# Abstracts

# Thursday 21st of March

## Small animal stream

| Time | Title |
|---|---|
| 16.00 | Influence of anaesthesia on the acetaminophen pharmacokinetics in Beagle dogs |
| 16.15 | The opioid-sparing effect of medetomidine constant rate infusion during thoraco-lumbar hemilaminectomy in dogs |
| 16.30 | Prevalence and management of pain in dogs in the emergency service of a veterinary teaching hospital |
| 16.45 | Effect of two different doses of butorphanol on propofol induction dose in dogs with suspected intracranial pathology undergoing brain MRI scan |
| 17.00 | Alfaxalone-midazolam anesthesia in Egyptian fruit bats (Rousettus aegyptiacus) and the effectiveness of flumazenil administration on recovery |
| 17.15 | Anaesthesia of zebrafish (Danio rerio): a comparison to two drugs for anaesthesia for caudal fin clipping. |
| 17.30 | Halothane minimum anaesthetic concentration determined for rock pigeons (Columbia livia) with a hybrid bracket methodology using stepwise electrical stimulation cycles |

**Influence of anaesthesia on the acetaminophen pharmacokinetics in Beagle dogs.**

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To determine if the anaesthesia procedure could influence the intravenous acetaminophen pharmacokinetics (PK) in dogs as previously described with other drugs (Karademir et al., 2016).

Nine Beagle dogs were used twice one month apart. Acetaminophen PK was determined in awake (AW group) and anaesthetized (AN group) healthy dogs. Blood samples were collected before and 5, 10, 15, 30, 45, 60, 90 minutes and 2, 3, 4, 6, 8,12 and 24 hours after 20 mg $kg^{-1}$ IV acetaminophen administration. Haematocrit, total proteins, albumin, alanine aminotransferase, aspartate aminotransferase, urea and creatinine were determined at baseline and 24 hours post-acetaminophen in both groups. Dogs were undergoing general anaesthesia (90 minutes) for dental cleaning. After dexmedetomidine (3 mcg $kg^{-1}$ IM), anaesthesia was induced with propofol to effect, followed by acetaminophen administration. Anaesthesia was maintained with isoflurane in 50% oxygen (Et Iso 1.3-1.5%). $FE´CO_2$ was maintained 35-45 mmHg using mechanical ventilation and mean AP 65-80 mmHg using dopamine. A Wilcoxon test was used to compare PK data between groups and laboratory parameters data between groups and before *vs* 24 hours after administration.

No significant differences were found for volume of distribution 1.64 (0.92-3.55) and 1.75 (0.91-2.53) L $kg^{-1}$, clearance 1.65 (0.73-2.24) and 1.60 (0.80-1.90) L $kg^{-1}$ $hour^{-1}$ or elimination half-life 2.41 (1.14-8.35) and 3.34 (1.92-6.34) hours between awake and anaesthetized dogs. Clinical laboratory parameters were within normal range and no significant differences were found. No side effects were registered.

Intravenous pharmacokinetics of acetaminophen was similar in awake and anaesthetized dogs under the study conditions.

1.Karademir U, Aksit D, Kum C, Erdogan H et al. (2016) The effect of surgery (ovariohysterectomy) on the plasma disposition of meloxicam following intravenous administration in dogs. BMC Veterinary Research 12:33.

**The opioid-sparing effect of medetomidine constant rate infusion during thoraco-lumbar hemilaminectomy in dogs**

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The opioid-sparing effect of a medetomidine constant rate infusion (CRI) during thoraco-lumbar hemilaminectomy in dogs was evaluated.

Forty-four client-owned dogs randomly received saline (SAL, n = 22) or medetomidine (MED, n = 22) 1 μg $kg^{-1}$ loading dose, followed by 1.7 μg $kg^{-1}$ $hour^{-1}$ CRI 10 – 20 minutes before surgical incision. Otherwise, all dogs received a standardised anaesthetic and analgesic protocol. Multiparametric monitoring, including invasive arterial blood pressures, was performed. The same investigator, unaware of the treatment, evaluated pain scores for 4 hours postoperatively. Rescue analgesia intraoperatively was with fentanyl if invasive SAP increased by ≥ 20% (first two boluses 5 minutes apart, followed by infusion if SAP did not return to baseline) or postoperatively with methadone if Glasgow pain score ≥ 5/20. Data was tested for normality (Shapiro-Wilk) and analysed with Fisher's exact test, Mann-Whitney U test, ANOVA and a mixed effects regression model.

The total amount of fentanyl administered (μg $kg^{-1}$ $hour^{-1}$) was significantly lower with MED [0 (0 – 5.6)] compared to SAL [3.01 (0 – 9.4)]. Fewer dogs in MED (n = 1) required a fentanyl infusion compared to SAL (n = 12) (p = 0.001). There were no statistically significant differences between groups for intra- and postoperative rescue analgesia lag times, postoperative pain scores or amount of postoperative methadone. No differences were found for the cardiovascular data collected.

The addition of a medetomidine infusion to the anaesthetic protocol decreased the intraoperative opioid requirements and the need for a fentanyl infusion in dogs undergoing hemilaminectomy.

