

# Abstracts from the International Veterinary Emergency and Critical Care Symposium, the European Veterinary Emergency and Critical Care Annual Congress, and the ACVECC VetCOT Veterinary Trauma & Critical Care Conference 2022

IVECCS Abstracts presented September 7–11, 2022 San Antonio, TX

Listing of Small Animal IVECCS Abstracts  
(in alphabetical order of presenter)

## ORAL PRESENTATIONS

### ACVECC General Grant Winners

#### EFFECTS OF CPAP ON POSTOPERATIVE RECOVERY IN BRACHYCEPHALIC DOGS UNDERGOING SURGERY: A PRELIMINARY REPORT OF A RANDOMIZED, PROSPECTIVE CLINICAL TRIAL

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**Introduction:** Brachycephalic obstructive airway syndrome (BOAS) describes a combination of anatomical abnormalities resulting in upper airway obstruction. BOAS-affected dogs can develop postanesthetic complications, including emergency reintubation, tracheostomy, or death. Continuous positive airway pressure (CPAP) increases the laryngeal area and improves oxygenation in dogs. Its use in brachycephalic dogs could improve postoperative outcomes. The aim of this prospective trial was to evaluate the postoperative effects of CPAP versus no CPAP. This is a preliminary report of the ongoing trial.

**Methods:** Brachycephalic dogs scheduled for elective surgery were eligible. Dogs undergoing thoracic surgical procedures and with a history of major cardiovascular and lower respiratory disease were excluded. A standardized anesthetic and ventilatory protocol was used in all dogs. A brachycephalic risk (BRisk) score was assigned to each dog preoperatively. Immediately after extubation, a CPAP helmet connected to medical air at a flow of 15 Lpm was placed, with dogs randomly assigned to receive a CPAP level of 0 cm H<sub>2</sub>O (NoCPAP group) or 5 cm H<sub>2</sub>O (CPAP group) by regulating the spring of a positive end-expiratory (PEEP) valve located at the expiratory outlet. Partial pressure of arterial O<sub>2</sub> and CO<sub>2</sub> (PaO<sub>2</sub> and PaCO<sub>2</sub>, respectively), heart rate, pH, and

temperature were measured at baseline (immediately after extubation and prior to regulating the PEEP valve) and 5, 15, 30, 45, and 60 minutes after extubation. Preoperative BRisk scores were compared between the CPAP and NoCPAP groups with the Wilcoxon rank-sum test. Longitudinal data were analyzed with linear mixed models and are reported as the difference of the change in time in the group CPAP versus NoCPAP for each mean variable. Data are expressed as regression coefficients with corresponding confidence intervals and *P*-value. Significance was set at *P* < 0.05.

**Results:** This preliminary report includes data from 10 dogs (6 in the group CPAP and 4 in the group NoCPAP). No differences were found in BRisk scores between groups (*P* = 0.141). The estimated difference in the change per study time in the mean PaO<sub>2</sub> and PaCO<sub>2</sub> in the CPAP group compared with the NoCPAP group was −0.60 (−1.35 to 0.14, *P* = 0.107) mm Hg and 0.09 (−0.12 to 0.30, *P* = 0.358) mm Hg, respectively. For mean heart rate, pH, and temperature, the estimated difference in the change per study time comparing the CPAP group with the NoCPAP group was 0.10 (−0.27 to 0.45, *P* = 0.617) beats per minute, −0.01 (−0.01 to 0.01, *P* = 0.665), and 0.02 (−0.01 to 0.05, *P* = 0.132) degrees Fahrenheit, respectively.

**Conclusion:** These preliminary results do not show an improvement in selected postoperative physiological variables in this surgical population of brachycephalic dogs with the use of CPAP. However, completion of the study with an adequate sample size and a larger population of dogs undergoing BOAS surgery may yield different results.

#### IMPACT OF 3 DIFFERENT WASH SOLUTIONS ON CANINE ERYTHROCYTES IN UNITS OF STORED WHOLE BLOOD

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**Introduction:** Washing stored units of canine blood products can reduce storage lesions, but can unintentionally cause RBC damage. The study objective was to determine which wash solution would minimize erythrocyte damage. Our hypothesis was that, compared to a balanced electrolyte crystalloid solution and 0.9% NaCl, a cell



controls. Baseline CS, BS, and STS scores [mean ( $\pm$  SD)] for those instituting WB were 37.5 ( $\pm$  3.5), 26.3 ( $\pm$  5.4), and 27 ( $\pm$  5.6), respectively. At 1 and 3 months, CS for WB increased ( $P = 0.085$ ). BS and STS were not significantly decreased (which would have indicated less compassion fatigue).

**Conclusions:** Interim analysis at 3 months identified a trend for increasing CS in participants implementing WB; indicators of compassion fatigue (BS and STS) remained stable. Final analysis at 6 months will evaluate for significant benefit of WB to study participants.

#### COMPARISON OF STANDARD TESTS OF COAGULATION IN HYPERCOAGULABLE AND NORMOCOAGULABLE SICK DOGS IDENTIFIED BY THROMBOELASTOGRAPHY

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**Introduction:** Standard tests of coagulation (prothrombin time [PT], activated partial thromboplastin time [aPTT]) are a mainstay in identification of coagulopathy. However, their utility in identifying hypercoagulable states is uncertain. Viscoelastic tests (VET) are available to diagnose disorders of hemostasis, including enhanced and impaired hemostasis. The first objective of this study was to compare coagulation tests (PT, aPTT, D-dimers), packed red blood cell volume (PCV), and platelet counts in sick dogs with hypercoagulable and normocoagulable states as identified by thromboelastography (TEG). The second objective was to compare tests of coagulation in dogs with and without confirmed thrombosis.

**Methods:** This was a prospective case-control study. Sick dogs were enrolled if they were suspected to be hypercoagulable or normocoagulable, which was determined by TEG maximum amplitude (MA) above or within the established reference interval, respectively. Samples for PCV, platelet count, coagulation panel (PT, aPTT, D-dimers), and a tissue factor-activated TEG were collected and analyzed. Presence or absence of confirmed thrombosis at the time of testing was recorded. Continuous variables were compared between groups using 2-sample independent *t*-tests or Wilcoxon rank-sum tests depending on data distribution.  $P < 0.05$  was considered significant. Correlation between variables was assessed using either Pearson's correlation coefficient or Spearman's rank correlation coefficient.

**Results:** Seventy dogs were recruited for this study. Fifty percent of dogs were classified as hypercoagulable (study group) and 50% were normocoagulable (control group). No significant differences in PT ( $P = 0.981$ ), aPTT ( $P = 0.249$ ), or D-dimers ( $P = 0.322$ ) were found between hypercoagulable and normocoagulable dogs. Hypercoagulable dogs had significantly lower PCVs ( $P = 0.017$ ) and higher platelet counts ( $P = 0.013$ ) than normocoagulable dogs. In addition, 13 dogs with confirmed thrombosis did not have significantly different PT ( $P = 0.88$ ), aPTT ( $P = 0.982$ ), or D-dimer ( $P = 0.365$ ) concentrations when compared to 57 dogs without thrombosis.

**Conclusion:** Traditional coagulation parameters were not useful in the identification of hypercoagulability in dogs as defined by TEG and were not associated with thrombosis. The influence of platelet counts and PCV on TEG values and their relation to hypercoagulable states should be considered. If there is clinical concern for presence of a hypercoagulable or prothrombotic state, VET could be a superior modality for its identification.

#### RETROSPECTIVE EVALUATION OF LACTATE AND GLUCOSE EFFUSION CONCENTRATIONS AND BLOOD TO EFFUSION DIFFERENTIALS TO IDENTIFY SEPTIC EFFUSIONS IN CATS: 121 CASES (2011–2020)

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**Introduction:** Aims of this retrospective study were to assess lactate [Lact]<sub>e</sub> and glucose [Gluc]<sub>e</sub> concentrations and blood to effusion differentials ( $\Delta$ Lact,  $\Delta$ Gluc) in abdominal and pleural effusions in a large population of cats, to define best value for the diagnosis of septic effusions and evaluate  $\Delta$ Lact  $< -2$  mmol/L and  $\Delta$ Gluc  $> 20$  mg/dl accuracy in a large cohort of cats.

**Methods:** Cats presented with abdominal or pleural effusions to the ICU of VetAgro Sup, Lyon, between January 2011 and July 2020 were included. [Lact]<sub>e</sub> and [Gluc]<sub>e</sub> on blood and effusion were recorded. Septic effusion was confirmed by intracellular bacteria on cytology and/or positive bacterial culture. Comparisons between septic/nonseptic effusion were performed with Wilcoxon rank-sum test. Significance was set at  $P < 0.05$ . ROC curves analysis was established to determine ideal cutoff values.

**Results:** A total of 42 out of 121 cats had abdominal effusion (10/42 septic) and 79 out of 121 cats had pleural effusion (26/79 septic). Mean [Lact]<sub>e</sub> was higher in septic compared to nonseptic effusions (abdominal 8.8 vs. 3.6 mmol/L; pleural 9.7 vs. 5.1 mmol/L).  $\Delta$ Lact did not differ significantly between septic and nonseptic effusions. Mean [Gluc]<sub>e</sub> was lower in septic compared to nonseptic effusions (abdominal 39 vs. 152 mg/dl; pleural 22 vs. 92 mg/dl).  $\Delta$ Gluc was significantly higher in septic abdominal ( $138 \pm 98$  mg/dl;  $21 \pm 40$  mg/dl;  $P = 8.1 \times 10^{-4}$ ) and pleural effusion ( $120 \pm 35$  mg/dl;  $61 \pm 72$  mg/dl;  $P = 2.9 \times 10^{-5}$ ). The best performing value was  $\Delta$ Gluc  $> 62$  mg/dl (Se: 100%, Spe: 90%) for abdominal and [Gluc]<sub>e</sub>  $< 33$  mg/dl (Se: 96%, Spe: 84.6%) for pleural effusion.  $\Delta$ Lact  $< -2$  mmol/L had a Se 63% and Spe 64% in pleural and a Se 50% and Spe 94% in abdominal effusions.  $\Delta$ Gluc  $> 20$  mg/dl had a Se 100% and Spe 22% in pleural and a Se 100% and Spe 45% in abdominal effusions.

**Conclusion:**  $\Delta$ Gluc  $> 62$  mg/dl and [Gluc]<sub>e</sub>  $< 33$  mg/dl were the best diagnostic tools to differentiate between septic and nonseptic abdominal and pleural effusion in cats, respectively. The widely used cutoff of  $\Delta$ Gluc and  $\Delta$ Lact showed moderate accuracy for differentiation between septic and nonseptic effusions.

## THE HEMOSTATIC PROFILE OF COLD-STORED WHOLE BLOOD FROM NON-GREYHOUND DOGS OVER 42 DAYS

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**Introduction:** Cold-stored whole blood (CSWB) may be preferable to blood components when treating acute hemorrhage with ensuing coagulopathy. Our objective was to evaluate the in vitro hemostatic profile of CSWB from non-greyhound dogs over 42 days to determine its potential as a hemostatic agent. We hypothesized that all bags would have a platelet closure time (PCT) above 300 seconds by day 7 after collection, that the means for rotational thromboelastometry (ROTEM) parameters Alpha angle (Alpha) and Maximum Clot Firmness (MCF), and all coagulation factor activities would decline but remain within 50% of baseline by day 14, and mean fibrinogen concentration would remain greater than 0.982 g/dl by day 14.

**Methods:** Whole blood (450 ml) was routinely collected from 10 non-greyhound blood donor dogs. A total of 150 ml was aseptically diverted into a blood transfer bag and refrigerated at 4°C for 42 days. Samples for PCT and ROTEM were collected and analyzed before refrigeration (baseline) and then at day 1 (d1), d3, d5, and d7, and for ROTEM only at d10, d14, d17, d21, d24, d28, d31, d35, d38, and d42. At each timepoint, samples were centrifuged and plasma was stored at -80°C for later measurement of coagulation factor activity or concentration (ACL-TOP 300). Alpha and MCF, for both INTEM and EXTEM, were summarized as means with 95% confidence intervals using linear mixed models.

**Results:** The PCT for all bags was above 300 seconds by d7. Mean Alpha for INTEM and EXTEM reached 50% of baseline at d38 and d31, respectively. Mean MCF for INTEM and EXTEM reached 50% of baseline at d42 and d28, respectively. There was a steady decline for INTEM and EXTEM Alpha and MCF, with the rate of decline increasing after d17. Coagulation factor results are pending.

**Conclusion:** The in vitro rate of clot formation and clot strength of non-greyhound CSWB gradually reduces over 42 days despite a rapid decline in PCT. Fibrinogen concentration and coagulation factor activity (analysis pending) will help characterize the mechanisms behind the decline in clot formation and clot strength.

## EVALUATION OF MICROCIRCULATION VARIABLES AND ENDOTHELIAL GLYCOCALYX USING SIDESTREAM DARK FIELD VIDEOMICROSCOPY USING GLYCOCHECK IN DOGS UNDERGOING CARDIOPULMONARY BYPASS—A PILOT STUDY

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**Introduction:** Our goal was to evaluate microcirculation variables and EGC using Glycocheck VM in canine CPB.

**Methods:** Dogs undergoing CPB for surgical correction of a naturally occurring cardiac disease were prospectively included. Variables collected were demographics, cardiac disease, red blood cell flow (Flow),

total 4–25  $\mu\text{m}$  vessel density (Density), capillary blood volume absolute (CBV-ABS), capillary blood volume relative (CBV-REL), and EGC width assessed by perfused boundary region (PBR). Institutional reference intervals were established. Microcirculation and EGC variables were compared at 4 timepoints: baseline under general anesthesia (T0), on CPB pump prior to cross clamping (T1), after cross clamp removal following surgical correction (T2), and at surgical closure (T3). Impact of CPB on Flow, Density, CBV-ABS, CBV-REL, and PBR at all timepoints was tested with an analysis of variance for repeated measures with Bonferroni correction. Significance between T0 and specific timepoints with values outside reference intervals was tested with a paired *t*-test. Significance was  $P = 0.05$ .

**Results:** Eight dogs were included. Age was 1.5 years (0.6–2.2). Body weight was 29.2 kg (12.4–54). Underlying cardiac disease were tricuspid valve dysplasia ( $n = 4$ ), atrioventricular septal defect ( $n = 2$ ), tetralogy of Fallot ( $n = 1$ ), and mitral valve dysplasia ( $n = 1$ ). Flow values were  $266.5 \pm 77.6$ ,  $120.7 \pm 38.2$ ,  $261.0 \pm 82.5$ , and  $161.3 \pm 32.3 \mu\text{m/s}$  at T0, T1, T2, and T3, respectively ( $P = 0.28$ ). Density values were  $209.1 \pm 51.2$ ,  $145.9 \pm 30.0$ ,  $229.8 \pm 56.3$ , and  $205.0 \pm 40.8 \text{ mm/mm}^2$  at T0, T1, T2, and T3, respectively ( $P = 0.58$ ). CBV-ABS values were  $9.9 \pm 2.3 \times 10^3$ ,  $11.9 \pm 2.7 \times 10^3$ ,  $12.4 \pm 3.5 \times 10^3$ , and  $10.9 \pm 2.0 \times 10^3 \mu\text{m}^3$  at T0, T1, T2, and T3 respectively ( $P = 1.0$ ). CBV-REL values were  $1.2 \pm 0.1 \times 10^3$ ,  $1.5 \pm 0.2 \times 10^3$ ,  $1.2 \pm 0.2 \times 10^3$ , and  $1.4 \pm 0.3 \times 10^3 \mu\text{m}^3$  at T0, T1, T2, and T3, respectively ( $P = 1.0$ ). Mean CBV-REL at T1 and T3 were above our reference interval, but not different compared to T0 ( $P = 0.23$  and  $P = 0.45$ , respectively). PBR was  $2.0 \pm 0.2$ ,  $1.9 \pm 0.2$ ,  $2.4 \pm 0.2$ , and  $2.1 \pm 0.2 \text{ mm/mm}^2$  at T0, T1, T2, and T3, respectively ( $P = 0.46$ ). Mean PBR at T2 was above our reference interval, statistically different to T0 ( $P = 0.02$ ).

**Conclusion:** Microvascular and EGC variables were not modified by CPB in our pilot study. A larger sample size is needed to confirm or refute those findings.

## RETROSPECTIVE EVALUATION OF THE RESPIRATORY RATE-OXYGENATION INDEX IN DOGS TREATED WITH HIGH-FLOW NASAL CANNULA OXYGEN THERAPY

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**Introduction:** High-flow nasal cannula oxygen therapy (HFNC) has become instrumental in treating hypoxemic respiratory failure (HRF). The respiratory rate-oxygenation index (ROX) and modified ROX (ROX-HR) have been validated when evaluating HFNC outcome in people. The aim of this study was to determine if these indices are associated with outcome in dogs undergoing HFNC.

**Methods:** Medical records were reviewed to identify dogs with HRF treated with HFNC. The ROX was defined as the  $\text{SpO}_2/\text{FiO}_2$  (SF) ratio divided by respiratory rate and the ROX-HR was defined as the ROX divided by heart rate, multiplied by 100. Logistic regression was used

to identify factors related to HFNC outcome. The overall power of the respiratory indices was determined using the area under the receiver operating characteristics curve (AUROC).

**Results:** Overall success rate of HFNC was 44.4% ( $n = 36/81$ ). The median duration of HFNC was significantly shorter for patients that failed HFNC. HFNC failure was associated with significantly lower ROX ( $P = 0.049$ ), ROX-HR ( $P = 0.08$ ), and SF ( $P = 0.044$ ) than the HFNC success group. The SF showed the best predictability (AUROC 0.81) followed by ROX (0.75) and ROX-HR (0.73). Indices measured at hour 6 of HFNC was found to have the best predictive value when all hours (1–15) were evaluated. The SF ratio and ROX had excellent discriminatory power in predicting HFNC failure at hour 6 with an AUROC of 0.87 (95% CI, 0.73–0.99;  $P < 0.001$ ) and 0.85 (95% CI, 0.72–0.99;  $P < 0.002$ ), respectively. The ROX-HR was found to have adequate discrimination at hour 6 with an AUROC of 0.73 (95% CI, 0.51–0.95;  $P < 0.122$ ). The optimal cutoff value for predicting HFNC failure at hour 6 was an SF ratio  $\leq 143$  (sensitivity 79%, specificity 93%), an ROX  $\leq 3.68$  (sensitivity 72%, specificity 92%), and an ROX-HR  $\leq 2.41$  (sensitivity 57%, specificity 100%).

