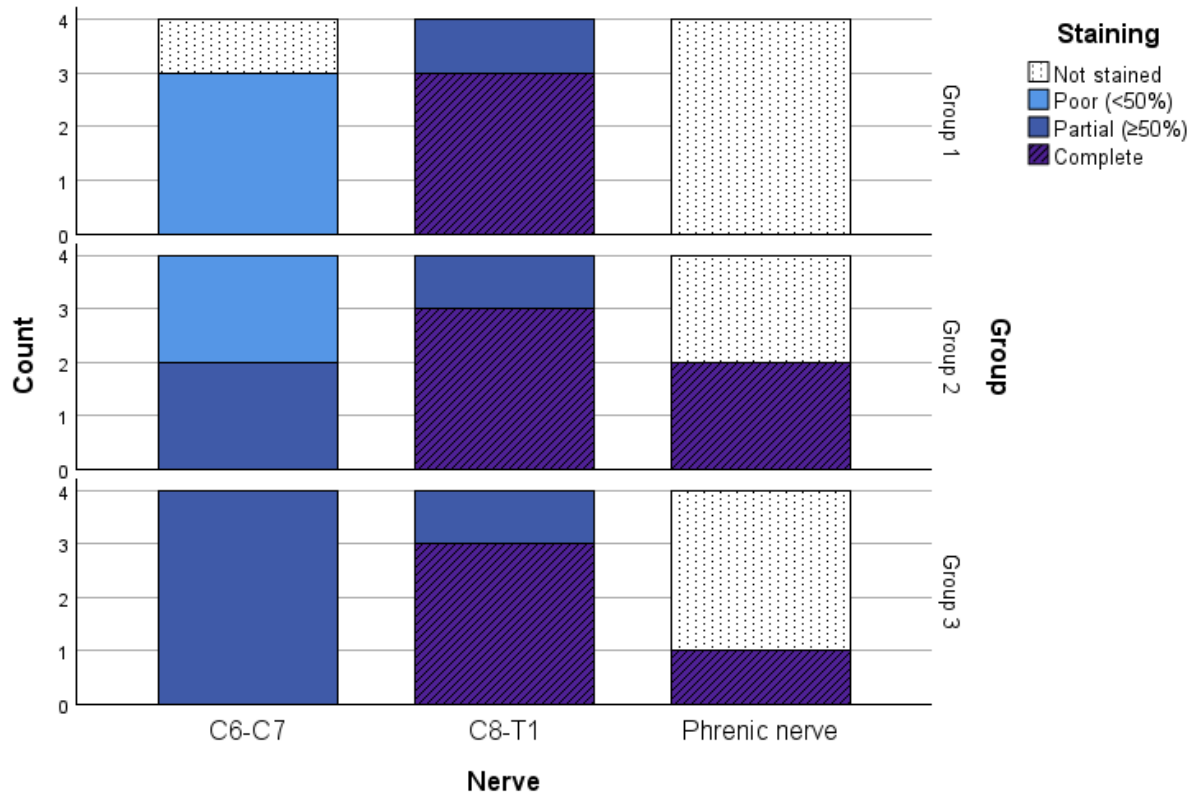In conclusion, the technique seems feasible in calves.

Figure 1. Brachial plexus branches staining count (Not stained, Poor < 50%, Partial ≥ 50% or Complete nerve circumference with at least 1-centimetre length)

62. Ultrasound-guided rectus sheath block in sheep: a cadaveric description

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The rectus sheath (RS) block has been described in several species but not in sheep. We aimed to evaluate sheep anatomy to determine the feasibility of an ultrasound-guided RS block in sheep cadavers.

Twenty-two cadavers weighing 52 kg (median, range: 47–62 kg) were employed. Firstly, six cadavers underwent anatomical evaluation of the ventral abdominal wall (n=2) and ultrasonographic examination of the RS (n=4). Two lateral approaches were identified (one- or two-injection). A one-injection approach resulted in better visualization of target structures (St James et al. 2020). The probe was positioned transversely to the ventral midline in the cranial third between the xiphoid process and the umbilicus scar. After linea alba was identified, the probe was moved laterally to visualize the transversus abdominis and the rectus abdominis (RAM) muscles. In a second stage, 14 cadavers were injected bilaterally, under ultrasound guidance, in the RS with a high (HV, 0.5 mL kg^{-1}) or low (LV, 0.25 mL kg^{-1}) volume of 1:1 mixture of bupivacaine 0.25% and methylene blue 0.5%. Cadavers were dissected to evaluate dye spread and nerve staining.

T11 thoracic nerve was stained in all cases with both volumes, but not T12 (HV=93%; LV=78%), and T13 only in two sheep with HV. A lack of spreading of injectate was consistently observed during dissection, suggesting compartmentalization of the interfascial RS plane. This was further investigated

in two additional sheep by injection of methylene blue and a neutral red dye (LV each) between RAM and its internal sheath on alternate muscle bellies. Following anatomical dissection, dye accumulation was observed without mixing of the dye solutions.

In conclusion, the RS interfascial plane block may not be feasible in sheep due to a different anatomical conformation preventing the spreading of the anaesthetic solution. Alternatively, injection at each muscular pocket would be required.

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63. Intraoperative effects of adding detomidine to a lidocaine paravertebral anaesthesia in cows undergoing standing abomasum displacement surgery

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The aim was to investigate the potential beneficial effects of adding detomidine to a lidocaine proximal paravertebral nerve block (PPNB) for standing laparotomy in cattle.

Forty female adult cows requiring surgery to correct abomasal displacement were enrolled in this prospective, blinded, randomized clinical study. Cows were divided into 2 groups: PPNB using lidocaine (40 ml 2% lidocaine per injection site) or lidocaine-detomidine (lidocaine + 5 μg/kg detomidine equally distributed to the lidocaine syringes). The PPNB was done at T13, L1 and L2 vertebra, always by the same investigator using a blind technique. Intraoperative pain score, sedation score, HR, fr were recorded by a single blinded observer before PPNB and repeatedly afterwards (T5, T10, T15, then every 15 minutes). At the end of the surgery, the surgeon, also blinded to treatment, attributed a final score (VAS) to the overall quality of anaesthesia. Rescue analgesia (local lidocaine infiltration) was applied based on surgeon's decision. Results were analysed using unpaired t-test (age, weight) and ordinal regression models to analyse the VAS score, pain score, sedation score, rescue analgesia, HR and fr between groups ($P < 0.005$).

Surgery could be completed in all cows. Two cows in the lidocaine-detomidine group went to sternal recumbency. Ten cows in the lidocaine and 5 cows in the lidocaine-detomidine group needed rescue analgesia. With lidocaine-detomidine the surgeons' final score was superior ($P < 0.00001$), sedation score was higher ($P < 0.00001$), pain score was lower ($P = 0.00106$) and fr was decreased ($P = 0.0154$). Otherwise, no significant differences were detected between the two groups.

The addition of detomidine improved the quality of locoregional anaesthesia, thereby improving cow comfort and surgeon satisfaction.