**Prevalence and management of pain in dogs in the emergency service of a veterinary teaching hospital**

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The prevalence and management of acute pain in dogs presenting to veterinary emergency services is sparsely described.
A prospective, cross-sectional study was designed to document: 1. prevalence of pain in dogs presenting to the emergency service of a veterinary teaching hospital, 2. provision of analgesics to painful dogs and 3. if treatment was instituted more quickly in painful dogs. Dogs were independently evaluated (Glasgow Composite Measure Pain Scale-short form) before (PRE) and after (POST) examination by the duty veterinarian and identified as painful/ non-painful based on pain scale intervention threshold (≥ 5/20). Time from initial veterinary examination to treatment was recorded. Comparisons between painful and non-painful dogs were performed with a Mann-Whitney test ($p < 0.05$ considered significant).
Complete PRE and POST data collected for 95 dogs. 36/95 (38%) were identified as painful. Approximately half of painful dogs (19/36) were provided analgesia in the clinic, the remainder were prescribed an analgesic for administration at home (11/36, 31%) or did not receive analgesics (6/36, 17%). Of those receiving analgesia in the clinic, the majority (12/19) showed a decreased pain score, below the intervention threshold. A smaller proportion of painful dogs not given analgesia in the clinic (3/17) showed a similar reduction in pain scores. There was no significant difference in the time from examination to treatment between painful and non-painful dogs ($p = 0.73$, 95%CI -14 to 20 minutes).
Pain assessment and management was suboptimal. Focused training in pain assessment, analgesic use and timely intervention is warranted and deserves further investigation.

**Effect of two different doses of butorphanol on propofol induction dose in dogs with suspected intracranial pathology undergoing brain MRI scan.**

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Butorphanol is a sedative commonly used as pre-anesthetic medication in dogs prior to non-invasive procedure (Girard et al. 2010).

The aim of this blinded, randomized trial was to compare 0.2 (L) and 0.3 (H) mg $kg^{-1}$ of IV butorphanol as pre-anesthetic medication in dogs with suspected intracranial pathology undergoing brain magnetic resonance imaging (MRI). The hypothesis was that dose H would result in larger sparing effect on propofol induction dose than L.

Dogs received IV butorphanol 10 minutes prior to induction of general anesthesia (GA) with propofol. Subjects were mechanically ventilated to maintain normocapnia and GA was maintained with isoflurane. Scores for mentation, neurological status and sedation were obtained; dose of propofol, quality of induction, ease of intubation and recovery quality were also recorded. Monitoring included: heart rate, arterial blood pressure, FE'$CO_2$ and inspired and expired fractions of isoflurane and oxygen.

Data were analyzed using two sample Wilcoxon test, Student t-test and ANOVA for repeated measures.

Thirty-two dogs were enrolled. No difference between groups was detected in gender, body mass and age; mentation and neurological scores were similar between groups. Sedation score was significantly different ($p$ = 0.017), with score of 3 (2 – 4) and 2 (1 – 4) in groups H and L respectively. Propofol induction dose was similar between groups. Monitored physiologic variables and recovery times were not statistically different.

The administration of 0.3 mg $kg^{-1}$ butorphanol IV prior to brain MRI resulted in higher sedation scores but no propofol sparing effect or other significant differences were observed.

Girard NM, Leece EA, Cardwell JM et al. (2010) The sedative effects of low-dose medetomidine and butorphanol alone and in combination intravenously in dogs. Vet Anaesth Analg 37, 1e6

**Alfaxalone-midazolam anesthesia in Egyptian fruit bats (*Rousettus aegyptiacus*) and the effectiveness of flumazenil administration on recovery**

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The objectives of this study were to describe the use of alfaxalone-midazolam anesthesia in Egyptian fruit bats (*Rousettus aegyptiacus*), and to evaluate the effect of flumazenil antagonist on recovery time and quality.

Using a randomized, blinded, crossover trial, ten male Egyptian fruit bats were anesthetized with 15 mg $kg^{-1}$ alfaxalone and 2 mg $kg^{-1}$ midazolam administered subcutaneously. During anesthesia, vital signs and anesthetic depth were monitored every 10 minutes. Sixty minutes following anesthetics administration, 0.3 mg $kg^{-1}$ flumazenil or saline 0.9% at an equivalent volume were administered subcutaneously. Time to induction (recumbency), time to first movement, and recovery time (flying) were measured, and quality of induction, anesthesia and recovery were assessed on a three-point scale (1 = poor, 2 = good, 3 = excellent). Student t-test and Wilcoxon signed-rank test were used for analysis, with $p$-value ≤ 0.05.

Mean ± SD induction time was 4.2 ± 1.9 minutes, with median quality score of 2 (range 1-3). Anesthetic depth indicators and heart and respiratory rates decreased significantly until 40-60 minutes. Time to first movement was 50 ± 12 minutes, with anesthesia quality score of 3 (1-3). Flumazenil administration significantly reduced mean recovery time compared to saline (10 ± 5 versus 45 ± 17 minutes, respectively), and significantly improved recovery quality (2.5 [2-3] versus 1 [1-2], respectively).

Combination of alfaxalone-midazolam provides smooth induction, muscle relaxation, and sufficient anesthesia in Egyptian fruit bats to perform non-painful procedures for at least 40 minutes. It is recommended to administer flumazenil for quicker and better recovery.

**Anaesthesia of zebrafish (*Danio rerio*): a comparison to two drugs for anaesthesia for caudal fin clipping.**

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Anaesthesia of zebrafish is required during the performance of procedures including caudal fin clipping. Buffered tricaine methanesulfonate (MS-222) is commonly used. The aim of this study was to compare the safety and efficacy of MS-222, at a commonly reported dose, with isoeugenol, according to the manufacturer's guidelines, for anaesthesia for caudal fin clipping.

Eighty zebrafish (AB strain, 5 months of age) were divided into 2 groups: MS-222 0.168 g $L^{-1}$ (n=40) and isoeugenol 18.5 mg $mL^{-1}$ (n=40). Within each group there were equal numbers of male and female fish. After the induction of anaesthesia the fish were removed from the bath for 30 seconds for caudal fin clipping. The times to induction of anaesthesia and the time to recovery from anaesthesia were recorded, the fish were monitored for 24 hours and euthanised the following day. Data were compared with an unpaired t-test.