**Conclusion:** The SF ratio, ROX, and ROX-HR are easily attainable and noninvasive parameters that are useful predictors of HFNC outcome. Future prospective studies are warranted to confirm these findings and to optimize cutoff values in a larger population of dogs undergoing HFNC.

#### EFFECT OF PREOPERATIVE LABORATORY PARAMETERS ON TRANSFUSION STATUS AND SHORT-TERM SURVIVAL IN DOGS UNDERGOING EMERGENCY ABDOMINAL SURGERY: A RETROSPECTIVE STUDY OF 149 DOGS

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**Introduction:** In human medicine, transfusion thresholds for packed red blood cells (pRBCs) exist, while guidelines directing plasma transfusions are less defined. Plasma transfusions are often used in patients with an increased risk of hemorrhage or coagulopathies; however, evidence to support their use is lacking. Standard plasma-based coagulation testing, including PT/PTT, is often performed in the preoperative period and used to support the use of FFP. The primary objective of this study was to identify preoperative laboratory parameters associated with transfusion status in dogs undergoing emergency abdominal surgery. Secondary objective was to evaluate the association of laboratory parameters and transfusion administration on short-term survival. We hypothesized that dogs with prolongations in PT and PTT are more likely to receive FFP, and that FFP transfusions would not be associated with survival to discharge.

**Methods:** One-hundred and forty-nine dogs that underwent emergency abdominal surgery between 2016 and 2021 were retrospectively evaluated. Data collected included age, sex, breed, weight, platelet count, hematocrit (HCT), total protein (TP), albumin (ALB) concentration, PT, PTT, type of surgery performed, final diagnosis, use of

transfusion products including pRBC and fresh frozen plasma (FFP), and survival to discharge. Results were analyzed by Mann–Whitney *U*-test, Fisher's exact test, or Chi square test. Significance was set at  $P < 0.05$ .

**Results:** Dogs with higher preoperative HCT and TP were less likely to receive a pRBC transfusion (OR: 0.877;  $P < 0.001$ ; OR: 0.552;  $P = 0.007$ ). Dogs with higher preoperative ALB were less likely to receive FFP (OR: 0.172; CI, 0.0713–0.370;  $P < 0.001$ ) and dogs with longer preoperative PT were more likely to receive a FFP transfusion (OR: 1.861;  $P < 0.001$ ). Dogs that received FFP transfusions had an increased survival to discharge (OR: 2.913;  $P = 0.009$ ).

**Conclusion:** ALB and PT values were associated with administration of FFP transfusions but were not associated with pRBC transfusions. No laboratory values were associated with survival to discharge in this population of dogs. Dogs that received FFP were more likely to survive to discharge. Large-scale, multicenter prospective studies assessing the use of pRBC and FFP in abdominal surgery in dogs is warranted.

#### RIGHT HEART PARAMETER SCORING TO ASSESS PRECAPILLARY PULMONARY HYPERTENSION IN DOGS

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**Introduction:** Invasive right heart catheterization is the gold standard for diagnosing pulmonary hypertension (PHT). Comprehensive echocardiography, including Doppler, enables noninvasive estimation of pulmonary arterial pressure, though may not be available to emergency practitioners. The objectives of this study were to (1) determine if non-cardiologist veterinarians can identify PHT using a PHT scoring (PHS) system, and (2) report interobserver variability of the PHS. We hypothesized that non-cardiologists can identify dogs with moderate to severe pre-capillary PHT using cine-loops obtained by cardiologists.

**Methods:** Medical records were reviewed for dogs undergoing echocardiograms. A PHT group with measurable tricuspid regurgitation (TR) and/or pulmonic insufficiency and a control group (normal echocardiogram or stage B1 MMVD with normal TR) were identified and masked by a cardiologist. Dogs with post-capillary PHT were excluded (LA:Ao  $\geq 1.6$ ). Three non-cardiologist veterinarians performed PHS for each patient. Scores of 0–2 were assigned for 5 right heart parameters: right heart chamber enlargement, right ventricular hypertrophy, interventricular septum flattening, pulmonary artery enlargement, and right sided congestion, leading to a global score between 0 and 10. When views assessing congestion were unavailable, a PHS-08 score was obtained. Spearman correlations tested correlation between mean PHS and cardiologist reported PHT severity (none, mild, moderate, severe). Area under the receiver operator curves and sensitivity and specificity cutoffs were generated. Interobserver agreement was evaluated using intraclass correlation coefficients.

**Results:** A total of 137 dogs were included. There was excellent to outstanding discrimination of moderate to severe PHT with PHS-08 scores (AUC [95% CI] = 0.90 [0.84–0.95],  $P < 0.0001$ ) and PHS-010 scores (AUC [95% CI] = 0.89 [0.81–0.97],  $P < 0.0001$ ) with 95% confidence that the discrimination is excellent to outstanding. PHS-08  $\geq 3/8$  was 64% sensitive and 98% specific for moderate to severe PHT (LR+ 32, LR– 0.37). PHS08  $\geq 2/8$  was 67% sensitive and 96% specific for all severities of PHS (LR+ 16.75, LR– 0.34). The interobserver agreement was good to excellent (ICC = 0.74 [95% CI, 0.66–0.80],  $n = 137$ ).

**Conclusion:** Non-cardiologists identified moderate to severe precapillary PHT in dogs using PHS on previously obtained cineloops. Interobserver agreement was good to excellent. Prospective studies are indicated to determine if non-cardiologists can obtain images for PHS.

### IMPACT OF COVID-19 VISITATION RESTRICTIONS ON VETERINARY CRITICAL CARE STAFF

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**Introduction:** Historically, visitation of critically ill animals had been common in veterinary ICUs, with visits chaperoned by both veterinarians and the nursing team. Visits may represent a source of comfort and information for owners, but may also be time-consuming to veterinary staff. During the COVID-19 pandemic, almost all specialty/emergency veterinary hospitals pivoted to curb-side service, and typically highly limited client entry into the building for staff safety. Similar restrictions on visitation were instituted in human ICUs, leading to stress among clinicians, nurses, and patient families. The proposed study aimed to assess the visitation policies reported by critical care veterinarians and technicians and the spectrum of effects on veterinary team members.

**Methods:** An electronic survey was distributed to the emergency and critical care community using email and social media. The study was exempted by the institutional review board. Survey questions included demographics, COVID-19 hospital policies, and questions about the impact of restricting visitation. Descriptive statistics were used.

**Results:** There were 326 respondents to the survey, with veterinarians (53%) and veterinary technicians/assistants (40%) being the most common. Visitation restrictions were reported by 286 (88%) participants. Of those, 264 (81%) reported permitting visits only for euthanasia/end-of life discussion and/or on a case-by case arrangement and 20 (6%) allowed no visitation at all. By comparison, prior to COVID-19, 309 (95%) respondents reported no visitation restrictions. For the veterinary team, 244 (75%) felt sad if they had to decline a visit, while 211 (65%) reported feeling anxious and/or guilty. Most respondents (218; 67%) felt the owners were understanding. Restricting visits was perceived to improve time for patient care for 195 (60%) respondents, decrease overall workload for 192 (59%) respondents, and decrease stress for 137 (42%) respondents.

**Conclusion:** Visitation restriction impacts veterinary staff both positively and negatively; careful evaluation of visitation policies is warranted. The impact on owners should also be evaluated.

### EVALUATION OF THE IMPLEMENTATION, FREQUENCY OF USE, NATURE, AND IMPACT OF VETERINARY EMERGENCY SERVICE PAUSE SYSTEMS: A SURVEY STUDY

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**Introduction:** Veterinary medicine has been facing a large-scale employee shortage, which has been pronounced in emergency practice. Although there are several current and developing curricula to encourage and incentivize veterinary professionals into emergency practice, many facilities have instituted Veterinary Emergency Service Pause Systems (VESPS) to help current staff meet the challenges of these shortages among ongoing demand for veterinary care. The objectives of this study were to determine how widespread VESPS are as well as to describe aspects of implementation and perceived impact.

**Methods:** A survey, developed by a Diplomate of the American College of Veterinary Emergency and Critical Care, and with the support of the board of the Veterinary Emergency and Critical Care Society (VECCS), was distributed through email to VECCS members starting December 2021. No incentive for participation was provided and anonymous, individual-authenticated responses were collected using commercial software. Descriptive statistics were applied to summarize responses.

**Results:** The survey was distributed to 6176 VECCS members with 1168 responses. Seventy-five percent of the respondents were DVMs. Ninety-one percent of respondents practice in the United States with 74% of them working at 24/7 multispecialty practices. Eighty-seven percent of respondents indicated patient volume had increased and 74% reported that a VESPS had been implemented in the prior 12–15 months. Sixty-two percent reported that their emergency service had been paused or closed once per week or more. The top reasons for service closure included excessive caseload and staffing shortages. A variety of methods were utilized to implement VESPS. Eighty-three percent reported their system was at least moderately effective and most reported the pause was highly supported by medical staff. Seventy-seven percent reported increased client frustration and complaints, and 57% reported staff were stressed from denying care. Of those who do not currently have a VESPS in place, 74% would prefer to have one.

**Conclusion:** VESPS are in widespread use and most have been implemented recently. The majority of VESPS were employed to mitigate increased caseload and staffing shortages. Although VESPS are largely supported by medical staff, drawbacks may include staff stress and client frustrations.

## ACID-BASE AND ELECTROLYTE EVALUATION IN DOGS WITH UPPER GASTROINTESTINAL OBSTRUCTION: A RETROSPECTIVE ANALYSIS OF 115 DOGS (2015–2021)

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**Introduction:** Metabolic alkalosis, although uncommon in small animals, has been previously associated with gastrointestinal (GI) obstructions, specifically of the pylorus and duodenum. The objective of this study was to determine the prevalence of metabolic alkalosis and other acid–base and electrolyte disorders in a cohort of dogs with a confirmed upper GI obstruction.

**Methods:** Electronic medical records at Texas A&M University Veterinary Teaching Hospital were reviewed to identify dogs that presented for vomiting, with evidence of a GI obstruction from January 2015 to October 2021. Traditional acid–base analysis was utilized to determine an acid–base status prior to relieving the obstruction. When available, postoperative venous acid–base status was determined within 24 hours and compared to preoperative results. Paired *t*-test or Wilcoxon signed-rank test was used to compare the values of normally or nonnormally distributed correlated continuous variables, respectively. The prevalence of metabolic alkalosis and acidosis prior to and after surgery was compared using the Exact McNemar's test.

**Results:** A total of 115 dogs were included in the study. Twenty-five out of 115 (22%) dogs displayed a simple or mixed metabolic alkalosis prior to surgery. Twenty-seven out of 115 dogs (37%) had a normal acid–base status at entry. Seventy-one dogs had pre- and postoperative venous blood gas results available. Postoperatively, a mixed metabolic acidosis and respiratory alkalosis was the most common condition, found in 25 out of 71 (35%) dogs. Venous pH, P<sub>v</sub>CO<sub>2</sub>, bicarbonate, and base excess were significantly higher preoperatively when compared to the postoperative results. Venous sodium, potassium, and chloride were significantly lower preoperatively.

**Conclusion:** Our study found a lower prevalence of simple or mixed metabolic alkalosis than reported in previous studies. Surgical or endoscopic alleviation of the upper GI obstruction resulted in resolution of metabolic alkalosis in nearly all patients. Serious derangements of electrolytes were infrequent, but statistically significant, and should not be overlooked in this patient subset.

## COMPARISON OF APOMORPHINE AND ROPINIROLE FOR INDUCTION OF EMESIS IN DOGS

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**Introduction:** Apomorphine (APO) is used to induce emesis in dogs. The IV route can be difficult in the aggressive/fearful dog. The goal of this study was to assess the efficacy and ease of various routes of apomorphine administration as well as ropinirole (CLEVOR) to establish if another route might be effective.

**Methods:** This prospective randomized study enrolled dogs where emesis was deemed necessary by a clinician. Dogs were randomized into groups: IV APO (0.03 mg/kg), intranasal (IN) APO (0.06 mg/kg), SC APO (0.03 mg/kg), transconjunctival (TC) APO (0.03 mg/kg), and ophthalmologic administration of ropinirole. Data collection included whether emesis was successful within 600 seconds, difficulty of administration (score of 1–10 with 10 being very difficult), length of time to emesis, and time required to administer drug. Results were compared to IV APO using a variety of statistics with *P* < 0.05 considered significant.

**Results:** A total of 125 dogs were enrolled with 25 dogs in each group. Emesis was successful in 22 out of 25 in IV APO with a median time to emesis of 67.5 seconds. A total of 18 out of 25 in IN APO group successfully vomited with a median time to emesis of 240 seconds. A total of 14 out of 25 in CLEVOR group successfully vomited with a median time to emesis of 480 seconds. Six out of 25 in SC APO group successfully vomited with a median time to emesis of 438 seconds. Four out of 25 in TC APO group successfully vomited with a median time to emesis of 120 seconds. The order of medication administration from fastest to slowest was as follows: SC APO, IN APO, CLEVOR, TC APO, IV APO. It was the most difficult to administer IV APO and TC APO, followed by IN APO and CLEVOR, then SC APO. When emesis was successful, it occurred most rapidly with IV APO, followed by TC APO, IN APO, SC APO, then CLEVOR.

**Conclusion:** IV APO effectively induces vomiting, but it takes longer and is harder to administer. IN APO is a viable alternative to IV APO. Vomiting induced by CLEVOR can be delayed compared to IV/IN APO but is more effective than SC APO or transconjunctival APO.

## COMPARISON OF POINT-OF-CARE VISCOELASTIC TEST RESULTS TO KAOLIN-ACTIVATED THROMBOELASTOGRAPHY IN DOGS WITH SUSPECTED HYPERCOAGULABILITY

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**Introduction:** Viscoelastic testing is used in veterinary medicine to evaluate dogs with coagulopathies, including those with hypercoagulable states. Conventional kaolin-activated thromboelastography (TEG) requires specialized equipment and laboratory techniques and is uncommonly available outside academic centers. The VCM-Vet is a cartridge-based viscoelastic test designed for cage-side use. Both TEG and VCM-Vet employ contact activation. The goals of this study were (1) to determine the correlation between clot strength as assessed by TEG and VCM-Vet in normal dogs and dogs with suspected hypercoagulability and (2) to determine how often dogs with clinically suspected hypercoagulability are abnormal on viscoelastic testing. Increased clot

strength in TEG is defined as an increased Maximum Amplitude (MA; mm), while in the VCM-Vet it is defined as an increased Maximum Clot Firmness (MCF; VCM units).

**Methods:** A reference range for VCM-Vet and TEG was created and a 95% confidence interval (CI) was determined for MA and MCF using a nonparametric approach. Spearman's correlation coefficient (CC) was used to evaluate the relationship between MCF and MA in healthy dogs (HEALTHY). Dogs admitted to the ICU with a clinical suspicion of hypercoagulable conditions (HYPER) were prospectively enrolled. Subsequent confirmed hypercoagulability in HYPER dogs was defined as an MA or an MCF above the 95% CI. Finally, the CC was calculated between MA and MCF for HYPER dogs.

**Results:** The 95% CI for MA was 47.7–69.7 mm and for MCF it was 27–38 VCM units. The CC between MA and MCF for healthy dogs was 0.55. Twenty-three dogs with suspected HYPER were enrolled; 17 were identified as HYPER based upon MA and 16 were identified as HYPER based upon MCF. No suspected HYPER dog was found to be hypocoagulable on either TEG or VCM-Vet. The CC between MA and MCF for HYPER was 0.60, indicating a strong correlation.

**Conclusion:** There is a moderate to strong correlation between 2 viscoelastic markers of clot strength, the MA and the MCF. Both the TEG and VCM reliably identify hypercoagulable tracings in dogs clinically suspected of being HYPER. Dogs that are clinically suspected to be HYPER are only confirmed HYPER by viscoelastic testing in 72% of cases.

#### NASAL PLANUM, FULL-FACE, OR OCULAR TEMPERATURE ASSESSED BY INFRARED THERMOGRAPHY IS NOT CORRELATED WITH RECTAL TEMPERATURE OR SEVERITY OF DISEASE IN DOGS PRESENTED TO AN EMERGENCY SERVICE

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**Introduction:** Few studies have evaluated the use of infrared thermography (IRT) in veterinary medicine as a surrogate for rectal temperature. No studies have evaluated IRT's association with severity of illness. Our study's goal was to determine the correlation between the temperature of the 3 following regions of interest (ROIs) as measured by IRT: nasal planum (NP), full-face (FF), and the average of both eyes (OU<sub>mean</sub>) to rectal temperature, severity of illness, and clinical outcome in dogs presenting for veterinary care.

**Methods:** Dogs that were presented to a veterinary teaching hospital emergency service and required bloodwork for a non-study-related reasons were eligible for inclusion. A thermal image of the dog's face was collected. The aforementioned ROIs were demarcated and analyzed using an accompanying thermal imaging software. Correlation between mean and maximum temperature of each ROI to rectal temperature, illness severity score, and clinical outcome was tested using Kendall-T measure of correlation.