64. Clinical validation of the Unesp-Botucatu pain scale in sheep undergoing orthopaedic surgery

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The Unesp-Botucatu scale for assessing postoperative abdominal pain in sheep (USAPS) was validated with a high level of evidence according to COSMIN (Consensus-based Standards for the selection of health Measurement Instruments) guidelines. We aimed to evaluate the psychometric properties of USAPS in sheep undergoing orthopaedic surgery.

This is a blinded, randomised, prospective, horizontal, and opportunistic study. A total of 23 healthy sheep underwent arthrotomy and were filmed at four-time points: before and after surgery, after analgesia, and 24 hours post-surgery. Videos were randomised and evaluated twice at one-month interval by four observers blind to the time-points. Statistical analysis was performed using R software following COSMIN guidelines. Differences were considered significant when p < 0.05. The multiple association test showed that USAPS has a unidimensional structure. Intra-observer reliability was very good for all evaluators (0.82 - 0.93). Inter-observer reliability was very good for two evaluators (0.84 - 0.9) and good for the other two (0.77 and 0.8). The strong Spearman correlation between USAPS and VAS (0.8) confirmed concurrent criterion validity. Responsiveness was evidenced by the lowest pain scores before [0 (0-4)], the highest scores at 2 and 24 hours after surgery [4 (0-10)], and intermediate scores after analgesia [3 (0-7)]. Spearman item-total correlation was acceptable (0.38 - 0.64) for all items, except 'appetite' (0.25). Internal consistency was excellent according to Cronbach's α (0.84) and acceptable according to McDonald's ω (0.75). Specificity was 71% and sensitivity was 100%, confirming predictive criterion validity. The cut-off point for analgesic rescue was ≥ 4 of 10, with an area under the curve of 0.91, demonstrating that USAPS has a high discriminatory capacity. 'Appetite' can be excluded without affecting the USAPS cut-off point. We concluded that USAPS, excluding 'locomotion', is a validated instrument to assess pain in sheep undergoing orthopaedic surgery according to COSMIN guidelines.

65. **Psychometric properties of the Bovine Pain Scale developed for postoperative pain assessment in the hospital setting**

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Pain is still neglected in cattle. We aimed to evaluate the psychometric properties of the Bovine Pain Scale (BPS) to assess postoperative pain in hospitalized cattle.

This is a blinded, randomised, prospective and horizontal study. Twenty-six animals were submitted to orthopaedic or soft tissue surgeries and ten healthy cattle were used as controls. The BPS incorporated the full UNESP-Botucatu cattle pain scale and 38% of the Cow Pain Scale (Tomacheuski et al. 2023) after content validity, including appetite, posture, limb movement/condition, interaction, response to approach, activity and locomotion, and miscellaneous behaviours. Videos (n = 118) of 6 minutes were recorded before, 2 to 6 hours after surgery, 1 hour after analgesic treatment with opioid and/or NSAID and 24 hours after surgery. Videos were randomly analysed by four evaluators unaware of procedures and time points, in two phases (five-week intervals). Statistical analysis was performed using R software.

The BPS is bidimensional according to the multiple association test. Intra and inter-rater reliability (intra-class correlation coefficient) was very good (0.83 – 0.94) and ranged from good to very good respectively (0.65 – 0.81). The correlation between the BPS and VAS was strong ($rho = 0.77$, $p < 0.0001$), confirming criterion validity. Item-total correlation was acceptable in only 3 of 9 items (0.33 – 0.43). Internal consistency was below acceptable (0.6). The scores increased after surgery; therefore the scale was responsive to pain, but scores did not decrease after analgesic treatments. Specificity was 69% and sensitivity 65%. The area under the curve of 0.90 demonstrated high discriminatory capacity. According to the receiver operating characteristic curve, the cut-off point for rescue analgesia was ≥ 5 of 18. The BPS showed intra and inter-rater reliability, content and criterion validities.

It may be used for assessing post-operative pain in hospitalized cattle. Refinement is necessary to warrant construct validity and sensitivity.

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Swine

66. Are neuromuscular blocking agents still being misused in laboratory pigs? (Preliminary Report)

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After conducting a literature review (2012-2014) and corresponding authors (CAs) survey, Bradbury and Clutton (2016) concluded that accidental awareness under general anaesthesia (AAGA) was commonplace in laboratory pigs due to the widespread misuse of neuromuscular blocking agents (NMBAs).

Using near-identical methods, the current study attempted to determine whether matters had changed over 8 years. Web of Science, MEDLINE, Scopus and CAB abstracts were used to identify papers (2020-2022) describing NMBA use in experimental pigs in a two-stage review. Of 662 papers meeting inclusion criteria, 234 reported NMBA use. Stage 1 was analysed to identify the frequency of 7 indices tabulated below. These indices were used in this and the previous study to estimate awareness of / indifference to the consequences of NMBA misuse in laboratory pigs. The frequency of indices in both studies were compared to determine whether the potential misuse of NMBAs in experimental pigs had changed. The CAs (n = 234) of all papers were sent questionnaires requesting additional information.

Items recorded	Current study	Change from 2016 study
Reference to AAGA risk	0	-13.1%
Description of AAGA avoiding measures	7	+6.2%
End-tidal concentrations of inhaled drugs cited	4	+1.8%
Anaesthetic technique description detail	56	-22.3%
(Cited) evidence for efficacy of anaesthetic technique	13	+8.2%
Remedial action for AAGA recorded	4	+3.1%
Reference to anaesthetist's competency level	7	+7%

Twenty-three of 205 CAs with functional emails replied (11%). Reporting frequency of 5 indices had increased indicating greater appreciation of AAGA. Grounds for concern remain in both manuscripts (the use of sevoflurane or pancuronium to maintain anaesthesia) and free text responses (the use of NMBAs to cause asphyxiation).

Initial data show that reported NMBA misuse in laboratory pigs has lessened. Safe and humane NMBA use is not universal. Stronger measures are required to ensure appropriate NMBA use in laboratory pigs.

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67. Four-point transversus abdominis plane block technique in pigs. A pilot cadaveric study

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This prospective pilot study in pig cadavers aimed to determine an ultrasound-guided transversus abdominis plane (TAP) block technique that would result in adequate staining of the nerves of the cranial and middle abdominal wall.

A methylene blue solution (1 mg kg^{-1} diluted with 5 % glucose; 0.2 mL kg^{-1} per injection point) was injected between the fascia of the transversus abdominis muscle and the fascia or aponeurosis of the internal oblique muscle in four anaesthetised pigs with 15 ribs prior to euthanasia. The landmarks from cranial to caudal direction on each hemiabdomen were: 1) half and 2) three quarters of the line between the xyphoid process and the most caudal part of the last rib; 3) the most caudal part of the last rib; 4) the halfway of a line parallel to the spine between the caudal end of the last rib and the coxal tuberosity. The ultrasound transducer was placed perpendicular to the spine below landmarks and the corresponding interfascial plane was localised by sliding ventrally. A needle was inserted in plane. Positive nerve staining was defined as continuous staining of at least 1 cm of the nerve length. Binary variables (positive/negative) were used for nerve staining assessment.