The time to induction of anaesthesia was shorter with isoeugenol (141 ± 70 seconds) compared to MS-222 (207 ± 103 seconds) ($p = 0.0015$). The time to recovery from anaesthesia was shorter with MS-222 (372 ± 125 seconds) compared to isoeugenol (491 ± 176 seconds) ($p = 0.001$). There was no difference in either of these parameters between male and female fish. Two female fish in the MS-222 group were not adequately anaesthetised for the procedure within 10 minutes so anaesthesia was not continued. One male fish in the MS-222 group died.

Isoeugenol was a safe and efficacious alternative to MS-222 for anaesthesia of zebrafish.

The project was approved by the Animal Ethics Committee of the University of Western Australia (RA/3/100/1558).

**Halothane minimum anaesthetic concentration determined for rock pigeons (Columbia livia) with a hybrid bracket methodology using stepwise electrical stimulation cycles**

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Halothane is often used during electrophysiological studies of anaesthetised animals (Murrell and Johnson 2006). The aim was to describe the minimum anaesthetic concentration (MAC) of halothane in domestic rock pigeons.

Seven pigeons were anaesthetised with halothane in oxygen ($FiO_2$ >95 %). Following intubation mechanical ventilation was instigated to maintain stable anaesthesia and normocapnia ($ET_{CO2}$ 30 – 40 mmHg). Electrical stimulation (30 Hz, 30 V, 7.5 ms duty-cycle) was used to determine MAC in a stepwise fashion as described by Valverde et al. (2003). Electrode impedance and delivered current were measured continuously using a digital oscilloscope. Paired electrodes were placed subcutaneously on the medial aspect of both left and right tibia and femur in a standardised pattern. The MAC of halothane was assessed starting at a predicted value ($ET_{halo}$ 1.1 %). If gross purposeful movement was observed following stimulation, $ET_{halo}$ was increased by 10 %, or if no movement was observed the $ET_{halo}$ was decreased by 10%. Following a 15-minute period of stabilisation, the stimulation cycle was repeated. Each bird was subjected to a maximum of eight periods of electrical stimulation. Results are displayed as mean ± SD.

Seven birds completed the study with a mean of 7.4 ± 1.5 periods of stimulations per bird. The minimum anaesthetic concentration of halothane was determined to be 1.59 ± 0.19 %.

This determination of halothane MAC is the first to be reported in rock pigeons and also the first use of a step-wise stimulation methodology to determine MAC in birds.

Murrell, J. C., and C. B. Johnson. 2006. 'Neurophysiological Techniques to Assess Pain in Animals'. *Journal of Veterinary Pharmacology and Therapeutics* 29 (5): 325–335.
Valverde, Alexander, Timothy E. Morey, Jorge Hernández et al. 2003. 'Validation of Several Types of Noxious Stimuli for Use in Determining the Minimum Alveolar Concentration for Inhalation Anesthetics in Dogs and Rabbits'. *American Journal of Veterinary Research* 64 (8): 957–62. https://doi.org/10.2460/ajvr.2003.64.957.

# Abstracts

# Thursday 21st of March

# Large animal stream

| Time | Title |
|---|---|
| 16.00 | Caudal cervical nerve root perineural injection under ultrasonographic guidance: a pilot cadaveric descriptive study in horses |
| 16.15 | Comparison of lithium dilution cardiac output measurements when using the jugular or cephalic vein for lithium chloride administration in isoflurane anaesthetised goats |
| 16.30 | Validation of the UNESP-Botucatu composite pain scale for assessing postoperative pain in sheep |
| 16.45 | Complication-related variables in equine anesthesia: a retrospective study on 1161 cases undergoing colic and non-colic surgery |
| 17.00 | Does positive end-expiratory pressure (PEEP) influence the relationship between total impedance change measured by electrical impedance tomography (EIT) and tidal volume? |
| 17.15 | Behavioural and cardiovascular effects of constant rate infusion of medetomidine compared to detomidine for standing sedation in horses |

**Caudal cervical nerve root perineural injection under ultrasonographic guidance: a pilot descriptive study on equine cadavers**

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Cervical radiculopathy has been identified in horses as a consequence of articular process joint arthropathy of the caudal cervical spine (Dyson 2011). Selective cervical nerve root injections are used in humans and dogs for therapeutic purposes and confirmation of cervical pain localization (Giambuzzi et al. 2016, Yamauchi et al. 2011).
The study aimed to describe the feasibility and the dye diffusion of selective perineural injection of the 7th and 8th cervical nerve *ramus ventralis* (C7 and C8) under ultrasonographic guidance in horses.
Perineural C7 and C8 injections on equine cadavers of similar lean neck conformation were performed under ultrasonographic guidance. Five C7 and five C8 were injected with a dye solution (7 or 14 mL randomly assigned for each root). Anatomic dissections including vertebral canal opening were conducted to confirm nerve dye staining and describe the extent of color diffusion.
The *ramus ventralis* of the spinal cervical nerves was visualized in all cadavers and had a portion stained for all 10 injections. Eight *rami* had a uniform transversal staining covering longitudinally a distance greater than 2 cm. One C7 and one C8 showed incomplete transversal staining with a more concentrated color on its cranial aspect and a longitudinal coverage of less than 2 cm. Five injections resulted in dye extending proximally and medially into the epidural space. Volume had no appreciable effect on the extent of nerve staining.
Ultrasonography-guided perineural injection of C7 and C8 *ramus ventralis* is a potentially reliable technique that may have multiple applications in multimodal analgesia.