**Results:** Fifty dogs were included. The median rectal temperature was 101.7°F (92–107.7°F,  $n = 50$ ). The median NP<sub>mean</sub> temperature was 93.3°F (72.4–103.8°F,  $n = 50$ ). The median NP<sub>max</sub> temperature was 97.9°F (81.9–109.3°F,  $n = 50$ ). The median OU<sub>mean</sub> temperature was 95.2°F (84.2–99.4°F,  $n = 22$ ). The median FF<sub>max</sub> temperature was 99.9°F (92–110.3°F,  $n = 50$ ). There was no statistically significant correlation between rectal temperature and NP<sub>mean</sub>, NP<sub>max</sub>, OU<sub>mean</sub>, or FF<sub>max</sub> temperatures ( $P = 0.558, 0.170, 0.150, \text{ and } 0.094$ , respectively). Similarly, no statistically significant correlation was found between NP<sub>mean</sub>, NP<sub>max</sub>, OU<sub>mean</sub>, or FF<sub>max</sub> temperatures and illness severity score as defined by APPLE<sub>full</sub> ( $P = 0.808, 0.142, 0.955, \text{ and } 0.251$ , respectively) or APPLE<sub>fast</sub> ( $P = 0.465, 0.650, 0.475, \text{ and } 0.368$ , respectively). A weak negative correlation was found between NP<sub>mean</sub> temperature and clinical outcome; as the average nasal planum temperature increased, the likelihood of survival to discharge decreased ( $t = -0.265, P = 0.025$ ). There was no statistically significant correlation between clinical outcome and NP<sub>max</sub>, OU<sub>mean</sub>, or FF<sub>max</sub> temperatures ( $P = 0.098, 0.811, \text{ and } 0.289$  respectively).

**Conclusion:** IRT of the canine NP, FF, or OU<sub>mean</sub> is not correlated with rectal temperature or severity of disease. The significance of the weak correlation between NP temperature and clinical outcome is unknown.

#### COMPARISON OF ROPINIROLE VERSUS APOMORPHINE FOR EMESIS INDUCTION IN DOGS: 53 CASES (2021–2022)

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**Introduction:** Induction of emesis for gastrointestinal decontamination is often recommended in veterinary medicine. Apomorphine, a nonselective dopamine and mu receptor agonist, is commonly used to induce emesis in dogs but is not FDA approved. Apomorphine's nonselectivity may cause side effects such as tachycardia, sedation, and lethargy. Ropinirole, a high-selectivity D2-type receptor agonist, the only FDA-approved emetic for dogs, is formulated as eyedrops for ease and speed of administration. The objective of this study was to characterize emetic profiles between agents.

**Methods:** This was a prospective randomized study. Fifty-three healthy dogs >4.5 months old and weighing >1.8 kg experiencing dietary indiscretion in the previous 4 hours were enrolled. Patients were randomly assigned to receive apomorphine or ropinirole to induce emesis. If no emesis was produced by 20 minutes, subjects were re-dosed with the same medication and dose. Incidence of emesis, number of emetic events, time to emesis, and need for anti-emetic were evaluated. Heart rate, respiratory rate, and temperature were tracked at time of induction, 20 minutes, and 40 minutes. Adverse events included tachycardia, hyperthermia, tachypnea, sedation, and ocular irritation. An anti-emetic rescue protocol was implemented if vomiting persisted past 30 minutes.

**Results:** Fifty-three patients met inclusion criteria. Emesis upon first dose in the ropinirole group was 83% (25/30) compared to 96% (22/23)



in the apomorphine group ( $P = 0.22$ ). All dogs requiring second dose had successful emesis. Ropinirole group required re-dosing 16.6% of the time versus 4.3% of the apomorphine group. Adverse events were not significantly different between groups ( $P = 0.78$ ). The rescue rate in the ropinirole group was 50% (15/30) compared to 0% (0/23) in the apomorphine group ( $P < 0.0001$ ). Median time to first emetic event median (95% CI) was 9 minutes in the ropinirole group compared to 1.6 minutes in the apomorphine group ( $P < 0.001$ ).

**Conclusion:** Preliminary results suggest apomorphine may be more efficacious than ropinirole at inducing emesis with a single dose, but results have not reached statistical significance. Apomorphine exhibited a shorter median time to first emesis by 7.4 minutes, less frequent re-dosing, and less need for the rescue protocol, leading to potential advantages for its use in a busy emergency room setting.

### COMPARISON OF $SpO_2/FiO_2$ AND $PaO_2/FiO_2$ RATIOS IN MECHANICALLY VENTILATED DOGS

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**Introduction:** Studies in critically ill human patients have demonstrated that the pulse oximetry saturation/fraction of inspired oxygen ( $SpO_2/FiO_2$  [SF]) ratio is a simple, noninvasive alternative to the partial pressure of oxygen in arterial blood/fraction of inspired oxygen ( $PaO_2/FiO_2$  [PF]) ratio, and can be used to diagnose acute respiratory distress syndrome (ARDS) and measure hypoxemia in mechanically ventilated (MV) patients. When compared to pulse oximetry, arterial sampling presents complications and difficulty in sampling technique. Additionally, iatrogenic anemia and cost to client of frequent arterial blood gas analyses are added concerns. The objective of this study was to determine whether the SF ratio correlates with the PF ratio in MV dogs. It was hypothesized that the SF ratio can be substituted for the PF ratio for assessment of oxygenation in MV dogs.

**Methods:** This was a prospective, longitudinal observational study in which dogs requiring MV at a private referral center were eligible for inclusion. Blood samples were obtained from arterial catheters via heparinized blood gas syringes and analyzed within 5 minutes of collection.  $SpO_2$  and  $FiO_2$  values were measured and recorded at the time of sampling.  $SpO_2$  values measuring  $<80\%$  were excluded from the data analysis due to inaccuracy of the pulse oximeter based on the steep portion of the oxygen-hemoglobin dissociation curve.

**Results:** Fourteen dogs and 143 SF and PF ratios were included in this study. There was strong correlation of  $SpO_2$  and  $PaO_2$  values ( $r = 0.76$  [95% CI, 0.41–0.92],  $P = 0.0005$ ) with 95% confidence that the correlation coefficient was  $>0.41$  (moderate correlation). There was very strong correlation of SF and PF values averaged over all MV dogs ( $r = 0.90$  [95% CI, 0.73–0.97],  $P < 0.0001$ ) with 95% confidence that the correlation coefficient was  $>0.73$  (strong correlation).

**Conclusion:** Preliminary results suggest a statistically significant correlation between SF and PF ratios in MV dogs, supporting our hypothesis

that SF ratios may serve as a noninvasive substitute for PF ratios for the assessment of oxygenation in MV dogs. Additional data collection is necessary to determine the specific SF ratio values corresponding with a PF ratio  $<300$  for Veterinary Acute Lung Injury (VetALI) or  $<200$  for VetARDS. Data collection is ongoing.

### RETROSPECTIVE EVALUATION OF TREATMENTS AND ADVERSE EFFECTS IN CATS WITH VENTRICULAR TACHYCARDIA

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**Introduction:** Treatment recommendations for ventricular tachycardia in cats are poorly established. IV lidocaine is generally avoided in cats due to sensitivity and risk of central nervous system or cardiovascular adverse effects. Efficacy of low-dose lidocaine and other antiarrhythmics has not previously been evaluated. The aim of this study was to report on the efficacy and safety of various antiarrhythmics used for emergency treatment of ventricular tachycardia in cats.

**Methods:** The medical records of cats diagnosed with ventricular tachycardia from May 2012 to December 2021 were reviewed. Cases were excluded if patients had supraventricular tachyarrhythmias or if response to treatment was not recorded. Data collected included rhythm diagnosis, age, weight, presenting heart rate and blood pressure, initial treatment and responses, secondary treatment and response if applicable, adverse effects, survival to discharge, and use of long-term antiarrhythmics. Descriptive statistics were used due to small sample size.

**Results:** Fourteen cases were included. Lidocaine was used as a first-line antiarrhythmic in 4 out of 14 of cats with a median bolus dose of 0.375 mg/kg (range: 0.25–0.5 mg/kg) followed by 20  $\mu$ g/kg/min constant rate infusion (CRI) (range: 5–40  $\mu$ g/kg/min). Other first-line treatment options included esmolol (2/14) with a median bolus dose of 0.15 mg/kg (range: 0.1–0.2 mg/kg) followed by 0.25  $\mu$ g/kg/min (range: 0.2–0.5  $\mu$ g/kg/min), procainamide (1/14) at a dose of 20  $\mu$ g/kg/min CRI, and amiodarone (1/14) at a dose of 2 mg/kg IV bolus followed by 2.5 mg/kg/h CRI. Five cats were treated only with oral medications (sotalol at median dose of 1.2 mg/kg or atenolol at median dose 0.8 mg/kg). Three of 4 cats initially treated with lidocaine converted to a normal sinus rhythm. Neither cat initially treated with esmolol converted; however, sinus rhythm was achieved after receiving lidocaine as a secondary drug. No adverse effects were recorded in cats that received lidocaine or any other antiarrhythmic drug.

**Conclusion:** Although uncommon, ventricular tachycardia may warrant emergency treatment in cats. While lidocaine toxicity remains a concern, no cats receiving lidocaine in this group had adverse effects reported. Oral treatment with sotalol may be considered for inpatient treatment and long-term management. Prospective studies are needed.

## THE EFFECTS OF METHADONE HCL ON GASTROINTESTINAL TRANSIT TIMES AND PH IN HEALTHY CATS: A PILOT STUDY

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**Introduction:** Opioid analgesics have been reported to cause gastrointestinal (GI) ileus in people, horses, and dogs. Little is known regarding their effect on GI function in cats. Methadone, a  $\mu$ -opioid receptor agonist, is approved in cats for the treatment of acute pain. The objective of this study was to evaluate the effects of methadone on GI function in cats.

**Methods:** In a randomized crossover design, 6 cats received 1 intramuscular injection: saline solution (0.06 ml/kg, SAL) or methadone (0.6 mg/kg, MET). Cats were fed their standard quantity once a day. On treatment days, food was withheld for 24 hours prior to being meal-fed their regular daily allowance for 1 hour. After the 1 hour, food was removed and a Bravo capsule was administered orally. Food was weighed before and after the feeding. Cats were fed the same food allotment every 24 hours on subsequent days following treatment. Net food consumption on day of (day 1) and after treatment (day 2) was compared between treatment via paired *t*-test. Descriptive statistics were calculated and reported as median [range]. Esophageal, gastric, and total GI transit times and mean esophageal, gastric, and intestinal pH were compared between treatments via Wilcoxon match-pairs signed-rank test. Intestinal transit was compared using a paired *t*-test. Statistical significance was defined as  $P < 0.05$ .

**Results:** There were no significant differences in food consumption on day 1 or day 2 between treatments. There were no significant differences found in esophageal (6.5 [1–96] vs. 7.5 [2–144],  $P = 0.56$ ), gastric (1086 [907–5473] vs. 2293 [1065–10,414],  $P = 0.06$ ), intestinal (1399 [1194–2406] vs. 1535 [928–2541],  $P = 0.92$ ), and total GI transit times (3075 [2244–6674] vs. 3676 [2191–11,486],  $P = 0.06$ ) between SAL and MET treatments, respectively. There were no significant differences found in esophageal (5.8 [5.4–6.2] vs. 5.1 [4.1–6.2],  $P = 0.063$ ), gastric (1.9 [1.3–2.9] vs. 1.9 [1.6–2.9],  $P > 0.99$ ), or intestinal (8.0 [7.1–8.3] vs. 7.4 [6.0–8.3],  $P = 0.063$ ) pH between SAL and MET treatments, respectively.

**Conclusion:** This is the first study using a Bravo capsule to evaluate the effects of opioids on the feline GI system. Our results did not detect significant differences in total GI transit times or pH following the 1-time administration of methadone in healthy cats.

## EVALUATION OF HEMOSTATIC DERANGEMENTS ASSOCIATED WITH CANINE ANAPHYLAXIS AND THE RELATIONSHIP TO DISEASE SEVERITY

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**Introduction:** Coagulation derangements have been documented as a sequela of anaphylaxis (APX) in people and in animals. There is some variability in the specific derangements identified in anaphylaxis-associated coagulopathies (AAC), including predominantly factor-based, fibrinogenolytic, and fibrinolytic phenotypes. The most cited clinical manifestations in APX that may be attributed to coagulation derangements are spontaneous hemoperitoneum and gastrointestinal hemorrhage, though the mechanisms of their occurrence have yet to be definitively elucidated in the veterinary literature. The purpose of this study was to utilize viscoelastic coagulation testing to further characterize AACs in dogs using a point-of-care viscoelastic coagulation monitor and to assess for an association between the presence of coagulopathy and disease severity.

**Methods:** Patients were prospectively recruited for this observational study of client-owned dogs from November 2018 to January 2022. Twenty-seven dogs diagnosed with anaphylaxis of varying severity were included. Study inclusion required complete testing and medical records, presentation  $< 6$  hours after the start of clinical signs, no recent treatments for another acute disease, lack of comorbidities expected to affect coagulation, and lack of disease state that could alternatively explain the clinical presentation. Blood samples were collected within the first hour of presentation for CBC, serum chemistry, prothrombin time (PT), activated partial thromboplastin time (aPTT), and viscoelastic coagulation testing for use with the VCM Vet.

**Results:** Data were recorded for PCV at the time of coagulation testing, platelet count, ALT, PT, aPTT, and all reported viscoelastic parameters. Clotting time (CT) and clot formation time (CFT) were prolonged, alpha angle (AA) and maximal clot firmness (MCF) were decreased, PT and aPTT were prolonged, and platelet counts were lower in severe (Grade 3) cases compared to less severe cases (Grade 1 and Grade 2). There were no differences for any parameter between Grade 1 and Grade 2 cases. The presence or absence of abdominal effusion was not associated with the coagulation status.

**Conclusion:** Global hemostatic derangements are a prominent feature of severe grade APX in dogs and should be considered for routine evaluation in these patients. There is no apparent association between hemostatic derangements and the presence or absence of anaphylaxis-associated hemoperitoneum.

## FREE HEME TRIGGERS FORMATION OF NEUTROPHIL EXTRACELLULAR TRAPS IN DOGS AND IS ATTENUATED BY HEMOPEXIN. AN EX VIVO INVESTIGATIVE MODEL OF CANINE IMMUNE-MEDIATED HEMOLYTIC ANEMIA

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**Introduction:** Canine immune-mediated hemolytic anemia (IMHA) and its high incidence of thromboembolic complications are a prime example of immunothrombosis and highlight the complex interactions between innate immunity and coagulation. Excessive neutrophil extracellular trap (NETs) formation has been reported in dogs with

IMHA, and their components like cell-free DNA and histones are prothrombotic. Free heme has previously been shown to stimulate NETs formation via reactive oxygen species (ROS) generation in mice. NETs generated by free heme may also be modulated by hemopexin, an acute phase protein that scavenges heme. We hypothesized that free heme induces NETs formation in canine neutrophils by inducing ROS production, which can be attenuated by sequestering heme with hemopexin.

**Methods:** Neutrophils ( $1 \times 10^5$  cells/ml) isolated from 21 dogs were treated ex vivo with 0, 5, 10, or 20  $\mu\text{M}$  hemin-ferritroporphyrin-IX-chloride (hemin) or Fe (III)meso-tetra(4-carboxyphenyl)porphine chloride (Fe-heme) for 120 minutes with/without NADPH oxidase inhibitor, diphenyleneiodonium chloride (DPI). In addition, 10  $\mu\text{M}$  Hemin-heme or 20  $\mu\text{M}$  Fe-heme were treated with hemopexin in a 1:2 molar substitution ratio (diluted in 1.5% bovine serum albumin). NETs, characterized as filamentous cell-free DNA, were quantified by live-cell fluorescence microscopy (10 $\times$  magnification) across 5–10 fields after the addition of fluorescent nucleic acid stains. Qualitative analysis of NETs was performed with immunocytochemistry to identify co-localization of citrullinated histone H3, cell-free DNA, and myeloperoxidase. Pairwise comparisons were performed using paired *t*-tests or 1-way ANOVA with post hoc testing.

**Results:** Dose-dependent effects of NETs formation were noted in hemin- and Fe-heme-treated neutrophils ( $P < 0.010$ ) ( $N = 6$ ). Significant elevation in NETs was noted at all concentrations compared to vehicle controls ( $P < 0.04$ ). Inhibition of ROS generation by DPI ( $N = 6$ ) attenuated hemin- and Fe-heme-mediated NETs formation ( $P < 0.003$ ). The addition of hemopexin–albumin complex ( $N = 9$ ) significantly reduced hemin-heme-induced ( $P < 0.001$ ) but not Fe-heme-induced NETs formation ( $P > 0.25$ ). Interestingly, hemopexin in the absence of hemes and albumin caused significant NETs formation ( $P < 0.02$ ).

**Conclusion:** Hemin and Fe-heme directly stimulates NETs formation via ROS generation in a concentration-dependent manner. Attenuation of hemin-induced NETs formation by hemopexin suggests a potential novel therapy to reduce NETs formation in canine IMHA by sequestering free-heme in plasma. Further clinical studies would be required to evaluate the safety and efficacy of hemopexin.

## EVALUATION OF NOVEL BIOMARKERS OF ENDOTHELIAL GLYCOCALYX DEGRADATION IN CANINE TRAUMA PATIENTS

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**Introduction:** The glycocalyx is a complex network of glycoproteins and proteoglycans on the endothelium. The extent of endothelial glycocalyx damage is involved with patient morbidity and development of coagulopathies and multiple organ failure. In an effort to inform future traumatic injury research, the purpose of this pilot study was to evaluate select plasma glycocalyx concentrations in canine trauma patients with extent of injury assessed using a validated injury severity score at presentation. Our null hypothesis is that systemic concentrations of

select endothelial biomarkers do not significantly differ between injury severity cohorts.

**Methods:** Nineteen dogs were enrolled in this study. Plasma was obtained at 4 timepoints: arrival (prior to fluid resuscitation), 3, 6, and 24 hours later. Patient degree of injury was classified based on ATT score (low [0–3], medium [4–6], and high [ $\geq 7$ ]). Sixteen healthy age-matched plasma samples were obtained for comparison. Plasma samples were processed and frozen for batch analysis. Syndecan-1 and hyaluronan were measured on each sample via ELISA.