We have targeted the nerves from the eighth thoracic (Th) to the third lumbar (L) nerve. The nerves in the middle (Th9 to L2) were stained with a higher success rate (6/8, 8/8, 8/8, 8/8, 7/8, 5/8, 8/8, 8/8), while the Th8 and the L2 nerves were stained with less success (1/8 and 3/8, respectively). The L3 nerve was not reached by any injection.

The four-point TAP technique could be used as part of a multimodal analgesia approach for cranial and middle abdominal surgery in pigs, but live animal studies are needed to evaluate the clinical applicability and efficacy of desensitisation.

Rabbits

68. Peri-operative analgesia for the pet domestic rabbit (Oryctolagus cuniculus) undergoing elective neutering in the UK – a survey.

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Pet rabbits commonly undergo surgical neutering. However, perioperative multimodal analgesia (MMA) is underutilised compared to other species (Askar et al., 2020), raising welfare, ethical and professional concerns.

To ascertain the current provision of MMA (full/partial mu opioids plus NSAIDS +/- local anaesthesia) for rabbits undergoing elective neutering, a JISC online survey (formerly Bristol Online Surveys – BoS) (JISC, 2024), composed of questions on demographics, analgesic protocols and timing of analgesic administration, plus use and timing of pain scoring systems, was distributed to UK veterinary surgeons and nurses via social media and professional organisation websites.

There were 154 respondents. Simple descriptive analysis and data visualisation were performed. Results are described in Table 1.

Question: Do you use…	% of 'yes' responses (n=154)
Perioperative full/partial mu opioids plus NSAIDs?	91.1 %
Pre-emptive opioids plus NSAIDs?	60.7 %
Local anaesthetics during surgical intervention?	51.3 %
Post-discharge analgesia?	43.8 %
Perioperative pain assessment?	83.8 %
Pre-operative baseline pain assessment?	23.3 %

Table 1. Reported provision and timing of perioperative full/partial mu opioid plus NSAID +/- local anaesthesia administration, and the use and timing of pain assessment tools for rabbits undergoing surgical neutering.

Based on this study, reported MMA, local anaesthesia and pain assessment use for rabbit neutering have improved since Benato et al., (2020). However, the reported use of baseline pain assessment and a decline in post-discharge analgesia compared to Benato et al., (2020) demonstrate there are still challenges associated with perioperative analgesia for elective neutering procedures.

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69. A composite ad hoc scale as alternative to the Rabbit Grimace Scale to recognise pain in neurologically compromised rabbits

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Post-operative pain assessment through Rabbit Grimace Scale (RGS) can be challenging in rabbits after short-term brain ischemia (Parodi et al. 2023). We aimed at comparing the usefulness of RGS and of a composite ad hoc scale.

Twenty-nine New Zealand White rabbits underwent, in standardized general balanced anaesthesia, surgical access of the right carotid artery through which a balloon catheter was advanced to the aorta. The aortic arch was occluded three times for 30 seconds each. After tracheal extubation, the rabbits were continuously monitored and need for rescue analgesia was checked at two hours interval from spontaneous sternal recumbency until six hours afterward. Each rabbit was evaluated through RGS and the ad hoc scale (a combination of Bristol Rabbit Pain Scale and selected parameters from the Paediatric Pain Profile). Rabbits were deemed evaluable with RGS if they could open their eyes and move the ears spontaneously or to sound. Also, with the ad hoc scale if every parameter could be consistently scored over the observation period (at each time point). Relative Risk (RR) was calculated, using RGS as control technique and the ad hoc scale as new technique, followed by Fisher Exact test. Significance was set at $p \leq 0.05$.

Evaluated rabbits = 29	Sternal	2 hours	4 hours	6 hours
Rabbits evaluable with RGS	51.7% (15)	89.6% (26)	100% (28)	100% (26)
Rabbits evaluable with ad hoc scale	100% (29)	100% (29)	100% (28)	100% (26)
RR	1.9	1.1	1	1

At sternal, the likelihood of successfully using the ad hoc scale was significantly higher than of successfully using RGS ($p < 0.001$). At 2 hours the difference was not significant ($p = 0.237$) and there was no difference at 4 and 6 hours.

The ad hoc scale showed a higher evaluation rate during the initial phase of post-operative recovery.

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70. Intranasal premedication with medetomidine-methadone-midazolam in 68 pet rabbits: a clinical, retrospective descriptive study

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Intranasal (IN) premedication is gaining interest in pet rabbits to reduce stress because of its non-invasiveness and fast drug absorption, but information about its clinical use is still lacking.

Anaesthesia reports from 95 rabbits scheduled for various procedures under general anaesthesia in the teaching hospital of the National Veterinary School of Toulouse from September 2022 to September 2023 were retrospectively assessed. Sixty-eight rabbits concomitantly premedicated IN as drops with midazolam, medetomidine and methadone were included. Demographic data (Breed, age, Body Weigh BW, Body Condition Score BCS, ASA status), drugs dosage (premedication and induction),

sedation score SSc (simple descriptive scale) and HR before (T_0) and 10 minutes after IN (T_{10}) were recorded.

Data normality was tested (Saphiro-test), and the influence of premedication drug dosages on sedation score was assessed with Kruskal-Wallis test.

ASA status was distributed as follows: I 60,3%; II 20,6%; III 19,1%. Nearly half of the rabbits (47.1%) had a SSc ≥ 2 while the other half, a SSc of 1 (48.5%). Only 3 rabbits, 4.4% (SSc of 0) needed a rescue premedication dose before IV catheterization. Drug dosage didn't significantly influence the level on sedation score.

Intranasal administration of medetomidine-methadone-midazolam is an effective and suitable method for premedication in pet rabbits in clinical settings. Comparative studies with IM route to evaluate differences on cardio-respiratory effects are needed.

Methadone (mg kg⁻¹)	Medetomidine (mg kg⁻¹)	Midazolam (mg kg⁻¹)	SSc [0-3]	$HRT_{10} - HRT_0$ (%)	Alfaxalone (mg kg⁻¹)	BCS [0-5]	BW (kg)
0.6 [0.5 - 1]	0.01 [0.005 - 0.025]	0.5 [0.3 - 0.6]	1 [0–3]	-12.5 [-55 - -33]	2.69 ± 1.58	3 [2 - 4]	1.78 ± 0.7

Table 1. Descriptive data for 68 pet rabbits after IN premedication with methadone + medetomidine + midazolam.
(Results are expressed in mean ± standard deviation or median [min - max])

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Non-domestic species

71. Comparison of three anaesthetic protocols in captive baboons (*Papio hamadryas*): preliminary results

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Baboons management often requires chemical restraint (Hotchkiss, Young, 2020). Three anaesthetic protocols were compared in captive *Papio hamadryas* undergoing clinical examination and vasectomy.

Baboons were darted with tiletamine/zolazepam (3 mg kg^{-1}), dexmedetomidine (20 µg kg^{-1}) (TZD_Group), ketamine (6 mg kg^{-1}), dexmedetomidine (30 µg kg^{-1}), methadone (0.2 mg kg^{-1}) (KDM_Group) and midazolam (2 mg kg^{-1}), dexmedetomidine (60 µg kg^{-1}), methadone (0.2 mg kg^{-1}) (MDM_Group).