Dyson SJ (2011) Lesions of the equine neck resulting in lameness or poor performance. Vet Clin North Am Equine Prac 27, 417–437.
Giambuzzi S, Pancotto T & Ruth J (2016) Perineural injection for treatment of root-signature signs associated with lateralized disk material in five dogs (2009–2013). Frontiers Vet Sci 3, 829–7.
Yamauchi M, Suzuki D, Niiya T et al. (2011) Ultrasound-guided cervical nerve root block: spread of solution and clinical effect. Pain Med 12, 1190–1195.

**Comparison of lithium dilution cardiac output measurements when using the jugular or cephalic vein for lithium chloride administration in isoflurane anaesthetised goats**

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Peripheral rather than central administration of lithium chloride (LiCl) for cardiac output (CO) measurement has been described as a valid alternative route in pigs and dogs (Kurita el at, 1999; Mason et al, 2002). The aim of this study was to compare CO measurements in goats when LiCl was administered via the cephalic and the jugular vein.

Paired cardiac output measurements were taken between 1 and 5 minutes apart during stable conditions in ten goats undergoing bilateral stifle arthrotomy. Normality was assessed with Kolmogorov-Smirnov test. Intraclass coeficient correlation (ICC) and 95% confidence interval (CI) and Bland-Altman method were used to analyze the agreement between the two routes of administration. Statistical analysis was performed using Stata 12.0. Significance was set at 0.05.

Forty-two paired CO measurements were included. The mean (SD) CO using the cephalic and jugular vein was 5.28 (1.29) L $min^{-1}$ and 5.20 (1.24) L $min^{-1}$ respectively. The ICC was 0.894 (95% CI 0.812; 0.941). The bias (cephalic-jugular) was 0.077 L $min^{-1}$ (95% CI -0.104; 0.258). The Bland-Altman graphical method confirmed high test-retest reliability. When the CO was 5 L $min^{-1}$, ICC was 0.854 (95% CI 0.658, 0.942) and, if CO was > 5 L $min^{-1}$, ICC was 0.709 (95% CI 0.441; 0.862).

There was no statistical difference in CO measurements between the administration of LiCl using the cephalic or the jugular vein. Administration of LiCl via the cephalic vein when measuring CO with LiDCO in goats is a reliable alternative route.

**References**

Kurita T, Morita K, Kato S et al. (1999) Lithium dilution cardiac output measurements using a peripheral injection site: comparison with central injection technique and thermodilution. J Clin Monit Comput 15, 279 – 285.

Mason DJ, O'Grady M, Woods JP et al. (2002) Comparison of a central and peripheral (cephalic vein) injection site for the measurement of cardiac output using the lithium-dilution cardiac output technique in anesthetized dogs. Can J Vet Res 66, 207 – 210.

**Validation of the UNESP-Botucatu composite pain scale for assessing postoperative pain in sheep**

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The elaboration of valid tools to evaluate pain is required to diagnose pain and determine when analgesics are necessary. This study aimed to validate a tool to measure postoperative pain in sheep.

Laparoscopy was performed in 48 sheep, which were filmed preoperatively (M1) and postoperatively, before (M2) and after rescue analgesia (M3) and at 24 hours (M4). Four blinded observers evaluated the randomized edited footages twice with one-month interval. Intra- and inter-observer reliability was investigated by *kappa* coefficient. Criterion validation was evaluated by Pearson's correlation against the visual analogue scale (VAS), numerical (NS) and simple descriptive scale (SDS). Internal consistency was evaluated by Cronbach's α coefficient. Responsiveness (construct validity) was established according to the total scores (Friedman). Determination of the optimal cut-off point for rescue analgesia (CUT) was calculated by the Youden index and discriminatory ability of the CUT was estimated by the area under the curve (AUC), based on the Receiver Operating Characteristics curve.

Intra- and inter-observer reliability varied from 65 to 83% and 55 to 72% respectively. Correlations with VAS, NS, and SDS were 0.84, 0.82 and 0.78 respectively. Internal consistency was 0.77 in M2. Specificity and sensitivity were < 30% and > 70% for each item of the scale, except appetite. Total median scores in M2 were higher (8; 0 -11) than M1 (2), M3 (2) and M4 (0). CUT was > 4 of 12. AUC (0.98) showed excellent discriminatory ability.

The scale showed good criterion validation, moderate to very good reliability, responsiveness, and excellent internal consistency.

The Institutional Animal Research Ethical Committee approved this study under the protocol number 27/2017.

Acknowledgments: CAPES and São Paulo Research Foundation (FAPESP) provided funding to support this study (thematic project 2017/12815-0).

**Complication-related variables in equine anesthesia: a retrospective study on 1161 cases undergoing colic and non-colic surgery**

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A retrospective analysis was performed to determine the 48h post-surgery mortality and morbidity rates for elective and emergency cases in an equine university teaching hospital. It investigated the effect of horse-, anesthetic-, timing and clinician experience-related variables on anesthetic complications.

In total, 1161 horses undergoing general anesthesia between January 2012 and December 2016 were included in the study. Patient information and details of the anesthetic, recovery period and immediate complications were retrieved from an archival database. Statistical analysis of qualitative and quantitative factors affecting anesthetic complications was performed using an univariable and multivariable ordinal logistic regression. Odds ratio of variables primarily affecting mortality and complications were calculated. Statistical significance was set at $p < 0.05$.