**Results:** Seven blunt and 12 penetrating trauma cases were included. Median ATT, age, mGCS, lactate, and iCa values by cohort (mild, moderate, severe) were as follows: age (7.0, 5.5, and 4.0 years), ATT (2, 4, and 6), mGCS (18, 18, and 15), lactate (1.7, 3.1, and 3.4 mmol/L), and iCa (1.34, 1.31, and 1.24 mmol/L). The plasma hyaluronan concentrations (median, IQR) for mild, moderate, and severely injured patients and age-matched controls were 47.17 (IQR: 48), 35.35 (IQR: 27), and 38.63 (range: 16.92–69.61 ng/ml) and 59.82 ng/ml (IQR: 60), respectively. The median syndecan-1 plasma concentration for each cohort was 0, although some dogs had concentrations  $> 30$  ng/ml.

**Conclusion:** Based on initial analysis of data in this pilot study, systemic concentrations of hyaluronan and syndecan-1 may not correlate with degree of injury as assessed by ATT score at presentation in canine trauma patients. Broader evaluation of these and other biomarkers in patients longitudinally may inform the design of future studies to determine the effect of injury and fluid resuscitation on the glycocalyx and patient outcome.

## POPULATION PHARMACOKINETICS OF SUBCUTANEOUS ENOXAPARIN IN HYPERCOAGULABLE DOGS

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**Introduction:** Enoxaparin is commonly used for thromboprophylaxis in hypercoagulable dogs. Initial dosage recommendations were based on inhibition of factor Xa activity in healthy dogs. However, evaluation of enoxaparin anticoagulant activity in hypercoagulable dogs is necessary to prevent treatment failures due to inappropriate dosage. This study aimed to determine the optimal enoxaparin dosage to provide consistent anticoagulation in hypercoagulable dogs, and to identify covariates that define the pharmacokinetic profile of a population of hypercoagulable dogs.

**Methods:** Dogs with naturally occurring disorders associated with a hypercoagulable state, and healthy dogs, were administered SC enoxaparin (0.8 mg/kg, q 6 h). Enoxaparin's anti-Xa activity was measured before and 5 times during drug administration. A population pharmacokinetic analysis was performed using a Nonlinear Mixed Effects Modeling software.

**Results:** Twenty-eight dogs (23 hypercoagulable and 5 healthy) were enrolled in the study. Anti-Xa activities of 16 out of 28 dogs (14 clinical and 2 healthy dogs) failed to reach a target range after the first dose. Compared to healthy dogs, hypercoagulable dogs had lower anti-Xa activities. Dogs with a higher body condition score (BCS), compared to dogs with an ideal or lower BCS, also had lower anti-Xa activities.

**Conclusion:** In hypercoagulable dogs, the initial dose of enoxaparin does not consistently induce anti-Xa activities within a target range. Healthy dog studies may not be directly applicable for diseased dogs, and patient factors such as hypercoagulability or high BCS may necessitate dose increases in individual dogs. A loading dose strategy may induce target range anti-Xa activity after the first enoxaparin dose.

#### ADMISSION CLINICOPATHOLOGIC ABNORMALITIES AND FACTORS ASSOCIATED WITH SURVIVAL IN FELINE BITE WOUNDS: A VETCOT DATA REGISTRY STUDY

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**Introduction:** Currently there is a paucity of information in the veterinary literature on feline bite wounds. A previous retrospective study found an association between increased plasma lactate, low ionized calcium, and low venous pH with higher ATT scores in cats that had bite wound trauma. In this study, increased ATT scores were associated with nonsurvival. The aim of this Veterinary Committee on Trauma (VetCOT) registry study was to identify if there is an association between admission parameters with ATT and MGCS score, differentiate nonsurvivors and survivors, and determine which patients would require transfusion and surgical interventions.

**Methods:** A total of 1065 feline bite wound trauma patients were obtained from the VetCOT data registry from April 2019 to June 2021. Predictors of the primary outcome (death or euthanasia) were assessed using univariable and multivariable logistic regression analysis. Predictors included point-of-care laboratory values, age, weight, sex, and trauma-specific illness severity scores (ATT, MGCS). Additional variables included trauma character (blunt vs. penetrating bite wound), transfusion therapy, presence of head or spinal injury, and surgical intervention.

**Results:** A total of 830 out of 1065 (78%) cats survived to discharge and 235 out of 1065 (22%) were either euthanized or died. A total of 345 out of 1065 (32%) cats underwent surgery. For every 1 year of age, odds of dying increased by 4.2%. Increased weight (kg) correlated with decreased mortality. Cats with an MGCS of 16 or lower were 5.8 times more likely to die when compared to an MGCS of 18. The odds of a cat dying with an ATT score of 3 or greater was 34.4 times higher when compared to an ATT score of 0. Cats with a higher ATT score were more likely to require surgical intervention and those cats that underwent surgical intervention were more likely to survive to discharge. The effect of admission clinicopathological abnormalities on survival

were not able to be determined due to the small number of animals with these data.

**Conclusion:** Mortality increased with older age, higher ATT score, and lower body weight and MGCS.

#### PREVALENCE AND FACTORS ASSOCIATED WITH INITIAL AND SUBSEQUENT SHOCKABLE CARDIAC ARREST RHYTHMS AND THEIR ASSOCIATION WITH PATIENT OUTCOMES IN DOGS AND CATS UNDERGOING CARDIOPULMONARY RESUSCITATION: A RECOVER REGISTRY STUDY

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**Introduction:** First diagnosed (initial) shockable cardiac rhythms in people undergoing cardiopulmonary resuscitation (CPR) are associated with better patient outcomes, while shockable rhythms developing later (subsequently) in the course of CPR are not. Information on cardiac rhythms in dogs and cats with cardiopulmonary arrest (CPA) is limited. This study reports prevalence and factors associated with initial (I-SHCR) and subsequent (S-SHCR) shockable cardiac rhythms in dogs and cats during CPR and explores their association with patient outcomes.

**Methods:** The Reassessment Campaign on Veterinary Resuscitation (RECOVER) CPR registry was retrospectively reviewed to identify dogs and cats with recorded cardiac arrest rhythm and outcome information. Ventricular fibrillation and pulseless ventricular tachycardia were combined as shockable rhythms. Multivariable logistic regression was used to evaluate the association of animal, hospital, and arrest variables with I-SHCR, S-SHCR, and return of spontaneous circulation (ROSC). Odds ratios (OR) were generated and significance set at  $P < 0.05$ .

**Results:** Initial cardiac arrest rhythms were available for 627 animals. Twenty-eight (4%) had I-SHCR. Odds were significantly ( $P < 0.01$ ) higher in patients with a metabolic cause of CPA (OR: 7.61) and those that received lidocaine (OR: 17.50) or amiodarone (OR: 21.22) during CPR, and significantly ( $P < 0.02$ ) lower in patients experiencing CPA during daytime hours (OR: 0.22), in the ICU (OR: 0.27), ER (OR: 0.13), out-of-hospital (OR: 0.18), and those that received epinephrine (OR: 0.19). Of 599 initial nonshockable rhythms, 74 (12%) converted to S-SHCR during CPR. Odds were significantly ( $P < 0.02$ ) higher in patients with higher body weight (OR: 1.03), those with hemorrhage (OR: 2.85) or intracranial (OR: 3.73) cause of CPA, and those that received lidocaine (OR: 18.72), and significantly decreased ( $P < 0.05$ ) in those experiencing CPA in the ICU (OR: 0.27), ER (OR: 0.29), out-of-hospital (OR: 0.38), and that received epinephrine (OR: 0.09). Overall, 171 (24%) patients achieved ROSC and 15 (2%) survived. Neither I-SHCR nor S-SHCR was significantly associated with ROSC.

**Conclusion:** Initial and subsequent shockable cardiac rhythms occur infrequently in dogs and cats undergoing CPR and are not associated

with ROSC. Due to low prevalence of I-SHKR, S-SHKR, and low rate of survivors in this population, further studies are indicated to confirm these findings.

### EVALUATION OF CONFIDENCE AND COMPETENCY OF LEADERSHIP, TEAMWORK, AND COMMUNICATION SKILLS RESULTING FROM THE RECOVER BLS AND ABBREVIATED ALS SIMULATION CPR TRAINING COURSE

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**Introduction:** In human emergency medicine, teamwork and communication among the medical team have been shown to improve patient outcomes. Current research in emergency nursing highlights that employees trained in effective communication have improved work environments and patient outcomes, and feel more empowered. Comparatively, research in veterinary medicine related to teamwork is lacking and there is a need for further education and research. The RECOVER Basic Life Support (BLS) and Advanced Life Support (ALS) online courses highlight important teamwork aspects in performing cardiopulmonary resuscitation (CPR). The objective of this project is to evaluate confidence and competence in team communication of in-person training participants (primarily veterinary students and technicians). We hypothesize that these characteristics will improve following their exposure to the RECOVER online modules, the in-person component of the RECOVER BLS course, and a series of author-developed abbreviated ALS scenarios.

**Methods:** Inclusion criteria included access to the online RECOVER modules and participation in the in-person simulations. Participants' confidence in communicating is measured on a self-reported Likert scale (1–5) before and after the in-person simulations. Competence is evaluated via a trained observer with 1–5 rating of communication skills throughout the author-developed ALS scenarios before and following the intervention. The intervention further exposes learners to teamwork communication topics and is placed between the first and second simulations.

**Results:** A total of 10 training sessions were analyzed with 61 learners. The median values found for confidence were compared using a 1-tailed t-test and found a significant *P*-value of 0.02. The median values of competence were similarly compared pre- and postintervention during author-developed abbreviated ALS scenarios and the result was found to be statistically significant with a *P*-value of <0.01.

**Conclusion:** These results show that confidence and competence in communication are statistically improved via the RECOVER BLS and author-developed abbreviated ALS in-person simulations scenarios. This study will inform the design of future studies on veterinary teams and support for inclusion of the RECOVER course in veterinary school curricula. A long-term goal would be to show that highly functional teams improve patient outcomes and increase the long-term satisfaction and retention of veterinary team members.

### POSTER PRESENTATIONS

#### POPULATION CHARACTERISTICS AND OUTCOMES IN DOGS AND CATS UNDERGOING CPR AFTER PREHOSPITAL CARDIOPULMONARY ARREST: A RECOVER CPR REGISTRY STUDY

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**Introduction:** Epidemiological information on dogs and cats with out-of-hospital cardiac arrest (OHCA) that are presented to veterinary hospitals (e.g., commonly referred to as “dead on arrival” or DOA) and undergo CPR at presentation is scarce. Using data from the RECOVER CPR registry, this study describes the population characteristics of cats and dogs that undergo CPR for OHCA and documents variables associated with important outcomes.

**Methods:** Data from the RECOVER CPR registry (2015–2021) contributed by 16 hospitals including 205 cats and 549 dogs were analyzed. Descriptive statistics were used to describe OHCA and IHCA populations, and Tukey, Wilcoxon, or Pearson tests were employed for comparisons between groups. Univariate and multivariate analyses were used to test for association between population characteristics and survival to discharge.

**Results:** Of the 754 reported CPR cases, 277 (37%; 95% CI, 33%–40%) were OHCA and 477 (63%; 95% CI, 60%–67%) were IHCA. While OHCA animals were similar in age (7.8 years, IQR 2–11) and proportion of species (dogs: 74%) as IHCA (age: 8.0 years, IQR 3.5–11.5; dogs: 72%), they were more frequently male (63% vs. 53%, *P* < 0.01). The most common suspected causes of OHCA were trauma (18%), heart failure (11%), and respiratory failure (11%) and were reported as unknown in 48% of cases. Thirty (11%), 7 (3%), and 1 (0.4%) patient(s) with OHCA achieved any ROSC, sustained ROSC, and survival to discharge, respectively; corresponding values were 182 (38%), 87 (18%), and 16 (3.4%) animals for IHCA. OHCA patients were 3 times as likely to be euthanized within 20 minutes after ROSC (OR: 3.0; 95% CI, 1.2–7.8) and 9.6 times less likely to survive to discharge (OR: 9.6; 95% CI, 1.3–72.6) than IHCA. However, when stratifying for arrest under general anesthesia, survival to discharge for nonanesthetized IHCA patients (*n* = 8 [1.8%]; 95% CI, 0.1%–3.6%) was comparably low as for OHCA patients (*n* = 1 [0.4%], 95% CI, 0.1%–2.0%).

**Conclusion:** Survival of patients with prehospital arrest was rare, but similar to nonanesthetized IHCA animals. Low survival rates were in part due to lower rates of any ROSC and higher euthanasia rates shortly after ROSC when compared to IHCA patients.

#### EVALUATION OF VISCOELASTIC COAGULATION ASSAYS IN CHICKENS (*Gallus gallus*)

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**Introduction:** Evaluation of coagulation is challenging in birds as common laboratory diagnostic tests typically use mammalian reagents that have uncertain utility in non-mammalian species. Coagulopathies like anticoagulant rodenticide toxicosis, however, can be common causes of morbidity and mortality in birds. Viscoelastic coagulation testing (VCT) has been shown experimentally to identify coagulopathic birds but remains rare in avian medicine. This study aimed to compare different traditional VCT assay protocols with a point-of-care viscoelastic coagulation monitor (VCM Vet) in domestic chickens.

**Methods:** A cohort of 10 domestic, layer chickens were enrolled to compare thromboelastography (TEG) parameters using 3 different activator protocols and identify correlations between these TEG parameters and corresponding parameters from native VCM Vet assays. A second cohort of 10 chickens was used to assess correlations between tissue factor-activated TEG parameters and tissue factor-activated VCM Vet parameters.

**Results:** Tissue factor-activated TEG parameters had lower coefficients of variation and significantly more rapid reaction (*R*) and clotting times (*K*) and larger alpha angles than either native or kaolin-activated TEGs. Regardless of activator used, TEG parameters were largely uncorrelated with native VCM Vet assays. Tissue factor-activated VCM Vet assays resulted in similar values to, but were largely uncorrelated with, tissue factor-activated TEGs. Importantly, these tissue factor-activated VCM Vet assays had narrower parameter ranges than native VCMs, thought to be a result of consistent activation.

**Conclusion:** Taken together, these results suggest that tissue factor-activated VCM assays can be a promising and feasible alternative to thromboelastography in chickens.

#### MiQLab BACTERIAL AND AMR TESTING VERSUS COMMERCIAL CULTURE AND SENSITIVITY FOR DETECTION OF ANTIMICROBIAL RESISTANT PATHOGENS IN POLYMICROBIAL SAMPLES

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**Introduction:** In this study, we assessed the performance of the MiQLab Test for detection of subpopulations of antimicrobial resistant (AMR) pathogens in contrived mixed samples and compared it to commercial Culture and Sensitivity Testing (C&ST). The MiQLab Bacterial and AMR Test V2 can detect 10 common bacterial pathogens infecting companion animals and 9 types of AMR markers that confer resistance to 4 classes of antimicrobials (Beta-lactams, Lincosamides, Sulfa-TMP, and Tetracyclines). We used *Escherichia coli* and *Staphylococcus pseudintermedius*, the leading cause of canine UTI and pyoderma, respectively, for the study.

**Methods:** Two *E. coli* and *S. pseudintermedius* strains (1 antimicrobial resistant and 1 susceptible each) were cultured overnight in BHI broth at 37°C with shaking. Each of the cultures were then diluted 1 ml into 9 ml of filter sterilized pooled Beagle urine (for *E. coli*) or PBS (for *S. pseudintermedius*). Resistant and susceptible strains of individual bacteria were then mixed such that the resistance strains are at 1000-fold lower concentration than susceptible strains in each mixture. Individual and mixed samples of *E. coli* and *S. pseudintermedius* were run on the MiQLab using the Bacterial and AMR Test V2. In parallel, samples were transferred to Liquid Amies medium via swab (for *S. pseudintermedius*) or sterile transport container (for *E. coli*) and shipped to 2 reference laboratories for C&ST.

**Results:** The MiQLab correctly identified *Staphylococcus* spp. and *E. coli* in the appropriate samples tested. Additionally, the MiQLab was successful in detecting AMR markers associated with resistance to Beta-lactams (*mecA*), Lincosamides (*ermA/B/C*), Sulfa-TMP (*dfpG/K*), and Tetracyclines (*tetM/O/S*, *tetK/L/38*) in the *S. pseudintermedius*-mixed sample as well as an AMR marker associated with Beta-lactam resistance (*blaTEM*) in the *E. coli*-mixed sample, representing successful detection of AMR strain subpopulations. In comparison, both reference labs reported the correct species of bacteria in each sample tested but failed to correctly report antimicrobial resistance associated with the subpopulation of AMR bacteria in the 2 mixed samples.

**Conclusion:** Together, these results indicate that in comparison to commercial C&ST, the MiQLab System performed better in detecting subpopulations of AMR bacteria with genotypic differences in polymicrobial samples.

#### A PILOT, RANDOMIZED, BLINDED, PLACEBO-CONTROLLED CLINICAL TRIAL FIELD STUDY TO EVALUATE THE SAFETY AND EFFICACY OF FUZAPLADIB SODIUM FOR THE TREATMENT OF ACUTE PANCREATITIS IN CLIENT-OWNED DOGS

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**Introduction:** Acute pancreatitis (AP) is an inflammatory disease involving mononuclear cell recruitment that leads to both morbidity and mortality. Current standard of care (SOC) is supportive, but there is currently no definitive treatment for AP in any species. Fuzapladib sodium (fuzapladib) is an activation inhibitor of leukocyte function-associated antigen-1 (LFA-1), blocking extravasation of mononuclear inflammatory cells, in turn preventing both pancreatic and systemic inflammation. The objective of this study was to assess the safety and efficacy of fuzapladib for treating AP in dogs.

**Methods:** Dogs with 2 or more clinical signs consistent with AP and an increased serum cPLI concentration (measured by Spec cPL) were considered to have AP, enrolled into the trial, and randomly assigned to receive fuzapladib (0.4 mg/kg intravenously once daily for 3 days) or placebo (excipients with 0.1 ml/kg sterile water for injection), with concurrent SOC. Sixty-one cases were included for the safety assessment, while 35 evaluable cases from 13 U.S. sites (19 fuzapladib:16 placebo) were included for efficacy assessment. Assessments included physical examination, clinical scoring with the Acute Canine Pancreatitis-5 score (ACP-5; the score evaluates activity, appetite, vomiting, abdominal pain, and dehydration previously Modified Canine Activity Index), serum cPLI, CBC/chemistry profile, urinalysis, and adverse events (AEs). The primary efficacy variable was change of the ACP-5 from day 0 (D0) to day 3 (D3). Serum cPLI was a secondary variable.