Propofol was titrated for intubation and maintenance. Sedation time and quality (Bertrand et al., 2016), and intra-anaesthetic vital parameters were recorded. Atipamezole (TZD 0.2 mg kg^{-1}, KDM 0.3 mg kg^{-1}, MDM 0.6 mg kg^{-1}) and flumazenil (MDM 0.02 mg kg^{-1}) were administered IM post-procedure. Recovery time and quality (Bertrand et al., 2016) were recorded. Data were analysed with ANOVA (one-way; repeated-measures).

Six baboons per group were included. Sedation was significantly milder in MDM (4.5, 4-5) compared to other groups (5, 5-5 both; $p = 0.02$), without differences in time and propofol doses. HR (beats minute^{-1}) and fr were significantly higher in MDM (77 ± 9; 33 ± 6) compared to TZD (57 ± 10; 22 ± 6; $p = 0.01$ both) and KDM (62 ± 11 $p = 0.02$; 21 ± 3 $p = 0.003$). MAP (mmHg) (MDM 79 ± 17; TZD 73 ± 14; KDM 74 ± 13), FE'CO$_2$ (mmHg) (MDM 40 ± 4; TZD 42 ± 5; KDM 35 ± 8), SpO$_2$, temperature were similar between groups. Recovery (minutes) was significantly shorter in MDM (4 ± 2) than KDM (14 ± 8) and TZD (25 ± 10) ($p = 0.02$). Recovery quality was better in MDM (3, 1-7) and KDM (3.5, 2-7) than TZD (8.5, 5-11) ($p = 0.001$).

All protocols maintained acceptable cardiopulmonary parameters. TZD and KDM provided deeper sedation compared to MDM, but TZD had poorer recovery. MDM is more suitable for minor procedures.

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72. A case report of ketamine-medetomidine-isoflurane or ketamine-medetomidine-vatinoxan-isoflurane in a collection of Diana monkeys

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Alpha-2 adrenoceptor agonists are widely used for immobilisation of non-human primates but have marked cardiovascular effects (Ølberg & Sinclair 2014). The peripheral α-2 adrenoceptor antagonist vatinoxan attenuates these effects.

This study compared the effects of medetomidine-ketamine and medetomidine-vatinoxan-ketamine in Old World primates.

Two male and two female Diana monkeys (*Cercopithecus diana*) aged 3.5 - 23 years weighing 6.7 ± 2.5 kg were anaesthetised twice, six weeks apart for pre-export health checks. Profound sedation was achieved with IM medetomidine (0.05 mg kg^{-1}) and ketamine) (5 mg kg^{-1}) (MK) on the first occasion and IM medetomidine-vatinoxan (0.05 mg kg^{-1})-ketamine (5 mg kg^{-1}) (ZK) on the second occasion. The plane of anaesthesia was improved using isoflurane via mask to allow safe handling and intubation. Following endotracheal intubation, anaesthesia was maintained with isoflurane in oxygen. Lactated Ringer's Solution was infused IV. The quality of the anaesthesia was quantified based on quality of induction, degree of muscle relaxation and overall anaesthesia. The time to lateral recumbency, intubation, duration of anaesthesia and recovery characteristics were recorded. Animals were continuously monitored; HR, PR, f_R, SpO$_2$, FE'CO2, SAP, MAP, DAP, rectal temperature, mucous membrane colour, capillary refill time and pulse quality were recorded. Haematology, biochemistry, survey radiographs and abdominal ultrasonography were undertaken. Blood glucose was measured 34 ± 7 minutes after induction. Post procedure atipamezole was administered for both protocols (0.25mg kg^{-1}). Data were compared using Student's t-test or Wilcoxon matched pairs as appropriate.

Blood glucose was the only parameter that was significantly different between groups: values were significantly lower (2.7 ± 0.3 mmol L^{-1}) in ZK compared to MK monkeys (8.2 ± 2 mmol L^{-1}). The severe hypoglycaemia required treatment.

Both combinations are suitable for immobilisation of Diana monkeys. Perioperative glucose monitoring is advised in monkeys undergoing anaesthesia that receive medetomidine-vatinoxan-ketamine as part of the protocol.

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73. **Left pneumonectomy in a red kangaroo (*Osphranter rufus*): a case report**

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A thirteen-year-old red kangaroo (*Osphranter rufus*) was admitted for evaluation of a left thoracic mass.

The kangaroo was premedicated intravenously [IV] with dexmedetomidine (5 µg kg^{-1}) and methadone (0.3 mg kg^{-1}) followed by induction with propofol (1.5 mg kg^{-1} IV). General anesthesia was maintained with isoflurane in oxygen. Regional anaesthesia was performed using intercostals nerves blocks and a serratus plane block with ropivacaine (2 mg kg^{-1}). Volume-controlled ventilation was set to target an End Tidal CO$_2$ [EtCO$_2$] between 35 and 45 mmHg, and a continuous rate infusion of ketamine (10 µg kg^{-1} min^{-2} IV) was initiated. Intraoperative monitoring included EtCO$_2$, SpO$_2$, pulse rate, respiratory rate, invasive blood pressure and arterial blood gases.

Severe hypotension (systolic arterial pressure of 70 mmHg, mean arterial pressure of 40 mmHg) was first managed with reduction of inhalants, NaCl 0.9%, 5 ml kg^{-1} and ephedrine 100 µg kg^{-1} IV, and then with dobutamine (10 µg kg^{-1} min^{-1} IV). Hypovolemia, bradycardia and reduced inotropism were the suspected causes of hypotension. An intercostal thoracotomy at the fourth intercostal space was performed and the left lung, presenting several fibrous adhesions, was carefully mobilized and removed. At the end of the procedure, a gradual reduction in the inspired fraction of oxygen was implemented, accompanied by close monitoring of blood gases. Postoperatively, the kangaroo was managed with transdermal fentanyl patch delivering 50 µg kg^{-1} h^{-1} and meloxicam 1 mg kg^{-1} PO, and

chest drainage for twenty-four hours. Follow-up radiographs showed no pleural effusion and optimal right lung expansion. Histology revealed severe fibronecrotic bronchopneumonia. Ten days of hospitalisation were necessary to safely reintroduce the kangaroo into the herd.

This case demonstrates the feasibility and challenges of performing a left pneumonectomy in a red kangaroo, emphasizing the importance of tailored anaesthetic and surgical protocols for macropods.

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74. Scoping review of general anaesthesia in non-human great apes

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Great apes continue to face more risk during anaesthesia compared to humans and domestic animals, despite medical advancements in both human and veterinary medicine. (Masters, Burns and Lewis, 2007). Little is known about the range of preparations, regimes or approaches used during great ape anaesthesia in both human care and free-ranging settings. A scoping review was undertaken to fill this knowledge gap.

Literature searches were conducted using the CAB Abstracts, Medline and Zoological Record databases, as well as conference proceedings of the American Association of Zoo Veterinarians, the British Veterinary Zoological Society, and the European Association of Zoo and Wildlife Veterinarians. Studies were included if they focused on general anaesthesia of captive or free-ranging great apes, regardless of study design, clinical setting, or location. For inclusion, published papers had to be recoverable using English search terms and include at least an English language abstract or summary.