General anesthesia-related global mortality rate was 1.29% but only 0.96% for non-colic cases. The overall anesthesia-related complication rate was 17%: neuromuscular (47%), respiratory (23.5%), systemic (17.5%) and cardiovascular (12%) problems. Ninety two percent of complications occurred during recovery. On overall complications fractures accounted for 0.5% and myopathies for 2%. Non-fatal major complications included postanesthetic paralysis, pulmonary edema, muscular weakness and myopathy.

Major risk factors for mortality and complications included increasing age (OR=1.7) and high weight (OR=1.6), ASA status (OR=2.1), lateral recumbency (OR=4.9), orthopedic surgery (OR=9.8), surgeon experience (OR=5.5), anesthesia length (OR=1.5) and hypotension (OR=1.2). In these models, colic surgery did not influence the rate of any complications.

This study reports similar mortality rates to Johnston (1995) for elective surgeries showing no evolution over the years.

Johnston GM, Taylor PM, Holmes WA et al. (1995) Confidential enquiry of perioperative equine fatalities (CEPEF-1): preliminary results. Equine Vet J 27(3) 193-200

Dugdale AH, Obhrai J, Cripps PJ (2016) Twenty years later: a single-centre, repeat retrospective analysis of equine perioperative mortality and investigation of recovery quality. Vet Anaesth Analg 43(2) 171-178

**Does positive end-expiratory pressure (PEEP) influence the relationship between total impedance change measured by electrical impedance tomography (EIT) and tidal volume?**

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The aim of this study was to determine the influence of positive end-expiratory pressure (PEEP) on $V_T$ estimation using electrical impedance tomography (EIT) technology, and spirometry (L/breath).

In ten cows, premedicated with xylazine 0.1 mg $kg^{-1}$, anaesthesia was induced with ketamine 2 mg $kg^{-1}$ and maintained with halothane in oxygen. An EIT belt was applied around the thorax at the level of the sixth intercostal space. Volume controlled ventilation was used. Tidal volume was measured using a spirometer connected to a flow-partitioning device. PEEP levels were increased in a stepwise manner 0,5, 10 and 15 $cmH_2O$ respectively. At each PEEP level the $V_T$ was increased stepwise at 5, 10 and 15 ml $kg^{-1}$ respectively. After a minute of stabilisation total impedance change (delta Z), measured using EIT and $V_T$ measured using spirometer data were recorded for the following minute before changing ventilator settings. Pearson's correlation between delta Z and L/breath was tested at each PEEP level, with a *P* value < 0.05 considered significant.

Both delta Z and L/breath increased with each step-wise increase in $V_T$ in a linear manner. At PEEP 0, delta Z was significantly correlated with L/breath ($r = 0.83$, $P < 0.001$), however this correlation weakened with each increase in PEEP (PEEP 5, $r = 0.80$, $P < 0.001$; PEEP 10, $r = 0.67$, $P < 0.001$; PEEP 15, $r = 0.73$, $P < 0.001$).

Further evaluations of spirometry data are necessary to elucidate if physiologic factors or technical interactions account for the weakening of the correlation.

**Behavioural and cardiovascular effects of constant rate infusion of medetomidine compared to detomidine for standing sedation in horses**

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Due to its shorter elimination half-life, medetomidine may be preferable to detomidine for providing prolonged sedation for horses.

To facilitate high dose rate brachytherapy treatments, fifty horses were sedated with intravenous acepromazine (0.02 mg $kg^{-1}$), followed 30 minutes later by an alpha-2 agonist and then 5 minutes later, butorphanol (0.1 mg $kg^{-1}$). A constant rate infusion (CRI) of the same alpha-2 agonist commenced 10 minutes after butorphanol administration and maintained for the duration of treatment. Each horse received detomidine (bolus dose, 10 µg $kg^{-1}$; CRI, 6 µg $kg^{-1}$ $hour^{-1}$) and medetomidine (bolus dose, 5 µg $kg^{-1}$; CRI, 3.5 µg $kg^{-1}$ $hour^{-1}$ given one week apart in a blinded, randomised, cross-over study (Valverde 2013, Bettschart-Wolfensberger et al., 1999). Heart rate was measured via electrocardiography, and sedation and behaviour evaluated using a previously published scale (Marly et al., 2014). Behavioural scores were compared with Wilcoxon signed-rank test, frequencies of arrhythmias with Chi-squared tests, and heart rates with two-tailed paired t-tests.

There were no significant differences in the heart rate or number of arrhythmias between infusions ($p \geq 0.09$). Treatment time for medetomidine was longer [86 minutes (56 - 210) versus 80 minutes (46 - 243)], and ear movements were more numerous than with detomidine, suggesting there may be a difference in the sedation level. Fifteen horses had arrhythmias other than second degree atrioventricular block. One horse showed violent behaviour with medetomidine, necessitating removal from the study.

There was no demonstrable superiority of medetomidine compared to detomidine CRI at the dose rates used.

[1] Valverde A (2013) Balanced anaesthesia and constant-rate infusions in horses. Vet Clin Equine 29, 89-122

[2] Bettschart-Wolfensberger R, Clarke KW, Vainio O et al. (1999) Pharmacokinetics of medetomidine in ponies and elaboration of a medetomidine infusion regime which provides a constant level of sedation. Research in veterinary science 67, 41-46.

[3] Marly C, Bettschart-Wolfensberger R, Nussbaumer P et al. (2014) Evaluation of a romifidine constant rate infusion protocol with or without butorphanol for dentistry and ophthalmologic procedures in standing horses. Vet Anaesth Analg 41, 491-497.