**Results:** A total of 142 AEs of systemic (18.3%), GI (12.0%), and cardiovascular (11.3%) origin were reported, including 27 serious AEs with 5 deaths or euthanasias, 4 in the fuzapladib group and 1 in the placebo group (2 placebo dogs were euthanized after study conclusion). None of the serious AEs were considered to be related to administration of fuzapladib. The change in total ACP-5 score from D0 to D3 was significant for the fuzapladib group ( $P = 0.0135$ ), but not for the placebo group. Serum cPLI concentrations between D0 and D3 were not significantly different for either group.

**Conclusion:** In conclusion, results of this study demonstrate that fuzapladib is effective for the treatment of canine AP. Additionally, no serious side effects were related to treatment with fuzapladib.

#### PRELIMINARY RESULTS ON POINT-OF-CARE ULTRASOUND-GUIDED OR CONVENTIONAL PERIPHERAL VASCULAR ACCESS IN DOGS PRESENTED TO AN EMERGENCY ROOM

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**Introduction:** Rapid peripheral catheterization is important in emergency situations. Catheterization can be challenging in debilitated patients. Point-Of-Care UltraSound (POCUS)-guided catheterization is poorly described in veterinary literature. The objective was to compare POCUS-guided (P) and conventional (C) peripheral catheterization in dogs in an emergency room by a single clinician. The hypotheses were (1) time to obtain vascular access and success rate are similar, (2) body weight and shock index (SI) influence results, (3) success is similar between in- and out-of-plane POCUS-guided catheterization, and (4) a learning curve exists for POCUS-guided catheterization.

**Methods:** Randomized, prospective study. Dogs (>5 kg) presenting to an emergency service were randomly allocated to P or C catheterization groups, cephalic (CE) or lateral saphenous (LS) vein catheterization. P was further randomized to be performed in- or out-of-plane.

**Results:** Thirty-six dogs were included, P = 15 (CE = 9, LS = 6) and C = 21 (CE = 7, LS = 14). P catheterization was successful in 60.0%

(9/15) (CE = 55.5% [5/9], LS = 66.7% [4/6]). C catheterization was successful in 85.7% (18/21) (CE = 85.7% [6/7], LS = 85.7% [12/14]). Mean time till P catheterization was 84.55 seconds (range: 67–122 s) (CE = 91.6 s [75–122 s], LS = 75.8 s [67–81 s]). Time till C catheterization was 68.44 seconds (58–122 s) (CE = 76.2 s [60–122 s], LS = 64.6 s [58–75 s]).

In smaller dogs (5–15 kg), success and time till P catheterization were 42.8% (3/7) and 87.7 seconds (81–96 s), compared to 75% (6/8) and 83 seconds (67–122 s) for larger dogs (>15 kg). In dogs with SI ≤1.0, success and time till P catheterization were 28.6% (2/7) and 78 seconds (75–81 s); for SI >1.0, 87.5% (7/8) and 86.4 seconds (67–122 s). Insufficient data were gathered regarding in- or out-of-plane catheterization to report. For the first half of the study, P catheterization success was 37.5% (3/8) and then 85.7% (6/7) for the second half; time till placement was 95.7 seconds (69–122 s) and then 79 seconds (67–86 s).

**Conclusion:** POCUS-guided peripheral catheterization was less successful and took longer. Improved success may occur in larger dogs or with a higher SI. These results suggest a learning curve exists: POCUS-guided catheterization may be a promising technique to develop if training can improve success.

#### UTILITY OF CORRECTED CHLORIDE CONCENTRATION AS A SCREENING TOOL FOR HYPOADRENOCORTICISM IN DOGS

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**Introduction:** The primary objectives of this study were to describe corrected chloride abnormalities in dogs with hypoadrenocorticism (HA) and to evaluate the utility of corrected chloride combined with plasma sodium-potassium ratio (Na:K) as a screening test for HA within a population of dogs with a clinical suspicion of HA. A secondary study objective was to develop a score that could objectively and accurately predict HA within the patient cohort.

**Methods:** Medical records were reviewed for dogs that had a clinical suspicion of HA that presented to the Texas A&M University Veterinary Teaching Hospital between June 1, 2001 and June 1, 2021. Dogs were included if they had electrolyte and cortisol measurements during the same hospital visit, and if they were hospitalized for IV fluid therapy. Demographic, historical, and clinicopathologic data were compared between the dogs with and without HA. Logistic regression models were used to investigate the utility of combining corrected chloride values with the Na:K to detect HA. A rubric score based on corrected chloride, Na:K, and lymphocyte counts was created.

**Results:** There was a marginal difference in corrected chloride ( $P = 0.09$ ) of 112.22 and 110.42 mmol/L in dogs with and without HA, respectively. The model with corrected chloride and Na:K had a 95% CI for the AUC of 0.75–1. The model with Na:K standalone had a 95% CI for the AUC of 0.72–1. After obtaining the rubric score, a mean score of 1.5 and 4.9 was seen between subjects without HA and with HA, respectively. A positive effect ( $P < 0.001$ ) of increase in 1 rubric point

showed an increase in odds for HA of almost 5. Similar to the first 2 models, the rubric score had the 95% CI for the AUC of 0.73–1.

**Conclusion:** On its own, corrected chloride does not distinguish between dogs with and without HA. A tiered grading system that combines a patient's corrected chloride, Na:K, and lymphocyte count may predict HA in dogs with clinical suspicion of HA. Additional studies are needed to validate this grading system in a separate validation population.

#### ZEROING IN ON THE VITAL VASCULAR NETWORK: EVALUATION OF THE MICROVASCULATURE AND ENDOTHELIAL GLYCOCALYX IN A CANINE HEMORRHAGIC SHOCK AND RESUSCITATION MODEL

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**Introduction:** The role of the EGC in normal and impaired perfusion needs investigation. Sublingual videomicroscopy by sidestream dark field imaging (Glycocheck) allows for analysis of microcirculatory variables and perfused boundary regions (PBR), a surrogate for EGC thickness. Our study's goal was to investigate microvascular and EGC in a canine hemorrhagic shock model.

**Methods:** Dogs were placed under general anesthesia with continuous monitoring of heart rate, end-tidal CO<sub>2</sub>, pulse oximetry, electrocardiography, and direct blood pressure. Manual blood removal via jugular catheter was performed until a mean arterial pressure (MBP) of 40 mm Hg or 60% of blood volume was removed. Equilibrium was maintained for 5 minutes before autotransfusion of shed blood. Microcirculatory variables red blood cell flow (Flow), total vessel density (TVD), capillary blood volume relative and absolute (CBV<sub>rel</sub> and CBV<sub>abs</sub>), and PBR were evaluated at 3 timepoints: baseline (T1), hemorrhagic shock (T2), and postresuscitation (T3). Normality was tested using the Kolmogorov–Smirnov test. Impact of hemorrhagic shock on Flow, TVD, CBV<sub>rel</sub>, CBV<sub>abs</sub>, and PBR between timepoints was tested with an analysis of variance for repeated measures with Bonferroni correction.

**Results:** Seven dogs were included. Median age was 5.0 years (3–5). Mean body weight was 8.8 ± 1.6 kg. Mean amount of blood withdrawn was 35 ± 12 ml/kg. Mean MBP was 72 ± 4, 45 ± 6, and 72 ± 7 at T1, T2, and T3, respectively. Flow values were 271.6 ± 38.0, 177.1 ± 17.0, and 305.9 ± 50.9 μm/s, at T1, T2, and T3, respectively (*P* = 0.039). TVD values were 230.4 ± 30.4, 441.9 ± 246.9, and 240.9 ± 30.7 mm/m<sup>2</sup> at T1, T2, and T3 respectively (*P* = 0.4). CBV<sub>rel</sub> values were 1.2 ± 0.06 × 10<sup>3</sup>, 1.3 ± 0.04 × 10<sup>3</sup>, and 1.3 ± 0.06 × 10<sup>3</sup> μm<sup>3</sup> at T1, T2, and T3, respectively (*P* = 0.16). CBV<sub>abs</sub> values were 15.7 ± 2.6 × 10<sup>3</sup>, 25.5 ± 11.7 × 10<sup>3</sup>, and 14.6 ± 2.9 × 10<sup>3</sup> μm<sup>3</sup> at T1, T2, and T3, respectively (*P* = 0.423). PBR values were 2.2 ± 0.1, 2.3 ± 0.09, and 2.3 ± 0.1 μm, at T1, T2, and T3 respectively (*P* = 0.89).

**Conclusion:** Our hemorrhagic shock model induced a reversible decrease in Flow. PBR was unchanged, although a type-II error cannot be excluded.

#### VETERINARY PERFORMANCE USING VIRTUAL REALITY

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**Introduction:** Virtual reality (VR) is an immersive, novel, interactive application that could be a model for simulation of veterinary training. The research study examined the interchangeability, acceptability, likeability, usability, and performance of VR as a training tool. The hypothesis assumes VR as a suitable technology to practice a veterinary task.

**Methods:** Second-year DVM students voluntarily participated in the study to learn a specific veterinary task (anesthesia machine). Students had the opportunity to practice at will using a real and VR anesthesia machine. Tasks learnt were components, function, pressure check of the circle, and nonbreathing systems. Equipment responses corresponded to mistakes made. Knowledge was assessed using a practical examination. Affective skills were assessed via a questionnaire. Data were analyzed using Wilcoxon matched pair signed-rank test and data correlation performed using linear regression analyses.

**Results:** Forty-nine students completed the study. Training modality selection by student was not different between groups investing 2.24 ± 1.32 hours to train with a real anesthesia machine and 1.97 ± 1.43 hours to train with VR (*P* = 0.19). No correlation between training modality or training time and exam performance was identified (*P* = 0.28 and 0.78 and *r*<sup>2</sup> = 0.05 and 0.003). Students found VR helpful for learning stating the training as 45% very helpful, 41% somewhat helpful, 12% neutral, 2% minimally helpful, and 0% not helpful. Further, 96% believed VR can enhance their educational experience. Comments reported were that they felt the VR platform provided practice with no harm to patient, indefinite repetitions, and flexibility. Cybersickness was a common complication observed with 39% reporting moderate to severe sickness.

**Conclusion:** The study demonstrates for the first time that VR platforms can complement veterinary medicine training. Students equally preferred training using VR to traditional methods. Students' performance was not associated with either training modality suggesting that VR could be a valuable tool to practice complex veterinary tasks. Cybersickness is a common problem observed that tends to improve with practice.

#### RETROSPECTIVE EVALUATION OF PAO<sub>2</sub>/FIO<sub>2</sub> AND SPO<sub>2</sub>/FIO<sub>2</sub> RATIOS IN DOGS TREATED WITH HIGH-FLOW NASAL CANNULA OXYGEN THERAPY

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**Introduction:** High-flow nasal cannula oxygen therapy (HFNT) is an advanced oxygen supplementation for patients that require support



beyond traditional oxygen supplementation. The correlation between  $\text{PaO}_2/\text{FiO}_2$  and  $\text{SpO}_2/\text{FiO}_2$  in dogs undergoing HFNT is currently unknown. The objective of this study is to determine whether the  $\text{SpO}_2/\text{FiO}_2$  ratio correlates with  $\text{PaO}_2/\text{FiO}_2$  in dogs treated with HFNT.

**Methods:** Medical records were retrospectively reviewed to identify dogs in hypoxemic respiratory failure treated with HFNT. Data relating to  $\text{SpO}_2$ ,  $\text{PaO}_2$ ,  $\text{FiO}_2$ , duration of HFNT, and outcome were recorded. Simultaneous  $\text{SpO}_2$  and  $\text{PaO}_2$  measurements were recorded with an exclusion criterion of  $\text{SpO}_2$  more than 98%.  $\text{SpO}_2$ ,  $\text{PaO}_2$ , and  $\text{FiO}_2$  were used to calculate the  $\text{PaO}_2/\text{FiO}_2$  and  $\text{SpO}_2/\text{FiO}_2$  ratio. Correlation coefficients and 95% confidence intervals (CIs) were calculated for all the data with Spearman correlation analysis and alternatively with Pearson's weighted correlation analysis to account for repeated measurements within dogs.

**Results:** Thirty data pairs with concurrent  $\text{SpO}_2$  and  $\text{PaO}_2$  measurements were identified from 19 dogs treated with HFNT. Median age for patients was 10 years (interquartile range [IQR] 1–11 years). The median time spent on HFNT was 13 hours (range: 4–107 h). Overall survival rate of dogs in this study was 47% ( $n = 9/19$ ). Median  $\text{PaO}_2/\text{FiO}_2$  ratio was 168 (IQR 108–297) and median  $\text{SpO}_2/\text{FiO}_2$  ratio was 186 (IQR 97–243).  $\text{SpO}_2/\text{FiO}_2$  ratios were positively correlated with  $\text{PaO}_2/\text{FiO}_2$  ratio ( $\rho = 0.86$  [95% CI, 0.73–0.93], weighted  $r = 0.89$  [95% CI, 0.74–0.96]).

**Conclusion:** In this population of dogs treated with HFNT,  $\text{PaO}_2/\text{FiO}_2$  and  $\text{SpO}_2/\text{FiO}_2$  had a strong positive correlation, suggesting that  $\text{SpO}_2/\text{FiO}_2$  ratio may be a useful, noninvasive surrogate for  $\text{PaO}_2/\text{FiO}_2$  ratio when assessing oxygenation. Further prospective studies are warranted to confirm and validate this correlation in larger number of dogs undergoing HFNT.

#### THE EFFECT OF SHORT-TERM PERIPHERALLY INSERTED CENTRAL CATHETER PLACEMENT ON COAGULATION PARAMETERS IN HEALTHY DOGS

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**Introduction:** Placement of peripherally inserted central catheters (PICCs) in people and pigs has been shown to increase the risk of thrombosis and induce a hypercoagulable state. In dogs, evaluation of hemostatic parameters with indwelling jugular catheters revealed no changes over 72 hours. PICCs are routinely used in veterinary practice for their ease of placement compared to central venous catheters. The effects of PICCs on viscoelastic parameters have not been evaluated in dogs. We aimed to determine the short-term effects of PICCs placement on coagulation parameters in healthy dogs using a point-of-care Viscoelastic Coagulation Monitor (VCM) Vet (Entegion corp.). We hypothesized that PICC placement would induce a hypercoagulable state.

**Methods:** Ten healthy teaching Beagle dogs were randomly divided into control and PICC groups. Control group had viscoelastic measure-

ment performed before sedation ( $t_0$ ) and 2 hours after sedation ( $t_2$ ) via direct venipuncture any peripheral vein. A PICC was placed in medial saphenous or femoral vein of under sedation and left for 4 hours. Viscoelastic measurements were performed prior to sedation ( $t_0$ ), 2 hours post placement ( $t_2$ ), and 2 hours after PICC removal ( $t_6$ ). Data within group were analyzed using the Friedman test. Comparison between control and PICC group was performed using the Mann-Whitney test.

**Results:** No significant differences were detected within each control. Within the PICC group, CFT at  $t_2$  (207 s, 200–303) was statistically but not clinically relevant when compared to  $t_6$  timepoint (178 s, 172–237;  $P = 0.0342$ ). Similarly, A10 at  $t_2$  (20, 15.7–21) was statistically but not clinically relevant compared to the  $t_6$  (22.4, 17.5–23;  $P = 0.0342$ ). No differences were detected between the groups at any timepoint for any of the VCM parameters.

**Conclusion:** Short-term insertion of peripherally inserted central catheter does not induce any detectable changes in viscoelastic monitoring in healthy dogs.

#### THE EFFECT OF HYPERBARIC OXYGEN THERAPY ON WOUND HEALING IN DOGS WITH SNAKE BITES

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**Introduction:** Local wound effects of *Crotalidae* or pit viper envenomation are characterized by swelling, pain, and tissue necrosis. Standard treatments include fluid therapy, analgesia, wound management, and sometimes, systemic antibiotics and antivenin. Hyperbaric oxygen therapy (HBOT) is used as an adjunctive treatment in many conditions to improve blood and tissue oxygenation, enhance antibacterial activity, and reduce inflammation, but there are no studies evaluating HBOT for the management of envenomation in dogs. The primary objective of this multicenter, prospective, randomized, controlled, blinded study was to assess the effect of HBOT on envenomation-induced wound swelling and severity, and pain in dogs. A secondary objective was to describe the safety and complications of HBOT.

**Methods:** Thirty-six client-owned dogs with naturally occurring snake bite were enrolled between 2017 and 2021; 1 dog was excluded. Dogs received 2 interventions with either HBOT ( $n = 19$ ) or control ( $n = 16$ ) within 24 hours of hospital admission. Local wound swelling, severity score, and pain score were assessed at admission, before and after each intervention, and at hospital discharge. Mixed-model ANOVAs compared groups and timepoints. Significance was set at  $P < 0.05$ .

**Results:** There was no significant difference after treatment for wound swelling ( $F(1,63.3) = 0.675$ ,  $P = 0.414$ ), severity score

( $F(1,76.1) = 0.000, P = 1.000$ ), or pain score ( $F(1,81) = 0.161, P = 0.689$ ) between HBOT and control groups. Regardless of the study intervention, pain decreased significantly over time ( $F(1,25.9) = 48.184, P < 0.001$ ). There were no significant complications associated with the study interventions.

**Conclusion:** In conclusion, HBOT is safe, but cannot be shown to significantly alter the short-term recovery from *Crotalidae* envenomation in dogs.

## INVESTIGATION OF PLEURAL PRESSURES AND LUNG ELASTANCE IN DOGS WITH PLEURAL EFFUSION UNDERGOING THORACOCENTESIS

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**Introduction:** Pleural manometry is a procedure used to monitor pleural pressure (PP) during thoracocentesis. Pressure-volume measurements can be used to calculate lung elastance and subsequently diagnose nonexpandable lung. In human medicine, preventing large drops in pressure during fluid aspiration may help reduce re-expansion pulmonary edema, cough, and pain. There are currently no studies reporting lung elastance in dogs with pleural effusion. The aim of this prospective observational study was to measure PP and calculate lung elastance in dogs with pleural effusion undergoing thoracocentesis.