One hundred and thirty-eight studies met the inclusion criteria: 51 conference abstracts and 87 peer-reviewed journal papers. The number of published papers increased steadily since the first one in 1960, reaching 40 studies per decade since 2000. Eighty percent of included papers were case studies and case series, only 28 papers with more robust study designs were reported. There is extensive coverage on chimpanzees, but a paucity of publications on Bonobos, Eastern gorillas, and Sumatran orangutans. Over 50 different anaesthetic drugs are reported in the literature, however, most studies focus on a much more limited range of drugs, most notably ketamine, tiletamine, zolazepam, midazolam, medetomidine, isoflurane. This review found that 48% of studies did not report on anaesthesia-related adverse events, and generally, there is need for improved reporting on key details to achieve reproducibility. This could, in the future, provide opportunities to assess the relative risks and benefits of various drugs and anaesthetic techniques.

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75. Validation of a sedation scale and assessment of sedative effects of dexmedetomidine-methadone and dexmedetomidine-methadone-ketamine in Bearded dragons (*Pogona vitticeps*)

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Bearded dragons are common pet reptiles and may require sedation to facilitate care. This study used two different sedation protocols to validate an existing Bearded dragon sedation scale.

In a randomized, blinded, experimental cross-over study, ten bearded dragons (age range 5–6 months; males; n = 5, females; n = 5) were intramuscularly sedated with dexmedetomidine (0.1 mg kg–1)-methadone (2 mg kg–1; DM) and dexmedetomidine (0.1 mg kg–1)-methadone (2 mg kg–1)-ketamine (10 mg kg–1; DMK), with a washout period of at least two weeks.

Experiments were video-recorded and sedation assessed in real-time (blinded observer) before (T0) and every five minutes from 10 to 60 minutes after injection. An existing 7 item sedation scale was adapted for use (Ferreira et al. 2019). Construct validity was evaluated by comparing sedation scores: a) within each treatment, using Friedman and Dunn's *post hoc* tests and b) between treatments, at the time point corresponding to peak sedation, using a Mann Whitney test. Inter-rater reliability was calculated between real-time scores and 25 videos scored by 9 inexperienced raters, using intraclass correlation coefficient (ICC). Internal consistency was calculated using Cronbach's alpha coefficient (α). Data are presented as [median (interquartile range)].

One animal in each treatment group was excluded from analysis due to misinjections. Significantly increased scores between T15-T40 compared to T0 in DMK treatment ($p < 0.05$) and higher scores in DMK [11 (10 – 12)] than DM (4 [3 - 5]; $p < 0.0001$) at peak sedation (T30) illustrate construct validity. Very good reliability (ICC > 0.91; CI 0.80 - 0.96) was observed. The scale showed excellent internal consistency (α = 0.90).

The scale is a valid and reliable tool to assess sedation in bearded dragons. The DM and DMK protocols resulted in mild and moderate sedation, respectively.

Reference
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76. Comparison of two different immobilisation protocols (medetomidine-midazolam and alfaxalone-midazolam) to restrain urban red foxes (*Vulpes vulpes*) in Dublin area

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Medetomidine-midazolam (MM) is recommended for immobilising wild foxes (Shilo *et al.,* 2010). However, medetomidine has unwanted cardiovascular effects.

The MM protocol was compared with an alfaxalone-midazolam (AM) combination. We hypothesised that both protocols would provide adequate sedation, with the AM resulting in higher HR and SpO$_2$ values.

Foxes were randomly allocated to either group MM (medetomidine 0.07 mg kg^{-1}, midazolam 0.8 mg kg^{-1} IM), or group AM (alfaxalone 3 mg kg^{-1}, midazolam 0.8 mg kg^{-1} IM). Sedation scores, recovery times, HR, and SpO$_2$ were recorded. Sedation was reversed with atipamezole 0.35 mg kg^{-1} IM (MM group) or flumazenil 0.01 mg kg^{-1} IM (AM group). A p value of 0.05 or lower was considered statistically significant.

A total of 15 foxes were captured, seven in group MM and eight in group AM, with no difference in sedation scores between groups (Table 1). A fox in AM group required sedation top-up. AM protocol resulted in slower recovery. HR and SpO$_2$ differed significantly between groups.

Variable	AM	MM	p-value
Sedation score	12.8 (11-14.5)	14.5 (12-15)	0.11
Time (minutes) from reversal to walking coordinated	51 ± 22	25 ± 8	0.01
HR (beats minute^{-1})	202 ± 49	80 ± 20	< 0.01
SpO$_2$ (%)	95 (90-98)	90 (84-99)	< 0.01

Table 1. Sedation scores, reversal times, HR and SpO$_2$ using two immobilisation protocols. AM provided similar sedation than MM with longer recovery times. HR and SpO$_2$ were better preserved in AM. PaO$_2$ and perfusion index were not evaluated, which are limitations of the study.

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77. Intranasal sedation with benzodiazepines and butorphanol in domestic chickens (*Gallus gallus domesticus):* a blinded-prospective study

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Given the fast onset of action, ease of administration and limited cardiorespiratory effects, intranasal (IN) sedation might be interesting to reduce stress during diagnostic procedures in birds.

A blinded, crossover study was conducted on 6 hens (*Gallus gallus domesticus*) evaluating the sedative properties of 3 treatments administered as drops through nasal catheterization: Midazolam MDZ (2 mg kg^{-1}), Midazolam + Butorphanol BUT (each at 2 mg kg^{-1}), Diazepam DZP + Butorphanol (each at 2 mg kg^{-1}). Sedation was assessed by scoring 9 parameters at 5, 10, 20, and 45 minutes post IN administration (t$_0$): alertness, posture, head carriage, eyes, dorsal recumbency, X-Ray positioning, nociceptive stimulation, blood sampling, tracheal swab.

Sedation significantly increased over time for the three groups. Sedation scores for DZP-BUT and MDZ-BUT were comparable from t$_{10}$ onwards, but onset and duration of sedation were respectively faster and longer with DZP-BUT, while midazolam alone offered a shorter sedation. Dorsal recumbency score for X-Ray positioning was statistically different for all groups when baseline (t$_{-5}$) was compared to t$_5$, t$_{10}$ and t$_{20}$, but only at t$_{45}$ for DZP-BUT. There were no statistical differences on reaction to nociceptive stimuli between treatments, nor within groups (comparison to baseline). No major adverse effects were observed, confirming the safety of IN drug administration in hens.

Butorphanol-Diazepam IN administration might be recommended in domestic chickens for minor and non painful procedures needing immobilization, sedation and myorelaxation compared to Butorphanol-Midazolam or Midazolam alone. Moreover, IN administration in domestic chickens is feasible, safe, and fast to realize in a clinical setting.