# Abstracts

# Friday 22nd of March

# Small animal stream

| Time | Title |
|---|---|
| 16.00 | Development and initial evaluation of a manual slide rule based system for target controlled infusion of propofol in dogs |
| 16.15 | Influence of Incisional Block with Bupivacaine Pre- or Post- Surgery on Opioid Consumption in Dogs Undergoing Hemilaminectomy |
| 16.30 | Perianesthetic mortality in English bulldogs: a retrospective analysis between 2010 and 2017 |
| 16.45 | Preliminary results for the comparison of topical treatment of gastro-oesophageal regurgitation in dogs under general anaesthesia |

**Development and initial evaluation of a manual slide rule based system for target controlled infusion of propofol in dogs.**

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The clinical use of target-controlled infusion (TCI) may be restricted by limited availability of software controlled infusion pumps. A manual slide rule based system would allow TCI to be performed using any syringe driver.

The methodology described by Bruhn et al. (2002) was used to construct a slide rule calculating infusion rate from elapsed time, body mass and plasma target and a table giving the intravenous bolus required to achieve a desired plasma concentration. Elapsed time was divided into epochs of increasing duration (15-120 minutes) over four hours in total. Infusion rate for each epoch was calculated using pharmacokinetic simulations based on an established propofol TCI model (Beths 2001). Performance of the manual system was evaluated with pharmacokinetic simulations utilising bolus dose and infusion rates derived from the developed materials over a range of body mass (10-50 Kg) and plasma targets (1.0-5.0 μg $ml^{-1}$). During analysis the initial epoch was further divided into 0-2 and 2-15 minutes and deviation of simulated plasma concentration from plasma target calculated.

Simulated plasma concentration was significantly correlated with plasma target ($r = 0.996$, $p < 0.001$). The deviation from target during the 0-2 minute epoch was 0.37 ± 0.79 μg $ml^{-1}$, otherwise it was 0.04 μg $ml^{-1}$ or less. Clinically significant relationships between deviation from target and plasma target or body mass were not demonstrated.

The manual system performed in a clinically appropriate way during simulations. Further evaluation, incorporating increases and decreases of plasma target, should be conducted before clinical use.

**References**

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**Influence of Incisional Block with Bupivacaine Pre- or Post- Surgery on Opioid Consumption in Dogs Undergoing Hemilaminectomy**

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Investigate the influence of bupivacaine infiltration before or after hemilaminectomy on peri-operative opioid consumption.

Thirty dogs, undergoing T13-L3 hemilaminectomy, were randomly assigned to receive bupivacaine 2mg/kg infiltration into the epaxial muscles before surgery (Group A), at wound closure (Group B) or no infiltration (Group C). Anaesthesia comprised dexmedetomidine 4 mcg/kg and methadone 0.3 mg/kg IV (premedication), alfaxalone IV (induction), and isoflurane in oxygen (maintenance). All dogs received meloxicam IV/PO. Response to surgery, defined as a change in physiological variables >20% above baseline, was treated with fentanyl 2.5 mcg/kg boluses, followed by a CRI at 5 mcg/kg/hr. The Glasgow Composite Pain Score (GCPS) was performed before premedication and at regular intervals until 24 hours postoperatively. Methadone 0.2 mg/kg analgesia was given IV if GCPS  5/20 or 6/24. Number of intraoperative, postoperative and total analgesic interventions was recorded. Analgesic interventions were analysed using Chi-Squared test, a Pocock approach (Schulz and Grimes, 2005) was used and statistical significance set as a p-value <0.029 with results presented as median ( range).

Intra-operative analgesic interventions in Group A 0 (1), differed significantly from Group B 3 (2) and Group C 3 (3) (p = 0.019). For postoperative interventions, Group A 0 (0) and Group B 0 (0) differed significantly from Group C (1 (2) (p = 0.025), for total number of analgesic interventions Group A 0 (1), was significantly different to Group B 3 (2) and Group C 4 (5) (p = 0.014).
Bupivacaine reduced opioid consumption with pre-surgical infiltration having greatest benefit.

SCHULZ, K. F. & GRIMES, D. A. 2005. Multiplicity in randomised trials II: subgroup and interim analyses. *Lancet,* 365**,** 1657-61.

**Perianesthetic mortality in English bulldogs: a retrospective analysis between 2010 and 2017**

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Overall perianaesthetic mortality in dogs is 0.17 % (Brodbelt et al. 2008). The aim of this study was to determine the perianaesthetic mortality rate in English bulldogs at a veterinary teaching hospital.

Medical records from all English bulldogs, anaesthetised between January 2010 and September 2017, were collected. Data collected included: age, ASA status, weight, procedure types, anaesthetic duration, anaesthetic recovery location, and cause of death.

Data were collected from 345 anaesthetic episodes from 229 bulldogs. Nine bulldogs had anaesthetic-related deaths (3.93 %). Ages of survivors and non-survivors were 3 (0.25 – 14) (median (min – max)) and 3.7 (0.45 – 10.8) years, respectively. Anaesthetic duration in survived episodes was 2.5 (0.5 – 10) hours, and 3.5 (0.5 – 4.5) in non-survived episodes. ASA status of survivors and non-survivors was 2 (1 – 4) and 3 (2 – 4), respectively. Weights of survivors and non-survivors were 24.6 (4.1 – 57.9) and 24.8 (17.7 – 36.7) kg, respectively. Non-survivors were anaesthetised for brachycephalic airway reconstruction (n = 4), laparotomy (n = 3), ophthalmologic procedure (n = 2), cardiac procedure (n = 1), other respiratory procedure (n = 1), and/or urogenital procedure (n = 1). In the non-survivors, 7 recovered in ICU, one recovered in intermediate care unit, and one arrested intraoperatively. Five non-survivors required oxygen therapy immediately following extubation. The most common cause of death was respiratory dysfunction (89 %).