**Methods:** Dogs of any age, breed, or bodyweight with pleural effusion were eligible, and could be enrolled more than once. Unstable patients, those with a pneumothorax or risk of hemorrhage were excluded. Thoracocentesis was performed either sternal or standing using any appropriately sized needle or catheter. Sedation was determined by clinician preference. Ultrasound-guided thoracocentesis was performed with a pressure transducer attached to the needle extension line and multiparameter monitor (Mindray Passport V). Pressure readings were taken at time zero and every 100 ml thereafter. Descriptive statistics were generated using Excel (Version 16.58). Lung elastance was calculated by dividing the mean PP by volume of fluid removed.

**Results:** A total of 45 thoracocentesis procedures were performed on 40 dogs during the study period. Five dogs were excluded due to incomplete data. Total volume of fluid removed ranged from 170 to 2200 ml. Pre-thoracocentesis PP ranged from 1 to 16 cm H<sub>2</sub>O, with no dogs having a negative starting pressure. Mean opening PP, after the initial 100 ml fluid was removed, was 4.8 cm H<sub>2</sub>O (range: 0–16 cm H<sub>2</sub>O). Mean closing PP was 0.7 cm H<sub>2</sub>O (range: –8 to +8 cm H<sub>2</sub>O), with 12 out of 40 dogs achieving a negative PP at final aspiration. Mean PP at 25%, 50%, and 75% fluid removal was 4.6, 3.5, and 2.5 cm H<sub>2</sub>O, respectively. Mean lung elastance was 44.8 cm H<sub>2</sub>O/L after the first 100 ml was removed, then 36.6, 13.7, 7.5, and 3.2 cm H<sub>2</sub>O/L at 25%, 50%, 75%, and 100% pleural fluid removal, respectively.

**Conclusion:** This study demonstrates a simple technique for measurement of PP and calculation of lung elastance in dogs. Pleural pressures decreased appropriately as fluid was aspirated; however, not all dogs achieved a negative closing PP. Lung elastance decreased similarly throughout thoracocentesis.

## SAFETY OF A MEDETOMIDINE-VATINOXAN COMBINATION DRUG (ZENALPHA) IN DOGS—A CLINICAL FIELD TRIAL

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**Introduction:** The objective of this study was to evaluate the safety and demonstrate the superiority of Zenalpha to dexmedetomidine at causing less bradycardia when used for sedation in dogs.

**Methods:** This was a multi-center, positively controlled, randomized, and blinded field study. Dogs at the age of  $\geq 4$  months that were in good general health (ASA I or II), not intended for breeding, and required sedation for noninvasive, nonpainful, or mildly painful procedures and examinations lasting no more than 45 minutes were included. A total of 223 client-owned dogs of various breeds and sex were allocated randomly to treatment groups to receive either an intramuscular injection of medetomidine 1 mg/m<sup>2</sup> and vatinoxan 20 mg/m<sup>2</sup> (ZEN) or dexmedetomidine 0.5 mg/m<sup>2</sup> (DEX) ( $n = 110$  and  $n = 113$ , respectively).

Heart rate (HR), respiratory rate (RR), and rectal temperature (TEMP) were recorded immediately prior to treatment and at intervals until 360 minutes posttreatment. HR was analyzed using a repeated measure mixed-effect model. Two-sample *t*-test was performed for RR and TEMP.  $P < 0.05$  was considered statistically significant.

**Results:** HR decreased after both treatments but remained significantly higher ( $P \leq 0.0002$ ) from 15 to 180 minutes posttreatment with ZEN when compared to DEX. HR remained within the normal range (60–140 beats per minute) and returned to pretreatment values by 180 minutes with ZEN. HR was lower than normal until 180 minutes posttreatment and remained below pretreatment levels until 360 minutes with DEX. RR decreased after both treatments and was significantly lower ( $P \leq 0.0014$ ) with ZEN from 5 to 30 minutes posttreatment when compared to DEX. However, from 60 to 360 minutes posttreatment RR was significantly higher ( $P \leq 0.046$ ) with ZEN than with DEX. TEMP decreased following both treatments. TEMP was significantly lower ( $P \leq 0.0006$ ) from 30 to 90 minutes and then significantly higher ( $P \leq 0.0083$ ) between 180 and 360 minutes posttreatment with ZEN when compared to DEX. No serious adverse events were detected with ZEN.

**Conclusion:** ZEN was superior to DEX at causing less severe cardiovascular suppression demonstrated by significantly higher HR, and overall, showed an improved physiological safety profile.

## Listing of Large Animal IVECCS Abstracts (in alphabetical order of presenter)

### ORAL PRESENTATIONS

#### COMPARISON OF TECHNIQUE: INTRATHECAL MEPIVACAINE AND INTRAVENOUS PENTOBARBITAL FOR HUMANE EQUINE EUTHANASIA

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**Introduction:** This study compared euthanasia using intrathecal mepivacaine or IV pentobarbital. Intrathecal lidocaine was approved as a method of euthanasia by the AVMA in 2020. This study aims to assess intrathecal mepivacaine for euthanasia in horses and compare it to a traditional euthanasia method using a single IV injection of pentobarbital. Quantitative and qualitative parameters were assessed. **Methods:** Horses were randomly assigned each treatment group. Following IV catheter placement, all horses were sedated with detomidine. The intrathecal mepivacaine group was anesthetized with ketamine and midazolam prior to intrathecal injection of mepivacaine via atlanto-occipital spinal tap. The remaining horses were induced and euthanized using IV pentobarbital and atlanto-occipital puncture with an intrathecal saline injection to provide blinding. Time from sedation to cessation of vital parameters (respirations, pulse, corneal reflex, and ECG) was recorded for each horse. All euthanasias were captured on video for review by a blinded anesthesiologist to assess quality of sedation, anesthesia induction, and lateral recumbency. **Results:** Time from detomidine administration to cessation of each vital parameter was significantly longer in the intrathecal mepivacaine group. While there was no statistically significant difference in qualitative scores between groups for sedation or induction, lateral recumbency was subjectively smoother in the intrathecal mepivacaine group (intrathecal mepivacaine mean score of 1.0708 and IV pentobarbital mean score of 1.3783,  $P = 0.0028$ ).

**Conclusion:** Intrathecal mepivacaine euthanasia was safe and effective, like results previously reported for intrathecal lidocaine. Advantages over pentobarbital include easier drug access, improved quality of recumbency, and a potentially lower risk of environmental contamination and scavenger animal poisoning.

#### INVESTIGATION OF PERITONEAL FLUID CELL-FREE DNA AS A BIOMARKER IN EQUINE COLIC PATIENTS

**Bayliss RL<sup>1</sup>, Martin EGM<sup>2</sup>, Sarkan KE<sup>2</sup>, Cooper BL<sup>1</sup>, Epstein KL<sup>2</sup>, Sheats KM<sup>1</sup>**

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**Introduction:** Cell-free (cf) DNA is a biomarker for gastrointestinal disease in people. Measurement of cfDNA in peritoneal fluid (PF) may yield additional information over plasma samples in patients with gastrointestinal lesions. Previous studies in other species have quantified cfDNA directly in PF using a portable fluorometer, suggesting potential for cfDNA as a point-of-care diagnostic. Our objectives were to assess direct measurement of cfDNA in equine PF using a portable fluorometer and to compare PF cfDNA concentrations between healthy horses and colic patients and between groups of colic patients.

**Methods:** The Qubit fluorometer was used to measure cfDNA concentrations in paired direct and extracted PF samples from 37 horses. The Qubit fluorometer was also used to directly measure cfDNA concentrations in PF from 109 colic patients and 25 healthy controls from 2 university veterinary hospitals. Colic cases were grouped based on lesion category, SIRS score, and short-term outcome; median PF cfDNA concentrations were compared between colic patients and controls and between colic groups using Mann-Whitney tests.

**Results:** Direct and extracted PF cfDNA concentrations were positively correlated (Spearman's  $\rho$ : 0.8699,  $P < 0.0001$ ). Median PF cfDNA concentration was higher in colic patients compared to healthy controls ( $P < 0.0001$ ). Median PF cfDNA concentrations were higher in horses with strangulating lesions versus nonstrangulating lesions ( $P < 0.0001$ ) and in nonsurvivors versus survivors ( $P = 0.0035$ ).

**Conclusion:** cfDNA can be measured directly and accurately in equine PF using a portable fluorometer and warrants further investigation as a potential diagnostic and prognostic biomarker in colic patients.

#### EVALUATION OF POINT-OF-CARE CAPILLARY BLOOD GLUCOSE CONCENTRATIONS IN HOSPITALIZED NEONATAL FOALS

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**Introduction:** Point-of-care glucometers (POC) are commonly used to monitor blood glucose in foals. The objective of this study was to compare glucose measurements obtained by POC from capillary and venous blood samples with a standard laboratory (colorimetric, glucose oxidase) assay (LABGLU), in a population of hospitalized neonatal foals.

**Methods:** Simultaneous capillary (muzzle, POCMUZ) and venous (jugular, POCJUG) samples were obtained from hospitalized foals  $\leq 30$  days of age to determine POC glucose concentrations. Venous samples obtained concurrently were analyzed with LABGLU. Each foal was

sampled at the time of enrollment or admission to the hospital, and at a subsequent point during hospitalization.

**Results:** Fifty-four foals were enrolled. Bland-Altman analysis showed a mean bias (95% limits of agreement) of  $-28.0$  ( $-88.6$  to  $32.6$ ) mg/dl for comparison of POCJUG versus LABGLU,  $-8.2$  ( $-94.3$  to  $78.0$ ) mg/dl for POCMUZ versus LABGLU, and  $18.8$  ( $-44.4$  to  $82.0$ ) mg/dl for POCMUZ versus POCJUG. A total of 63.5% of the POCJUG and 45.2% of the POCMUZ samples exceeded the reference value by  $\pm 15$  mg/dl (for LABGLU samples  $<75$  mg/dl) or  $\pm 15\%$  (for LABGLU samples  $\geq 75$  mg/dl). Concordance correlation coefficient (95% confidence interval) indicated a fair agreement between POCJUG and LABGLU (0.75, 0.66–0.82), and POCMUZ and LABGLU (0.71, 0.58–0.80).

**Conclusion:** The chosen POC glucometer lacked agreement in the sampled population compared to reference values. Limits of agreement were wide for both POCJUG and POCMUZ, with POCMUZ performing only slightly better. The inaccuracies in POC results could impact clinical decisions in the management of glycemic control in hospitalized neonatal foals.

#### SYNCHRONOUS DIAPHRAGMATIC FLUTTER IN HORSES: 27 CASES

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**Introduction:** Involuntary diaphragmatic contractions known as synchronous diaphragmatic flutter (SDF) or “thumps” is a rarely documented condition in horses presented for emergency care. It has been linked to endurance athletes suffering from exhaustion and electrolyte derangements, and hypocalcemia is often present. There are minimal studies describing the disease processes and survival associated with SDF. The objective of this study was to describe common clinical presentations, concurrent conditions, biochemical findings, and treatments in horses presented with SDF among multiple treatment centers.

**Methods:** Medical records from 4 referral hospitals were reviewed for cases containing the words “Synchronous diaphragmatic flutter” or “thumps” between 2004 and 2022. Cases where a horse was treated at an endurance event were excluded. Variables recorded and evaluated included signalment, clinical signs, clinical pathologic data, treatments, and survival to discharge.

**Results:** Survival rate for horses with SDF was 85% (23/27). SDF was most frequently observed secondary to gastrointestinal diseases, including colic (5/27), esophageal obstruction (4/27), and colitis (3/27). Hypocalcemia (median Ca  $++ = 1.14$  mmol/L; range = 0.65–1.56) was present in 17 out of 18 recorded cases and hypochloremia was present

in 6 out of 17 recorded cases (Cl<sup>-</sup> median 98 mmol/L; range 75–106). IV fluid therapy with supplementation of calcium gluconate was a frequently administered treatment.

**Conclusion:** SDF in horses is frequently associated with gastrointestinal disease with hypocalcemia and hypochloremia being common laboratory findings. Treatment with IV fluids containing calcium supplementation is common.

#### TRANSCUTANEOUS IDENTIFICATION OF IMPLANTED MICROCHIPS AS A METHOD OF TRACKING EQUINE LARGE COLON POSITION

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**Introduction:** Colic due to large colon displacement is one of the top causes of morbidity and mortality in horses, yet there is no model to study the pathophysiology of this condition. The primary goal of this proof-of-concept study was to determine if the subserosal implantation of bioinert microchips in the large intestine of a horse would be detectable by an RFID (radiofrequency identification) receiver when immediately adjacent to the body wall, thus effectively identifying specific locations of colon/cecum within the abdomen. The ultimate goal is to develop a model that can be used in future studies to monitor colonic movement under various stimuli.

**Methods:** A horse without prior gastrointestinal disease underwent ventral midline celiotomy to implant 12 bioinert microchips into the subserosa at predetermined locations within the large colon and cecum. An RFID receiver was used to monitor the location of the colon via transcutaneous scanning 1–5 times daily for a 1-month period. Following humane euthanasia, postmortem examination of the horse was performed to assess microchip implantation sites for migration along with histologic assessment.

**Results:** Ten out of the 12 implanted microchips were successfully identified transcutaneously in focal abdominal locations at occurrences as high as 90%. The most frequently identified segments of the colon were the sternal flexure, ventral band of the right ventral colon, and the lateral band of the cecum.

**Conclusion:** Microchips implanted into subserosa of the equine large colon can be used as a means of identifying the approximate location of equine large colon via transcutaneous identification by an RFID scanner.

#### EVALUATION OF CLINICAL, CLINICOPATHOLOGICAL FINDINGS AND OUTCOME IN EQUIDS FOLLOWING SURGICAL TREATMENT OF FECALITH INTESTINAL OBSTRUCTIONS

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**Introduction:** Fecaliths cause simple obstruction of the ascending or descending colon in equids. Miniature horses, ponies, foals, and older horses with poor dentition are predisposed, but a large study has not been performed. The objective of this study is to evaluate short-term survival and prognostic factors following surgical treatment of fecalith intestinal obstruction in equids.

**Methods:** Medical records of equids undergoing surgery for fecalith obstruction between 2000 and 2020 were reviewed. Diagnosis was confirmed by exploratory celiotomy. Signalment, clinical signs, and clinicopathological data, as well as history, surgical findings and complications, and short-term survival, were evaluated.

**Results:** Sixty-four females, 52 geldings, and 31 intact males were included. Three equids presented twice. Miniature horses and ponies represented 47% ( $n = 71$ ) of the presenting cases and full-sized breeds in 53% ( $n = 79$ ). On hundred and thirty-eight equids (92%) survived to discharge, 6% ( $n = 9$ ) were euthanized intraoperatively, and 2% ( $n = 3$ ) were euthanized during hospitalization. Nonsurvivors showed more severe colic signs on admission ( $P = 0.04$ ). Higher heart rate on admission ( $P = 0.04$ ) and hyperlipemia ( $P = 0.007$ ) were associated with nonsurvival. Equids with postoperative colic and complications were less likely to survive ( $P = 0.008$  and  $P = 0.002$ , respectively).

**Conclusion:** Miniature horses and ponies are overrepresented compared to the colic population; however, full-sized breeds are also at risk. Surgical treatment has an excellent short-term prognosis. Severe colic signs, tachycardia, hyperlipemia, postoperative colic, and surgical complications negatively affect short-term survival.

## THERMOGRAPHIC EVALUATION OF THE VENTRAL ABDOMEN AND JUGULAR VEIN IN HEALTHY HORSES

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**Introduction:** Surgical site infection and jugular vein thrombophlebitis are major postoperative complications in hospitalized horses. Current diagnostic methods do not allow for early detection of such complications. Thermography may be used as a diagnostic tool for early detection of inflammatory processes based on abnormal body surface temperature. Normal thermographic data must be established for the ventral abdomen and jugular vein prior to clinical evaluation of celiotomy incisions and jugular vein catheterization sites, respectively. This study was conducted in order to evaluate the effects of clipping, and sedation on thermal imaging, since horses are sedated and clipped prior to ventral midline celiotomy and jugular vein catheterization. It was hypothesized that the thermographic pattern would be unaffected by clipping or sedation.

**Methods:** Images of the ventral abdomen and jugular vein were obtained before and after sedation with an alpha-2 agonist, as well as before and after clipping with a #40 clipper blade. Images were obtained in triplicate, with standardized camera settings and distance

from the region of interest. Images were analyzed with standardized parameters using the camera manufacturer's software.

**Results:** Statistical analysis revealed significant differences between the unclipped, unsedated, clipped, and sedated timepoints for 1 ventral abdomen parameter ( $P = 0.0105$ ). All other comparisons were not significant.

**Conclusion:** Clipping and sedation were found to have a minimal effect on thermographic imaging.

## COMPARISON OF BLOOD L-LACTATE BETWEEN JUGULAR AND CEPHALIC VEINS IN HEALTHY AND SYSTEMICALLY ILL HORSES USING A POINT-OF-CARE DEVICE

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**Introduction:** L-Lactate (LAC) is a product of anaerobic metabolism that is commonly measured using commercially available point-of-care (POC) meters for the assessment of systemically ill horses. Hyperlactatemia in clinical cases is commonly due to inadequate tissue perfusion resulting in decreased oxygen delivery/utilization to tissues as in SIRS/sepsis or shock.

**Methods:** Blood samples were collected from the jugular vein (JV) and cephalic vein (CV) and placed in EDTA tubes for healthy and sick horses prior to any medical therapy. LAC values were obtained from blood tubes following sampling using a POC meter and again following a 20-minute hold at room temperature. Comparisons between groups were made with a paired t-test or Wilcoxon signed-rank test for normally and nonnormally distributed data, respectively ( $P < 0.05$ ).