Figure 1. Sedation Score over time (mean +/- SD; Significant difference when compared to baseline
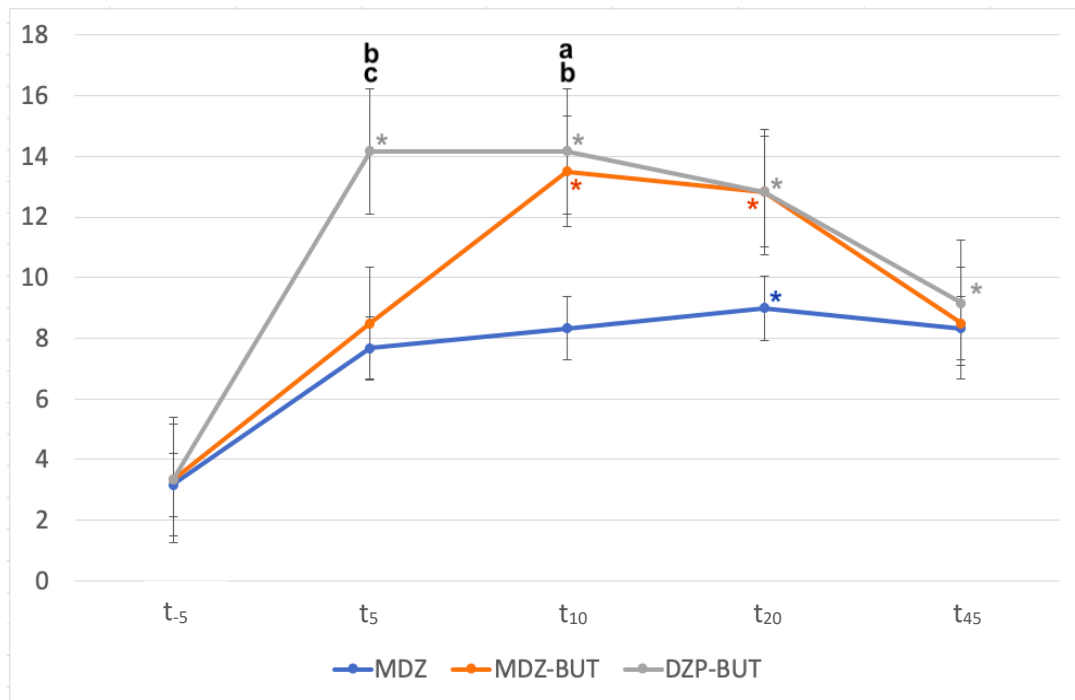
(t_{-5}) within groups = *; between groups [MDZ] and [MDZ-BUT] = a; [MDZ] and [DZP-BUT] = b; and [MDZ-BUT] and [DZP-BUT] = c; $p < 0.05$; Tukey HSD Test).

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Equipment

78. Near-infrared spectroscopy during mouth opening in alpacas at two different head heights

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Based on the knowledge that cats can develop cerebral hypoxia during mouth opening (Martin-Flores et al.2014) and following several clinical observations in alpacas (Vicugna pacos) our study aimed to investigate cerebral perfusion in alpacas during mouth opening at two different head heights using near-infrared spectroscopy (NIRS).

Six adult male alpacas were enrolled in a prospective, randomised, crossover study. Each alpaca was anaesthetised twice with a 7-week washout period and randomly assigned to one of two starting positions: Head Up (HU) or Head Down (HD) (Figure 1).

The NIRS sensor was placed on the forehead to measure cerebral regional oxygen saturation (rSO_2c) and a second on the forelimb muscle (flexor carpi radialis) to measure peripheral regional oxygen saturation (rSO_2p). The mouth was opened for 6 cm with a mouth gag twice for 5 min in each head position: open (MO) and closed (MC). The difference in rSO_2c and rSO_2p (ΔrSO_2c and ΔrSO_2p) between MC and the lowest value during MO was calculated. The influence of head position and alpaca was analysed using Kruskal-Wallis one-way ANOVA. The rSO_2c was correlated with withers height and body weight of the alpacas.

The ΔrSO_2c was (5.8 ± 7.5 %) significantly larger than ΔrSO_2p (-0.3 ± 0.9 %) ($p < 0.0001$). The ΔrSO_2c and ΔSO_2p between HU and HD were not significantly different but were significantly different between the alpacas ($p < 0.0001$). Withers height ($r = -0.4129$, $p < 0.0002$) and body weight ($r = -0.7202$, $p < 0.0002$) were significantly negatively correlated with ΔrSO_2c.

We found a strong relationship between the decrease in rSO_2c during mouth opening and the size of the alpaca.
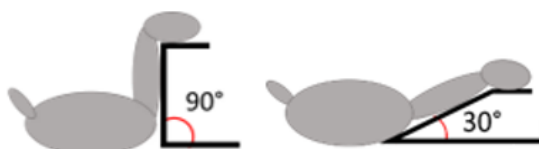

Figure.1

Martin-Flores, M., Scrivani, P.V., Loew, E., Gleed, C.A. and Ludders, J.W. (2014). Maximal and submaximal mouth opening with mouth gags in cats: Implications for maxillary artery blood flow. *The Veterinary Journal*, 200(1), pp.60–64.

79. Inhalational anaesthetic agent consumption within a multidisciplinary veterinary teaching hospital: An environmental audit

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Inhalational anaesthetic agents contribute significantly to greenhouse gas emissions.

We conducted a 55-day prospective observational study at a veterinary teaching hospital, monitoring isoflurane and sevoflurane consumption across small, equine and farm animal clinics and analysed the resulting environmental impact. Consumption was measured by weighing the isoflurane and sevoflurane bottles before and after use with a precision scale. Anaesthetists were also prompted to complete a survey, detailing patient information, vaporizer use and duration of anaesthesia. Emissions in CO_2 equivalents (CO_2e) were calculated using global warming potentials over 100 years for isoflurane and sevoflurane, 510 and 130, respectively (Jones and West, 2019). Car mileage equivalents were also calculated, assuming European average petrol passenger vehicle emissions of 134 grams of CO_2e per kilometre driven (European Environment Agency, 2022).

A total of 9.36 litres of isoflurane and 1.27 litres of sevoflurane were used to anaesthetise 409 animals over 1,489 hours. Isoflurane consumption rates were 8.7, 13- and 41.2-mL h^{-1} for small, farm and equine anaesthesia, respectively, while sevoflurane consumption in small animals was 12.4 mL h^{-1}. This corresponded to 7.36 t of CO_2e in total emissions or 2.4 – 31.3 kg of CO_2e per hour. This emission is equivalent to driving approximately 49 to 234 kilometres per hour of anaesthesia depending on the species and type of inhalant used. Comparison to human anaesthesia settings showed similar isoflurane consumption rates (8.9 to 12.7 mL/h) to small animals, suggesting shared environmental implications, albeit on a smaller scale (Vithayathil et al., 2022).

This study highlights the significant environmental impact of inhalant anaesthetics in veterinary practice, particularly emphasizing the higher consumption rates and emissions in equine anaesthesia. It is essential for anaesthetists to be aware of the environmental consequences of their choices. Balancing patient safety and care with environmental responsibility should be a primary goal in future veterinary practices.