English bulldogs have a greater perianaesthetic mortality rate than what is reported for the general canine population. Most deaths occurred in the postoperative period secondary to respiratory complications.

Brodbelt DC, Blissitt KJ, Hammond RA, et al. (2008) The risk of death: the confidential enquiry into perioperative small animal fatalities. Vet Anaesth Analg 233, 1096-1104.

**Preliminary results for the comparison of topical treatment of gastro-oesophageal regurgitation in dogs under general anaesthesia**

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Gastro-oesophageal regurgitation (GOR) can lead to severe consequences such as oesophageal strictures. This study aimed to determine if oesophageal lavage significantly increases oesophageal pH during GOR management.

Dogs presenting with GOR under general anaesthesia were randomised into groups: lavage (G1) or no lavage (G2). All dogs underwent oesophageal suctioning until no further regurgitated material was retrieved. Dogs in G1 then had oesophageal lavage with tap water until the suctioned water was clear. All dogs had 4.2% sodium bicarbonate (0.6 ml $kg^{-1}$) instilled into the oesophagus. An oesophageal pH probe was placed to record pH immediately after: GOR (T1), suctioning (T2), lavage of the oesophagus (T3; G1 only) and sodium bicarbonate instillation (T4). Data were analysed with the Wilcoxon Rank-sum test and reported as median (range); $p < 0.05$ was considered significant.

Seventeen animals were recruited (G1: 8, G2: 9). pH was not significantly different at T1 [G1 3.18 (1.28 – 6.67), G2 2.95 (2.18 – 5.6); $p = 0.5$] or T4 [G1: 7.72 (6.2 – 8.9), G2: 7.8 (6.3 – 8.6); $p = 1.0$]. After lavage, pH increased by 1.2 (0.11 – 5.2) but overall change in pH following bicarbonate administration (T1 to T4) was not significantly different between groups [G1: 5.16 (2.11 – 6.21), G2: 4.12 (2.55 – 5.92); $p = 0.34$].

Both groups had similar and clinically important increases in oesophageal pH. Whilst oesophageal lavage increased pH this did not affect the final oesophageal pH when sodium bicarbonate was used. For this reason, oesophageal lavage may be an unnecessary treatment step.

# Abstracts

# 22nd of March

# Large animal stream

| Time | Title |
|---|---|
| 16.00 | Pharmacokinetics and pharmacodynamics of hydromorphone hydrochloride in healthy horses |
| 16.15 | Clinical comparison of medetomidine and xylazine for isoflurane anaesthesia in horses |
| 16.30 | Evaluation of the Parasympathetic Tone Activity (PTA) monitor in horses undergoing xylazine-ketamine-isoflurane anaesthesia. Preliminary study. |
| 16.45 | Comparison of the cardiovascular effects of lidocaine or xylazine constant-rate infusion (CRI) in horses anaesthetized with isoflurane |

**Pharmacokinetics and pharmacodynamics of hydromorphone hydrochloride in healthy horses**

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Opioids are a cornerstone of veterinary pain management, but have been minimally evaluated in horses. Study objectives were to determine physiologic and behavioral effects, and pharmacokinetics of hydromorphone in horses.

In a prospective crossover study, six healthy horses received hydromorphone 0.025 mg $kg^{-1}$ IV (H0.025), hydromorphone 0.05 mg $kg^{-1}$ IV (H0.05), or 0.9% saline, with a 7-day washout period. For each treatment, physiological, hematological, abdominal borborygmi score (ABS) and behavioral data were recorded over 5 hours. Fecal output was recorded over 24 hours. Data were analyzed using repeated measures ANOVA with significance at $p < 0.05$. Group H0.05 underwent blood sampling for quantification of hydromorphone and the metabolite, H3G, and pharmacokinetic modeling.

Hydromorphone administration resulted in increased heart rate (HR) and blood pressure, with values in H0.05 remaining higher than controls for 5 hours. Peak HR and mean arterial pressure for H0.05 were 59 ± 17 bpm and 169 ± 23 mmHg, respectively. Groups H0.025 and H0.05 had lower ABS than the saline group. Fecal output did not differ among treatments. No evidence of abdominal discomfort was observed. Recorded behaviors did not differ between groups. For hydromorphone, mean  SD for volume of distribution at steady state, total systemic clearance, and AUC until the last measured concentration were 1.00  0.29 L $kg^{-1}$, 106  21 mL $min^{-1}$ $kg^{-1}$, and 8.0  1.5 ng*h $mL^{-1}$, respectively.

Hydromorphone administered to healthy horses resulted in an increase in HR and BP with decreased abdominal borborygmi; however, fecal output was not affected

**Clinical comparison of medetomidine and xylazine for isoflurane anaesthesia in horses**

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This study compared the effects of two anaesthetic protocols (isoflurane + medetomidine versus xylazine) on cardiopulmonary parameters and recovery in horses.