**Results:** LAC was higher in CV than JV in both healthy and sick horses ( $P < 0.001$ ). All values were within the reference range (RR) for healthy horses. In sick horses, JV LAC was within RR while CV LAC was increased. There was no effect of a 20-minute room temperature hold ( $P > 0.1$ ).

**Conclusion:** The CV is an acceptable alternative venipuncture site for POC LAC measurement if the JV is not safely accessible or requires preservation for subsequent catheterization, with the caveat that sick horses may have a CV LAC outside RR with the corresponding JV LAC within RR, which must be taken into consideration during clinical assessment and serial monitoring.

## PHENYLBUTAZONE, FLUNIXIN, AND MELOXICAM CLINICAL EFFICACY FOR LAMENESS AND LAMINITIS IN HORSES

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**Introduction:** This study aims to compare the effects of phenylbutazone (PBZ), flunixin (FLU), and meloxicam (MEL) in equine

lameness and laminitis. If PBZ was clearly superior to FLU and MEL, then it could support its inclusion in the “essential list” for horses.

**Methods:** During the crossover blinded study, 10 horses and ponies presenting with laminitis (4) or lameness (6) received orally, randomly, and alternatively (2 days washout) PBZ, FLU, and MEL (4, 1.1, and 0.6 mg/kg) once a day for 2 days. Lameness and laminitis scores (LS) were established from videos recorded morning and evening for 3 days (AAEP scale 0–5). Total scores, means, and changes were compared among treatments (Friedmann rank-sum test, BiostaTGV).

**Results:** From same initial LS (32; mean 3.56), day 1 and day 3 LS improvements are FLU (–3; 3.22), MEL (–4; 3.22), and PBZ (–9; 2.56)  $P < 0.008$  and FLU (–1; –0.17), MEL (–2; –0.22), and PBZ (–12; –1.33)  $P < 0.01$ . Day 2 dose allows the best clinical changes (–6, –5, and –12, respectively) and a residual effect (evening day 3) with PBZ only (–8 and –0.89) ( $P = 0.27$ ). Results suggest faster onset of action, longer action, and more persistent clinical benefits for PBZ in horse’s lameness and laminitis pain management.

**Conclusion:** PBZ appeared clinically superior to FLU and MEL in this study, which supports its potential inclusion in the essential list for horses and should inform clinical decision-making to use better pain treatment without having horses to be signed out of the food chain.

#### FOLLOW-UP SERUM AMYLOID A CONCENTRATIONS IN NEONATAL FOALS AFTER 18–60 HOURS OF HOSPITALIZATION ARE ASSOCIATED WITH DISEASE TYPE AND OUTCOME

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**Introduction:** Sepsis is a leading cause of death in neonatal foals. Serum amyloid A (SAA) is an acute phase protein that is associated with infection and inflammation. This study aimed to determine the diagnostic and prognostic value of SAA in ill neonatal foals at different timepoints after hospitalization.

**Methods:** Repeated SAA samples were collected from 142 hospitalized foals (<14 days). Foals were classified as “healthy,” “ill-nonseptic,” or “septic” and outcome was recorded. Kruskal–Wallis with post hoc pairwise comparison and Mann–Whitney *U*-tests were used for statistical analysis. Data are presented as median (interquartile range).

**Results:** At hospital admission (0–12 h), SAA was significantly lower in healthy foals ( $n = 14$ , 18 [0–58] mg/L) compared to both ill-nonseptic ( $n = 90$ , 125 [31–655] mg/L,  $P = 0.001$ ) and septic foals ( $n = 26$ , 671 [22–1025] mg/L,  $P \leq 0.001$ ). No significant differences in SAA were observed between ill-nonseptic and septic foals ( $P = 0.103$ ). Follow-up SAA at 18–60 hours after hospitalization ( $n = 84$ ) was significantly lower in ill-nonseptic (267 [67–867] mg/L) compared to septic foals (1263 [561–1980] mg/L) ( $P < 0.001$ ). At hos-

pital admission, no differences in SAA concentration were observed between survivors and nonsurvivors. In contrast, follow-up SAA after 18–60 hours of hospitalization was significantly higher in nonsurvivors (706 [421–1248] mg/L) than survivors (290 [68–1050] mg/L) ( $P = 0.038$ ).

**Conclusion:** SAA at hospital admission can aid in differentiation between healthy and ill foals, but not between septic and ill-nonseptic foals. Follow-up SAA, after 18–60 hours of hospitalization, was higher in septic compared to nonseptic foals. Also, follow-up SAA is associated with outcome. This likely reflects the severity of disease combined with the response to initial treatment.

#### HOLDING TIME IMPACTS VCM-VET RESULTS USING EQUINE BLOOD

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**Introduction:** Viscoelastic coagulation testing of equine blood has become more common with great potential to improve case management. However, limitations exist with traditional methods. The VCM-Vet, a point-of-care (POC) device, provides practical repeatable results in equine blood and has established normal ranges. We hypothesized that sample holding time will alter VCM-Vet coagulation parameters in horses with normal traditional plasma-based coagulation profiles.

**Methods:** Blood was collected by jugular venipuncture for determination of PT, aPTT, fibrinogen concentration, and platelet count. Additional blood was collected by direct jugular venipuncture (18-ga needle, 3-ml syringe, opposite jugular vein) and held at 37°C for 2, 4, 6, or 8 minutes. Syringes were inverted 2×, blood expressed into testing cartridges until filled, and cartridges placed within the VCM-Vet device. VCM-Vet assessed included clot time (CT), clot formation time (CFT), alpha angle, amplitude 10/20 minutes (A10/A20), maximal clot firmness (MCF), and lysis index 30/45 minutes (LI30/LI45), differences examined using R, ANOVA Type Statistic (ATS), Bonferroni adjustment,  $P \leq 0.05$ .

**Results:** Commonly used plasma-based coagulation tests were within normal limits. Holding time decreased CT. Clinical pathology (mean  $\pm$  SD): PT, 12.2  $\pm$  4 seconds; aPTT, 41.6  $\pm$  4.0 seconds; platelets, 177  $\pm$  45  $\times 10^3/\mu\text{L}$ ; and fibrinogen, 129  $\pm$  29 mg/dl. VCM-Vet: CT decreased over total holding period ( $P = 0.003$ ). Differences were present between holding times except for between 2 and 4 minutes ( $P > 0.05$ ); 2 and 6 minutes ( $P = 0.023$ ); and 2 and 8 minutes ( $P < 0.001$ ). For remaining times and parameters,  $P > 0.05$ .

**Conclusion:** Holding time impacts VCM-Vet testing results of normal equine blood and samples are best analyzed within 4 minutes of collection for best results.

## POSTER PRESENTATIONS

**CHARACTERIZING THE BIOGEOGRAPHICAL TOPOGRAPHY OF THE EQUINE RESPIRATORY MICROBIOME**

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**Introduction:** Equine respiratory disease is associated with transportation, aspiration of oral contents, and primary infectious disease, with significant economic and welfare implications for all aspects of equine industry. Advancements in sequencing technologies have allowed for characterization of microbial communities previously undetectable by culture-based methods. A dynamic microbial population has been described within healthy lungs of other species but has yet to be investigated in horses. Regional variation in temperature, nutrient availability, pH, and oxygen tension creates different niches for microbial flora within the respiratory tract. Development of infectious respiratory disease is complex and multifactorial, with proliferation of normal commensal microbes contributing to initiation and progression of clinical disease.

**Methods:** Samples were collected by nasopharyngeal lavage, transtracheal aspirate, and bronchoalveolar lavage of 6 distinct regions within the lung of 4 healthy adult horses. Full-length 16S ribosomal DNA sequencing was performed. Microbial profiling analysis was performed using commercially available software.

**Results:** Over 1800 taxa were identified, which were reduced to 160 after filtering and agglomeration. Predominant phyla across sample types were Actinobacteriota, Proteobacteria, and Firmicutes. However, prevalence and abundance of taxa were highly variable across samples. There was significant difference in alpha diversity indices between combined nasopharyngeal and transtracheal aspirates compared to bronchoalveolar lavage. Beta diversity was significantly associated with horse, but not sample location.

**Conclusion:** Taxa were more similar between regions within the same horse, than between the same region of different horses. Findings suggest that respiratory microbiota are unique to individuals and do not support presence of a core respiratory microbiome across individuals.

**EVALUATION OF THE HEMOCUE HEMOGLOBIN DEVICE AS POC METHOD IN HORSES**

**Scicluna CBL, Dubois C, Guindeuil G**

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**Introduction:** Hemoglobin (Hb) is an important parameter of equine general health status, also used as diagnostic tool to detect anemia. HemoCue Hb 201+ System is a POC device validated as standard Hb measurement in humans that could be useful in routine equine practice.

**Methods:** To evaluate reliability, repeatability, and clinical interest of the HemoCue Hb device (HC Hb) as a POC for equine medicine, samples from 28 examined healthy and sick horses were analyzed with Vet ABC (once) and HC Hb (3 times). Student *t*-test was used to compare means. Variances and their coefficients were calculated to check reliability and repeatability. Accuracy was determined using both Bland–Altman and Pearson correlation tests ( $P < 0.05$  significant).

**Results:** Means were statistically comparable ( $P = 1.56$ ) for the 109 tests:  $14.59 \pm 9 \text{ g}^{-1}$  (Vet ABC);  $14.70 \pm 2.22 \text{ g}^{-1}$  (HC Hb). Variances were 4.263 and 4.741, with VC 14.43% and 15.10%, respectively, for Vet ABC and HC Hb. Accuracy was good (mean bias  $0.107 \text{ g}^{-1}$ ) and limit of agreements (CI) was between  $-0.626$  and  $0.841 \text{ g}^{-1}$ . Good and highly significant correlation coefficient was calculated (0.986;  $P < 0.0001$ ). HC Hb was easy to use everywhere in any conditions with dry chips and on battery. Tests were inexpensive.

**Conclusion:** HC Hb evaluation demonstrated a clinically acceptable accuracy of Hb measurement compared to Vet ABC in equine practice. HemoCue Hb 201+ System can be useful as a POC standard technique in equine practice to detect early anemia and optimize therapeutic decisions on site.

**EVECC Congress Abstracts presented June 2–4, 2022 Ghent, Belgium**

**Listing of Small Animal EVECCS Abstracts (in alphabetical order of presenter)**

**ORAL PRESENTATIONS**
**MULTICENTRIC AORTIC THROMBOEMBOLISM RETROSPECTIVE STUDY IN 158 CATS: THE MATERS STUDY**

**Cambournac M<sup>1</sup>, Damoiseaux C<sup>1</sup>, Guillaumin J<sup>2</sup>, Goy-thollot I<sup>3</sup>, Pouzot-nevoret C<sup>3</sup>**

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**Introduction:** Feline aortic thromboembolism (FATE) is the sudden migration of thrombus into the aorta. While tissue plasminogen activator (TPA) improves outcomes in many thromboembolic diseases in people, outcome improvement has not been demonstrated in FATE, possibly due to sample size. Our study leverages a large retrospective caseload to compare outcomes in FATE treated with or without thrombolysis.

**Methods:** Multicenter, retrospective study from 2 French multispecialty hospitals (Fregis Veterinary Hospital and Lyon-VetAgroSup) between 2005 and 2020. Inclusion criteria were a diagnosis of FATE with  $\geq 2$  limbs affected, based on 5 criteria: pale, cold, pulselessness, painful and paralysis, and/or ultrasonographic visualization of thrombi. Exclusion criteria were missing data or enrollment in another FATE trial. TPA-treated cats were compared to no-TPA cats. Primary study

outcomes were arterial recanalization and functional recovery. Secondary outcomes were survival to discharge and complication rates. After excluding cats euthanized at admission, statistical analyses of recanalization, functional recovery, survival proportions, posttreatment creatinine, and potassium were performed. Continuous variables and categorical variables were analyzed using *t*-test combined with Levene test for variance and Fisher's exact test, respectively.

**Results:** A total of 158 cats were included (52 TPA-treated cats and 106 no-TPA cats), with a mean age of  $7.7 \pm 4.2$  years. There was no significant difference in demographic and clinical data at admission between groups. Euthanasia proportion at admission was 24%, higher for Lyon-VetAgroSup compared to Fregis (53% vs. 15%,  $P = 0.001$ ). A total of 121 cats were left for further analysis: 56 TPA-treated and 65 in the no-TPA group. Median time-from-event-to-TPA was  $3.8 \pm 1.5$  hours. TPA protocol was 1 mg/kg IV over 1 hour. Arterial recanalization proportion was higher in TPA-treated than in no-TPA cats (54.5% vs. 20.9%,  $P < 0.001$ ). Functional recovery was higher in TPA-treated than in no-TPA cats (26.1% vs. 13.8%,  $P = 0.007$ ). Survival proportion was not different in TPA-treated and no-TPA (35.5% vs. 34.7%,  $P > 0.05$ ). Post-treatment creatinine and potassium were similar for TPA-treated and no-TPA (130 vs. 118 mmol/L,  $P = 0.5$  and 6.9 vs. 5.4 mmol/L,  $P = 0.49$ , respectively).

**Conclusions:** Our study is the first to show an improvement in arterial recanalization and functional recovery with TPA in FATE without increasing mortality.

## EVALUATION OF NEW-ONSET ORGAN DYSFUNCTION IN DOGS WITH SYSTEMIC INFLAMMATION

**Ciuffoli E, Troia R, Giunti M**

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**Introduction:** According to the novel Sepsis-3 definition in people, sepsis is the life-threatening organ dysfunction (OD) caused by a dysregulated host response to infection. OD is associated with a negative outcome in critically ill dogs. The aim of this study was to investigate the value of new-onset OD for the prediction of sepsis and outcome in dogs with systemic inflammation.

**Methods:** Critically-ill dogs with systemic inflammation (based on serum C-reactive protein  $>1.6$  mg/dl) were retrospectively included. Sepsis was confirmed by cytology, microbiology, or molecular techniques. The following newly diagnosed ODs on admission to ICU were registered: acute kidney injury (AKI, IRIS guidelines), hyperbilirubinemia (total bilirubin  $>0.4$  mg/dl), coagulation abnormalities (prothrombin time [PT]  $>9$  s or activated partial thromboplastin time [aPTT]  $>16$  s or platelet count  $<150,000/\text{mm}^3$ ), hyperlactatemia, hypoxemia, presence of stupor/coma, fluid-refractory hypotension, and unexplained acidemia. Multiorgan dysfunction syndrome (MODS), as previously reported, and outcome at hospital discharge were also recorded. Nonparametric statistics were performed, and significance was set at  $P < 0.05$ .

**Results:** A total of 275 dogs were enrolled: 147 out of 275 (53%) had noninfectious systemic inflammation; 128 out of 275 (47%) had sepsis. Only the presence of fluid-refractory hypotension was significantly associated with a diagnosis of sepsis (OR: 10.51; CI, 3.08–35.94;  $P < 0.0001$ ). According to univariate logistic regression, MODS (OR: 2.58; CI, 1.53–4.34;  $P = 0.0003$ ), AKI (OR: 4.15; CI, 2.44–7.04;  $P < 0.0001$ ), stupor/coma (OR: 5.65; CI, 1.95–16.38;  $P = 0.0006$ ), hyperbilirubinemia (OR: 2.01; CI, 1.14–3.53;  $P = 0.0158$ ), increased plasma lactate (OR: 1.22; CI, 1.09–1.38;  $P = 0.0006$ ), fluid-refractory hypotension (OR: 5.12; CI, 2.13–12.29;  $P = 0.0001$ ), prolonged PT (OR: 1.26; CI, 1.07–1.49;  $P = 0.0014$ ), and decreased base excess (BE) (OR: 0.89; CI, 0.84–0.93;  $P < 0.0001$ ) were associated with nonsurvival. AKI (OR: 3.97; CI, 1.71–9.24;  $P = 0.0014$ ), stupor/coma (OR: 8.43; CI, 1.33–53.25;  $P = 0.0234$ ), PT (OR: 1.20; CI, 1.00–1.44;  $P = 0.0437$ ), and BE (OR: 0.93; CI, 0.87–0.99;  $P = 0.0472$ ) were the only variables retained in the multivariate model.

**Conclusions:** In our population of critically ill dogs, only fluid-refractory hypotension was associated with a diagnosis of sepsis. However, ODs were independently associated with outcome, with AKI, stupor/coma, prolonged PT, and decreased BE being associated with higher risk of nonsurvival. Finally, screening of OD in critically ill dogs with systemic inflammation is warranted.

## MEDICAL MANAGEMENT OF DOGS AND CATS WITH METALLIC SHARP-POINTED GASTROINTESTINAL FOREIGN BODIES: 15 CASES

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**Introduction:** To describe the conservative management of ingested straight metallic sharp-pointed foreign bodies (FBs) in dogs and cats.

**Methods:** Retrospective descriptive study in a veterinary teaching hospital. The electronic records of dogs and cats with gastrointestinal straight metallic sharp-pointed FBs presenting between 2003 and 2021 were reviewed. Species, presenting complaint, FB location, treatment, complications, intestinal transit time, length of hospitalization, and outcome were recorded. Cases were excluded if an FB was identified in a nongastrointestinal location, was removed by endoscopy or surgery, or if resolution was unknown.

**Results:** During the study period, 56 cases of straight metallic sharp-pointed FB were noted, but 41 were excluded (23 nongastrointestinal, 5 removed surgically, 4 removed endoscopically, and 9 with unknown outcome), leaving 15 cases (11 dogs and 4 cats) managed conservatively. Median age was 10 months (3–72 months) for dogs and 17.5 months (16–34 months) for cats. Foreign body ingestion was witnessed in 14 cases (93.3%), while in 1 case the FB was incidentally noted during magnetic resonance imaging for investigation of chronic spinal pain. Clinical signs likely related to the FB were reported in 2 (13.3%) cases. Foreign bodies were needles in 10 (66.7%) cases, sewing pins in 3 (20%) cases, and a drawing pin and a nail in 1 (6.7%) case each.



Location on admission was the stomach in 13 (86.7%) cases, and proximal duodenum and colon in 1 (6.7%) case each. Prior to conservative management, removal of the FB had been attempted via endoscopy or surgery in 3 cases each. Conservative management was successful in 13 out of 15 (86.7%) cases with no complications reported. In 2 (13.3%) cases, the FB was surgically removed as it was still in the stomach after 24 hours hospitalization. The mean time to defecation of the FB was  $48 \pm 24$  hours. Survival to hospital discharge was 100%.