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### 80. Improving the information derived from a time-capnogram

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A traditional time-capnogram does not indicate the direction of gas flow, meaning that instances of rebreathing can be hidden. By monitoring gas flow direction using an air flow sensor, the precise start of inspiration (SOI), end of inspiration (EOI), start of expiration (SOE) and end of expiration (EOE) can be detected.

A capnogram indicates the concentration of CO_2 in the airway. With no change in concentration there is no change in the waveform height even though the direction may change, with the patient subsequently inspiring high levels of CO_2. In circles and Mapleson-A circuits this condition is followed by a return to zero of the trace and the capnograph does not indicate rebreathing, as $FiCO_2$ is zero. Similarly, the changeover from inspiration to expiration is hidden. A new system, designed by the author, uses digital delay methods to synchronise the direction data from an inline pneumotachograph (Burtons Medical, Research Model) with the capnograph data (IRMA/ISA CO_2, Masimo Corporation). The resultant capnogram uses colour to differentiate the phases of the breath cycle and indicates the degree of rebreathing and magnitude of the dead space. By integration of flow data, CO_2 rebreathing can be quantified. Figure 1 shows a traditional capnogram from a patient on a circle system.

Figure 1

Figure 2 shows the same patient with phases indicated by colour.
Expiration=white. Inspiration=blue. Pause=yellow.
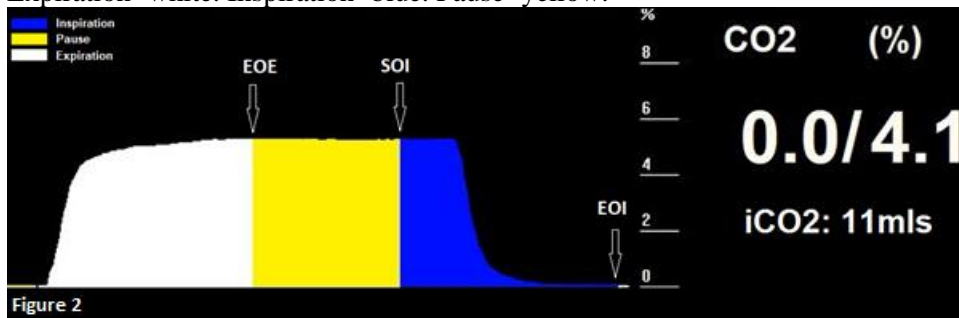
Figure 2

SOI begins in advance of the fall of the CO_2 waveform indicating significant rebreathing, which is quantified by iCO_2, the inspired volume of CO_2. This rebreathing is hidden and is not indicated by the traditional capnogram in Figure 1.

The combination of trace, flow and direction data increases the information derived from the time capnogram, exposes hidden rebreathing and allows informed control of gas flow rates, especially in low flow systems.

81. **Efficiency of isoflurane capture from anaesthetised veterinary patients: a single-centre study**

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Volatile anaesthetics are potent greenhouse gases which contribute to climate change (White et al. 2022). This single-centre study evaluated the capture efficiency of a volatile capture device (VET-can) in anaesthetised animals.

Purposeful sampling at a companion animal research institute was used to recruit enough animals undergoing general anaesthesia for elective procedures as part of routine healthcare to fill one VET-can to $\geq$ 90%. The VET-can was sited downstream of the anaesthetic breathing system and upstream of the active gas scavenging system. The vaporiser and VET-can were weighed pre- and post-anaesthesia to determine *in vivo* mass transfer (MT) of isoflurane and water. All equipment was leak tested prior to use and waste gas monitoring was undertaken. At the end of the study period, the VET-can's contents were desorbed by the manufacturer. The primary outcome was the capture efficiency (isoflurane delivered: desorbed, %). The secondary outcomes were associations between *in vivo* mass transfer (MT) and patient characteristics and anaesthesia parameters, tested by backwards-elimination multiple linear regression with significance set at $p < 0.05$. A hypotensive index was calculated as the sum of hypotensive periods (MAP below 60mmHg) multiplied by the degree of hypotension.

Twenty-six anaesthetics (25 animals) were initially included in the study. There was an overall capture efficiency of 65.0% isoflurane and 5.6% water. Two cases were excluded from regression analysis as low outliers with MTs of 14.3 and 18.5%. The median MT for the remaining 24 anaesthetics was 82.1% (range 32.6 – 99.5%). There was a statistically significant negative

relationship between MT and F_E'ISO at disconnection (p = 0.024) and a calculated hypotensive index (p = 0.025), both potentially suggesting reduced isoflurane elimination.

This device captured an average of 3.75 kgCO_2e for each 20-minute isoflurane anaesthetic period and is a promising clinical carbon-reduction lever. Research should focus on factors affecting MT.

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Teaching and Learning

82. Anesthesia curricula and new graduate skill expectations

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The purpose of this study was to document the anesthesia curricula and methods in AVMA-accredited Colleges of Veterinary Medicine (CVM) and compare it with student clinical supervision and expectations of new graduates.

Emails were sent to anesthesiologists at each CVM to solicit participation for institutions. Disagreement among institutions was defined by more than 20% of institutions taught the topic a great deal or much and more than 20% of institutions did not teach the topic at all. An email was sent to ACVA-L to recruit individual participants. Individuals indicated if students are allowed to perform any of 80 skills under direct or indirect supervision and indicated if any of the skills are "needed" or "not needed" as a Day One Competency. The percentage of respondents indicating they would allow a student to perform a skill was subtracted from the percent of respondents who indicated the skill was "needed".

Forty-one different institutions responded and 88 individual surveys were completed. Institutional curricula disagreed on the importance of the topics of blood gas interpretation, patient safety/systems thinking, diagnosing and treating chronic pain, acid-base & electrolyte physiology, professionalism, and cardiopulmonary arrest and resuscitation. When comparing individual responses about what is a Day One Competency and institutional curricula, the top five topics with the highest need and lowest incidence of emphasis in the core anesthesia course were how to communicate with clients about anesthesia, critical event debriefing, euthanasia, renal physiology, and arrhythmia diagnosis and treatment. The top five skills with the highest "needed" and lowest allowed % were communicate with clients about anesthesia, diagnose and treat regurgitation, draw, record, waste controlled substances, equine restraint, and equine recovery.

There is broad alignment between what anesthesiologists believe students need to learn and what is being taught, but there are important areas of disagreement that should be evaluated.

83. Veterinary students do not need an elephantine memory: the effectiveness of a preinduction safety checklist

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Safety checklists are an example of cognitive aids and are an effective strategy to improve patient safety in operating rooms (Haynes et al. 2009). This observational study assessed effectiveness of a preinduction safety checklist used by veterinary students during anesthesia training.

A 20 item preinduction checklist, adapted from those of the Association of Veterinary Anaesthetists and World Health Organization, was tested. Checklist items included pre-measuring endotracheal tube insertion depth, confirming open pop-off valve, having intubation supplies and emergency interventions available, and medications prepared, among others.