Sixty horses undergoing elective surgery were randomly assigned to group medetomidine (M; n = 31) or xylazine (X; n = 29). After IM premedication with acepromazine horses were sedated with medetomidine 7 µg $kg^{-1}$ or xylazine 1.1 mg $kg^{-1}$ intravenously. Anaesthesia was induced with ketamine/diazepam and maintained with isoflurane in oxygen/air and medetomidine 3.5 µg $kg^{-1}$ $hour^{-1}$ or xylazine 0.69 mg $kg^{-1}$ $hour^{-1}$. Ringer's acetate and dobutamine were administered to maintain normotension. Controlled mechanical ventilation maintained end-tidal carbon dioxide pressures at 45 ± 5 mmHg (5.3 - 6.7 kPa). Heart rate, invasive arterial blood pressures, inspired and expired gas composition were recorded and arterial blood gases measured. Medetomidine 2 µg $kg^{-1}$ or xylazine 0.3 mg $kg^{-1}$ was administered before recovery. Recovery was timed and quality assessed with three different scoring systems. Data were analysed using two-way repeated-measures ANOVA, Mann-Whitney Rank Sum and t-test ($p \leq 0.05$).

No significant differences in mean ± SD were detected between groups regarding: anaesthesia duration (M: 145 ± 35, X: 148 ± 36 minutes), cardiovascular and respiratory variables and blood gases. With medetomidine $PaCO_2$ was higher at individual time points. Recovery was significantly longer with medetomidine (median (range): medetomidine: 64 (30 – 115), xylazine: 47.5 (24 – 92) minutes). Recovery scores did not differ between groups.

Medetomidine and xylazine at dose rates tested are comparable for isoflurane balanced anaesthesia for equine elective surgery.

**Evaluation of the Parasympathetic Tone Activity (PTA) monitor in horses undergoing xylazine-ketamine-isoflurane anaesthesia. Preliminary study.**

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To evaluate the association between changes in Parasympathetic Tone Activity (PTA) and haemodynamic parameteres (Gruenewald et al., 2013; Mansour et al., 2017) during noxious stimuli and drug administration in horses.

Observational, prospective study. Thirteen ASA I-II horses undergoing general anaesthesia for surgery. Horses received xylazine (1 mg $kg^{-1}$) IV. Anaesthesia was induced with ketamine (2.7 mg $kg^{-1}$) and diazepam (0.1 mg $kg^{-1}$) and it was maintained with isoflurane in oxygen. Depth of anaesthesia was assessed by palpebral reflex, nystagmus and muscle relaxation. Parameters (PTA, HR and MAP) were registered before and after the following events: 1-3-5 minutes after incision; 10 minutes after morphine administration (0.1 mg $kg^{-1}$); 3-5 minutes after ketamine administration (0.5 mg $kg^{-1}$); 5 minutes after dobutamine administration (0.5 μg $kg^{-1}$ $min^{-1}$). Nociception was considered if HR increased ≥ 10%, MAP increased ≥ 20% or PTA decreased ≥ 20%. Data before and after each event were analysed using a Friedman and a Bonferroni tests. For the incision period Spearman correlation between PTA, HR and MAP was performed.

No significant changes were found during incision in PTA ($p = 0.272$), HR ($p = 0.113$) or MAP ($p = 0.268$), neither for other events. During incision, PTA and MAP showed a positive weak correlation (0.391). Ketamine and dobutamine events were registered in 10 and 21 occasions respectively. Six PTA decrement and three HR and three MAP increments were registered as nociceptive events.

During adequate depth of anaesthesia PTA showed a similar behaviour to haemodynamic parameters, remaining steady during the procedure.

1. Gruenewald M, Ilies C., Herz J et al. (2013) Influence of nociceptive stimulation on analgesia nociception index (ANI) during propofol-remifentanil anaesthesia. Br J Anaesth 110 (6), 1024–30.

2. Mansour C, Merlin T, Bonnet-Marin JM et al. (2017) Evaluation of the Parasympathetic Tone Activity (PTA) index to assess the analgesia/nociception balance in anaesthetised dogs. Res Vet Sci 115, 271–277.

**Comparison of the cardiovascular effects of lidocaine or xylazine constant-rate infusion (CRI) in horses anaesthetized with isoflurane**

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Lidocaine and xylazine are under investigation for preconditioning effects in intestinal ischemia-reperfusion syndrome.

Therefore we aimed to compare effects of lidocaine or xylazine CRI on haemodynamic variables during isoflurane anaesthesia.

As part of a terminal surgical study investigating pharmacological preconditioning, horses received either lidocaine 1.3 mg $kg^{-1}$ or xylazine 1 mg $kg^{-1}$ over 10 minutes as premedication. Anaesthesia was induced with guaifenesin to effect and ketamine 2.5 mg $kg^{-1}$, maintained with isoflurane and a CRI of lidocaine 0.05 mg $kg^{-1}$ $minute^{-1}$ (group L; n = 5) or xylazine 1 mg $kg^{-1}$ $hour^{-1}$ (group X; n = 5). Horses were mechanically ventilated. End-expiratory isoflurane concentration in both groups was kept at 1.2 - 1.3 vol%. Cardiac output (thermodilution), arterial and mixed-venous blood gases were determined at 60, 90, 170 and 200 minutes. Haemodynamic variables were calculated by standard equations indexed to bodyweight. Data were analysed using two-way-ANOVA and Bonferroni's t-test ($p < 0.05$).

Averaged over the four time points HR, MAP, cardiac index and oxygen extraction ratio were 35 ± 0 and 29 ± 2 beats $minute^{-1}$ ($p = 0.41$) , 62 ± 6 and 71 ± 6 mmHg ($p = 1.0$), 41.2 ± 3.2 and 30.8 ± 5.3 ml $min^{-1}$ $kg^{-1}$ ($p = 0.21$), 0.24 ± 0.02 and 0.36 ± 0.05 ($p = 0.49$) in group L and X, respectively.

In conclusion, both protocols obtain acceptable haemodynamic and oxygenation variables. Lidocaine seemed to maintain better cardiovascular function, which remained unproven due to the small sample size.