The study population was third year veterinary students (n = 53) performing anesthesia and spay-neuter surgery of 83 dogs and cats during a two week teaching laboratory. Students had access to the checklist when preparing their workstation. Applying the checklist as a team (two to three students and an anesthesia technician) was mandatory immediately before induction of anesthesia. Checklist use was observed by one of three supervising anesthetists. Checklist items were assessed as complete or incomplete. Students were required to complete incomplete items before proceeding. Completeness between weeks were compared with Fisher's exact test.

At least one item was incomplete in 67.5 % (56/83) of checklists. The number of incomplete checklists reduced significantly between the first (82.9 %; 34/41) and second weeks (52.4 %; 22/42, p = 0.0046). Premeasuring endotracheal tube insertion depth was the most frequently incomplete item (42.2 %; 35/83), followed by testing endotracheal tube cuffs and having gauze available (15.7 %; 13/83, for each), and emergency interventions and tube tie available (13.3 %; 11/83, for each). The checklist identified inadvertently closed pop-off valves in 4.8 % (4/83) of cases.

The preinduction safety checklist effectively identified incompleteness of key items linked to patient safety and prevented adverse events. Performance in completing checklist items improved over the observation period.

References

Haynes AB, Weiser TG, Berry WR et al. (2009) A Surgical Safety Checklist to Reduce Morbidity and Mortality in a Global Population. N Engl J Med, 360, 491–499.

84. Choose your own adventure: using Twine for gamified interactive learning in veterinary anaesthesia

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To assess the effectiveness of Twine, an open-source tool for creating interactive, nonlinear stories, in teaching clinical skills to veterinary anaesthesia students.

Five clinical cases were created using Twine, allowing students to make decisions and observe the outcomes. Gamification elements were integrated, enabling students to earn or lose points based on their choices and manage a 'budget' for resources. The workshop engaged 849 veterinary students from the 2nd, 3rd, and 4th years, who were invited to participate in an anonymous survey. The survey used a five-point Likert scale to evaluate the effectiveness of the interactive approach, the platform's user-friendliness, and overall satisfaction. Open-ended questions gathered additional feedback. Descriptive statistics were used to analyse the survey results.

Three hundred sixty-seven out of 849 students completed the survey. Twine's interactive and narrative format received highly positive feedback. Regarding the workshop's impact on their training in veterinary anaesthesia, 52.9% agreed, and 37.9% strongly agreed that it was helpful. Regarding the interactive case's helpfulness in improving their knowledge, 21.5% agreed, and 75.5% strongly agreed. For ease of use, 18.3% rated the system as "easy" and 76.3% as "very easy". Overall, 29.7% described the experience as "good," and 67.0% as "very good."

Twine proved highly effective in training veterinary anaesthesia students for clinical case resolution, enabling dynamic, hands-on learning. The positive feedback indicates substantial potential for integrating interactive technologies into veterinary education for a more engaging and practical learning experience.

References

Twine (2024). Twine: An open-source tool for telling interactive, nonlinear stories. Available at: https://twinery.org (Accessed: 07 June 2024).

Health and Wellbeing

85. Comparison of two formulas for estimating number of staff for a veterinary anesthesia service

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Little's law (LL) is a mathematical queueing theory foundational formula that can be used to estimate the number of staff needed based on arrival rate of customers or patients. However, in human health care settings, a modification of the formula (MF) including work force efficiency and patient to staffing ratio to estimate the number of nurses needed is used for various services. The purpose of this study was to compare LL to MF for different case numbers and average case duration for a veterinary anesthesia service.

Calculations were performed for one to 25 cases of average duration of 60 to 300 minutes, at 30 mintues intervals, using LL [$N = (\lambda*T)/H$, where N = the number of anesthesia personnel, λ = the number of cases per day, T = the average duration of anesthesia (time from premedication to extubation), and H = work hours per day (shift length)], and MF [$N = (\lambda*T)/(H*EF*SR)$ where EF = efficiency factor (0.8, human standard), and SR = patient to staff ratio (1:1 for anesthesia)]. For each case duration interval, results from LL and MF were compared using a Wilcoxon matched pairs test. A $p < 0.05$ was used for significance.

Data are summarized in table format. For all time points, MF estimated a significantly larger number of anesthesia personnel for all case duration intervals than LL (all $p < 0.001$).

Time/Group	60	90	120	150	180	210	240	270	300
LL	2(1,4)	3(1,5)	4(1,7)	5(1,8)	5(1,10)	6(1,11)	7(1,13)	8(1,15)	9(1,16)
HF	3(1,4)	4(1,6)	5(1,8)	6(1,10)	7(1,12)	8(1,14)	9(1,16)	10(1,18)	11(1,20)

A larger number of staff may be required for an anesthesia service when staff efficiency and patient to staff ratio are considered.

Critical care

86. Description of patient-ventilator asynchrony in long term mechanically ventilated dogs and cats: 65 cases

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Patient-ventilator asynchrony (PVA) is common in critically ill patients undergoing assisted mechanical ventilation (MV) and may have detrimental effects (Esperanza et al., 2020).
This retrospective study aimed to describe the type of PVA in critically ill patients undergoing MV for minimum 24 hours. From 2021 to 2024, when prolonged PVA occurred in MV patients, a criticalist took a waveform screenshot and properly managed the asynchrony. Images were retrospectively evaluated, and ventilator waveforms were classified (Saavedra et al. 2022). Descriptive statistics was used.
A total of 55 dogs and 10 cats underwent MV with a mean duration of ventilation of 2.87 (1-13) days. Positive End Expiratory Pressure was used in all patients and was selected according to clinical conditions. Relevant data are summarized in table 1.
In 47/55 dogs and in 7/10 cats PVAs were noticed, with ineffective trigger being the most common; in some cases, more than one PVA type were present during MV.

Table 1		DOGS (n = 55)	CATS (n = 10)
DISEASE INVOLVING	Upper Airways	9	2
	Lower Airways	25	2
	Nervous System	16	4
	Cardiovascular System	5	2
VENTILATION MODE	Pressure Assist/Control	39	6
	Volume Assist/Control	3	0
	Pressure Support Ventilation	11	4
	Continuous Positive Airways Pressure	1	0
	Airways Pressure Release Ventilation	1	0
PVA	Ineffective Trigger	33	4
	Reverse Trigger	10	0
	Autotrigger	5	0
	Double Triggering	3	2
	Premature Cycling	9	0
	Delayed Cycling	13	1
	Insufficient Flow Asynchrony	3	0
OUTCOME	Weaned	27	6
	Non-Survivor	28	4

To the author's knowledge this is the first veterinary study describing PVAs, which have been shown to be frequent. Monitoring of patient-ventilator interaction with early identification of PVA's is fundamental to avoid negative consequences. Further studies are warranted to evaluate PVAs frequency and their relationship with ventilation mode, sedation level, kind of disease and outcome.

References
Esperanza JA, Sarlabous L, de Haro C, Magrans R, Lopez-Aguilar J, Blanch L. Monitoring Asynchrony During Invasive Mechanical Ventilation. (2020) Respir Care. 65, 847-869
Saavedra SN, Barisich PVS, Maldonado JBP, Lumini RB, Gómez-González A, Gallardo A. (2022) Asynchronies during invasive mechanical ventilation: narrative review and update. Acute Crit Care. 37,491-501.