**Conclusions:** Conservative management may be considered as a safe and effective alternative for the treatment of metallic sharp-pointed gastrointestinal FBs, although careful monitoring is required. Human guidelines suggest interventions should be considered if the FB fails to progress within 3 days from ingestion or if the patient develops new clinical signs.

#### XENOTRANSFUSION OF CANINE BLOOD TO CATS: INDICATIONS, EFFECTIVENESS, LIMITATION, AND ADVERSE EFFECTS IN COMPARISON TO ALLOTRANSFUSION—A RETROSPECTIVE STUDY

**Elkin M, Amichay Menashe N, Segev G, Kelmer E, Aroch I, Klainbart S**

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**Introduction:** Xenotransfusion is the transfusion of blood from one species to another. Despite set guidelines for transfusing blood products to cats, and the availability of allogenic feline blood (AFB), there are various circumstances when canine blood is transfused to cats. The objective of this study was to compare a group of anemic cats that received canine xenotransfusion with a group of anemic cats treated with matched AFB. The study aims to describe the clinical situations in which transfusions were used, assess acute and late transfusion-related adverse effects (TRAE), and evaluate survival and long-term outcome.

**Methods:** The medical records of cats treated with xenotransfusion or AFB (years 2013–2021) were retrospectively reviewed.

**Results:** The study included 105 cats that received xenotransfusions and 206 cats that received AFB. The most common reason for anemia in the study and control groups was hemorrhage 61/99 (62%) and hemolysis 74/200 (37%), respectively ( $P < 0.001$ ). A total of 80% (63/79) of cats that suffered anemia due to decreased production received allotransfusions, while only 20% (16/79) received xenotransfusions ( $P < 0.001$ ). In the study group, 55% of cats survived to discharge versus 73% of the control group ( $P = 0.007$ ). Thirty-day survival rate was 90% and 87.5% in the study and control groups, respectively ( $P = 0.850$ ). The most common reason for xenotransfusion was financial constraint (49%). Mean PCV following transfusion was significantly higher in the study group compared to the control (22% vs. 18%,  $P < 0.001$ ) and still significantly higher 48–96 hours posttransfusion (23% vs. 18%; respectively,  $P < 0.001$ ). Cats in the study group

experienced significantly more TRAE (37.1%), compared to the control group (19.4%) ( $P = 0.0010$ ) and significantly more delayed hemolytic transfusion reactions (85% vs. 42.5% of TRAE, respectively,  $P < 0.001$ ), while the control group suffered significantly more acute transfusion reactions (60% of TRAE), compared to the study group (20% of TRAE), ( $P < 0.001$ ). There were no differences in survival to discharge between cats that experienced TRAE and those that did not. Nonsurvivors had higher creatinine concentration pre- and posttransfusion ( $P = 0.008$  and  $P = 0.037$ , respectively).

**Conclusions:** Xenotransfusions might be a life-saving procedure in emergency situations when AFB is not available. The long-term survival of cats treated with xenotransfusion and survive to discharge is excellent.

#### A RETROSPECTIVE STUDY ON THE INCIDENCE OF PARAPNEUMONIC EFFUSION IN 130 DOGS WITH A CLINICAL DIAGNOSIS OF PNEUMONIA

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**Introduction:** Parapneumonic effusion is defined as free fluid in the pleural space in association with a simultaneous diagnosis of bacterial pneumonia. The incidence of parapneumonic effusion in human patients is reported to be 40%–60%. Parapneumonic effusion has been described in dogs with pneumonia, but its incidence has not been reported. The aim of this study was to assess the incidence of parapneumonic effusion in dogs with a clinical diagnosis of pneumonia in a veterinary university clinic. The second objective was to assess the frequency of thoracocentesis and thoracic drain placement in these patients. A final objective was to evaluate the outcome of dogs with and without parapneumonic effusion.

**Methods:** Medical records were searched for dogs with a clinical diagnosis of bacterial pneumonia from 2017 to 2021. Clinical diagnosis was suspected on a combination of thoracic radiographs compatible with bacterial bronchopneumonia and increased serum C-reactive protein (CRP) concentrations. Moreover, a positive bronchoalveolar lavage culture or positive clinical evolution and decreased CRP concentrations in response to antibiotic therapy were required to confirm the clinical diagnosis of bacterial pneumonia. Patients diagnosed with inflammatory nonseptic pneumonia, parasitic pneumonia, or neoplastic disease were excluded.

**Results:** One hundred and thirty dogs were included. The incidence of parapneumonic effusion was 33.8% (44/130). In only 4 dogs (3%), a thoracocentesis was performed. Two of these dogs displayed regional effusion and thoracocentesis was performed to characterize the effusion. In the 2 other dogs, thoracic drains were placed after thoracocentesis due to unilateral or bilateral severe effusion. Regarding outcome, overall mortality rate was 22.3% (29/130). In dogs with parapneumonic effusion, mortality was 18.1% (8/44). One dog undergoing thoracocentesis was euthanized for financial reasons, while the 3 others survived.

**Conclusions:** In this single-center retrospective observational study, the incidence of parapneumonic effusion in dogs with a clinical diagnosis of pneumonia was 33.8%. Although parapneumonic effusion appeared to be rather common, it rarely required thoracocentesis or thoracic drain placement. Moreover, outcomes of dogs with or without parapneumonic effusion appeared to be similar.

#### SELF-REPORTED CLINICAL PRACTICE OF SMALL ANIMAL CARDIOPULMONARY RESUSCITATION AND COMPLIANCE WITH RECOVER GUIDELINES AMONG VETERINARIANS IN WESTERN EUROPE

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**Introduction:** The objective of this study was to assess whether small animal veterinarians across Western Europe are compliant with the 2012 cardiopulmonary resuscitation (CPR) guidelines by the Reassessment Campaign on Veterinary Resuscitation (RECOVER).

**Methods:** A previously published online questionnaire from Switzerland was translated into 7 languages, corresponding to national languages in Austria, France, Germany, Ireland, Italy, Liechtenstein, the Netherlands, Portugal, Spain, and the United Kingdom. The survey was distributed via respective national veterinary organizations and social media outlets. A subset of questions was analyzed to evaluate respondent demographics, RECOVER guideline awareness, and allocate composite compliance scores for CPR preparedness (PREP), basic life support (BLS), and advanced life support (ALS). Percentages of group total (95% confidence interval) were calculated. Percentage of compliant respondents was compared among regions using Chi-square test and compliance in respondents aware versus unaware of guideline existence was compared using Fisher's exact test. Significance was defined as  $P < 0.05$ .

**Results:** Nine-hundred and thirty respondents were included in analysis. RECOVER guideline awareness was significantly different across regions with the highest reported awareness in Italy, in 76% (63%–86%) of respondents, and lowest in France, in only 16% (11%–23%) of respondents ( $P < 0.004$ ). PREP, BLS, and ALS compliance were significantly different across regions ( $P < 0.004$ ). Lowest PREP compliance was reported in Portugal (1% [0%–5%]) and highest in Germany/Austria (35% [23%–49%]). Compliance with BLS recommendations was highest in Germany/Austria (33% [21%–47%]) and lowest in

France (4% [2%–9%]) and Portugal (4% [2%–9%]). ALS compliance was highest in Germany/Austria (22% [13%–36%]) and lowest in France (0% [0%–3%]) and Portugal (0% [0%–3%]). Compliance across all 3 categories was highest in Germany/Austria (14% [7%–27%]), followed by U.K./Ireland respondents (5% [3%–8%]). Switzerland, Spain, France, Portugal, Italy, and the Netherlands were ascribed total guideline compliance in 1% of respondents or less. Respondents aware of guideline existence had higher compliance than those unaware when combining all regions ( $P < 0.004$ ).

**Conclusions:** Awareness and compliance with RECOVER guidelines varied significantly among countries surveyed; however, overall compliance scores in all countries were considered low. Further research may highlight factors surrounding poor guideline awareness and compliance so targeted efforts can be made to improve veterinary CPR in Europe.

#### EFFECTS OF HYPOVOLEMIA AND VOLUME OVERLOAD ON ULTRASONOGRAPHICALLY DERIVED CAUDAL VENA CAVA PARAMETERS IN HEALTHY LIGHTLY SEDATED CATS

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**Introduction:** This study investigated the effect of hypovolemia and volume overload on ultrasonographically derived caudal vena cava (CVC) parameters in healthy, lightly sedated cats.

**Methods:** Randomized, blinded, prospective, cross-over study involving 14 healthy cats assigned to a hypovolemia or volume overload group with a 7-day washout period. The hypovolemia group received furosemide: 2 mg/kg IV every 30–60 minutes up to 14 mg/kg or 10% weight loss was achieved. Lactated Ringer's solution or hydroxyethyl starch (130/0.4) at 10 ml/kg IV was then administered over 10 minutes. The volume overload group received 30 ml/kg of IV lactated Ringer's solution over 10 minutes. Both groups had subxiphoid sonographic CVC parameters measured at 3 timepoints—T0 (baseline), T1 (hypovolemia or pre-volume overload, respectively), and T2 (post-fluid challenge or volume overload, respectively) by a blinded operator. CVC measurements were obtained at the narrowest inspiratory and widest expiratory diameter (CVC<sub>insp</sub> and CVC<sub>exp</sub>, respectively) where the CVC crosses the diaphragm, and the collapsibility index (CVC-CI) was calculated from recorded cine-loops by a blinded rater. A Shapiro–Wilk test was used to assess normalcy and a 1-way ANOVA was used to compare groups at different timepoints. A  $P$ -value  $\leq 0.05$  was considered significant.

**Results:** All data passed normalcy. There was a significant difference between CVC<sub>insp</sub> and CVC<sub>exp</sub> at each timepoint ( $P < 0.0001$ ). CVC<sub>exp</sub> values were statistically different between baseline and volume overload ( $3.02 \pm 1.00$  and  $4.17 \pm 0.62$  mm, respectively,  $P < 0.001$ ). There were no statistically significant differences between CVC<sub>insp</sub>, CVC<sub>exp</sub>, and CVC-CI values between any timepoints that were measured on the same day.

**Conclusions:** These preliminary results suggest that compared to CVC-CI and CVC<sub>insp</sub>, CVC<sub>exp</sub> measurements may be more sensitive at predicting volume status in cats, particularly volume overload. However, the sample size is small and further research is needed to assess the utility of all CVC parameters to estimate volume status in cats.

#### THE DIAGNOSTIC UTILITY OF HYPOPHOSPHATEMIA FOR DIFFERENTIATION OF GENERALIZED TONIC-CLONIC SEIZURES FROM SYNCOPE IN DOGS: A CASE-CONTROL STUDY

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**Introduction:** In human patients, transient hypophosphatemia is commonly detected after generalized tonic-clonic seizures (GTCS), and serum phosphorus concentration (sPi) is a useful marker to differentiate GTCS from other causes of transient loss of consciousness (TLOC), namely, syncope, especially when the episode was unwitnessed. The aim of this retrospective study was to examine the occurrence of hypophosphatemia in dogs presented to an emergency service due to seizures compared to those presented due to syncope, and assess the usefulness of hypophosphatemia as a diagnostic marker for canine GTCS

**Methods:** Computerized medical records were searched (January 2018–August 2021) for the terms “seizure,” “epilepsy,” “status epilepticus,” and “syncope.” Dogs were included if the episode occurred  $\leq 3$  from presentation, and if sPi and serum creatinine (sCr) were measured. Dogs were excluded if aged  $< 1$  year or if sCr exceeded 2 mg/dl.

**Results:** The study included 87 and 26 dogs diagnosed with seizures and syncope, respectively. There were no group differences in serum concentrations of creatinine, sodium, chloride, potassium, or glucose. Hypophosphatemia (sPi  $< 3$  mg/dl, RI: 3–6.2 mg/dl) occurred in 28 dogs (32%) in the seizure group, of which 9 (10%) had sPi  $< 2$  mg/dl. In the syncope group, no dog had sPi levels below 3 mg/dl. Median sPi was significantly ( $P = 0.00003$ ) lower in the seizure group (3.1 mg/dl; range: 0.93–6.77) compared to the syncope group (4.2 mg/dl; range: 3–8.4). Furthermore, in dogs that presented while seizing (24/87; 28%) median sPi was significantly lower ( $P = 0.05$ ) compared to those that were not (2.8 mg/dl, range: 0.93–5.39 vs. 3.2, range: 1.03–6.77). ROC analysis of sPi as a marker for GTCS yielded an area under the curve of 0.757 (95% confidence interval, 0.667–0.847), with an optimum cutoff point of 3.0 mg/dl, corresponding to specificity and sensitivity levels of 100% and 44%, respectively.

**Conclusions:** Based on these results, sPi following TLOC might serve as a diagnostic tool to differentiate GTCS from syncope in dogs. Hypophosphatemia, especially with sPi concentration  $< 3$  mg/dl, in samples collected  $\leq 3$  hours post-TLOC may be useful in clinical practice to rule in a GTCS episode.

#### PREVALENCE, CLINICAL MANIFESTATIONS, LABORATORY FINDINGS, AND OUTCOME OF INTERMEDIATE SYNDROME IN ANTICHOLINESTERASE INTOXICATION OF DOGS—A RETROSPECTIVE STUDY

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**Introduction:** Organophosphates and carbamates are important intoxication sources in dogs, inducing several neurological syndromes. Intermediate syndrome (IMS) occurs 7–96 hours following acute cholinergic crisis (ACC). IMS, well recognized in people, but described previously in only 2 dogs, manifests clinically by proximal limb, respiratory, and neck flexor muscle weakness and prolonged cholinesterase inhibition. Decreased serum butyrylcholine esterase (sBuChE) activity occurs in people with IMS, and is among the hallmarks of this syndrome, along with the typical clinical manifestations and history of anticholinesterase exposure. This study describes the prevalence, clinical findings, and outcome of IMS in a relatively large cohort of dogs.

**Methods:** The medical records of dogs diagnosed with ACC, IMS, or both (years 2017–2021) were retrospectively reviewed. Six additional dogs diagnosed with IMS before the study period were also included.

**Results:** The study included 32 dogs diagnosed with anticholinesterase intoxication, of which 23 (72%) displayed only ACC signs, while 9 (28%) presented IMS. The hospitalization period was longer, and positive-pressure mechanical ventilation (PPMV) requirement was higher in the IMS group versus the ACC group. Overall, the study included 15 dogs with IMS. Dogs with IMS demonstrated proximal limb, neck flexor, and respiratory muscle weakness. The latter was associated with respiratory failure, requiring PPMV in 4 dogs (27%). Three out of 15 dogs did not demonstrate ACC prior to IMS. sBuChE activity at presentation was below reference interval (RI) in 13 out of 14 dogs with IMS. Interestingly, sBuChE activity was later within RI (WRI) in 7 out of 15 dogs with IMS, although clinical signs of IMS still persisted, which is a novel finding. The survival rate of anticholinesterase intoxication-associated IMS was 100%.

**Conclusions:** sBuChE activity cannot be a marker recovery of IMS in dogs, as in 47% of cases herein it was WRI, although its clinical signs were still ongoing. IMS should be suspected in dogs demonstrating respiratory, neck, and proximal limb muscle weakness or paralysis, especially after occurrence of ACC-related signs, but even in their absence, or when sBuChE activity is WRI.

#### EVALUATION OF B-LINES WITH 2 POINT-OF-CARE LUNG ULTRASOUND PROTOCOLS IN CATS WITH RADIOGRAPHICALLY NORMAL LUNGS\*

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\*Winner of the best original study

**Objective:** To compare 2 point-of-care lung ultrasound (LUS) protocols for quantification of B-lines in cats without evidence of respiratory disease based on history, physical examination, and thoracic radiography.

**Methods:** A prospective observational study was conducted at a single veterinary teaching hospital. Fifty-seven cats without respiratory disease based on history, physical examination, and thoracic radiographs were enrolled. All cats had 2 point-of-care LUS protocols performed bilaterally: a regional protocol (VetBLUE), and a more comprehensive vertical sweeping protocol (VS). The total number of B-lines per cat, number of sites with B-lines, and maximal number of B-lines at each site were recorded and compared.

**Results:** Ten cats (18%) had at least 1 B-line identified with VetBLUE, versus 29 (51%) with VS. Comparing protocols, VS had a statistically higher total number of B-lines per cat, higher number of sites with B-lines, and higher maximal number of B-lines per site. B-lines that were too-numerous-to-count were identified at a single location in 1 cat with VetBLUE and 2 cats with VS. A maximum of 3 B-lines were identified at all other positive sites regardless of the protocol used. On average, it took 1.7 times longer to complete VS bilaterally compared to VetBLUE (mean  $142 \pm 4.2$  vs.  $82 \pm 2.3$  s, respectively,  $P = 0.001$ ).

**Conclusions:** This study demonstrates it is not uncommon to identify a single or even multiple B-lines in 1 or several sites on LUS in cats deemed to be clinically free of respiratory pathology: essential knowledge when using LUS as a screening test and to monitor intrathoracic lesions. In cats asymptomatic for respiratory disease, VS generally identifies more B-lines than VetBLUE, likely because it assesses a larger lung surface area. The sonographic identification of B-lines should be interpreted considering the LUS protocol used, history, and other diagnostics to determine their clinical significance.

#### PREVALENCE OF AZOTEMIA AND ITS ASSOCIATION WITH SEVERITY AND OUTCOME IN VETERINARY TRAUMA PATIENTS: A SINGLE-CENTER STUDY

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**Introduction:** Acute kidney injury (AKI) is a common sequela to human trauma occurring in up to 25% of trauma patients with 10% of these requiring renal replacement therapy. Trauma is occasionally cited as a cause of AKI in cats, with 1 study reporting up to 10% cases of AKI were due to trauma. However, the prevalence of azotemia and AKI in veterinary trauma is unknown. The primary aim of this retrospective study was to describe the prevalence of azotemia in canine and feline trauma patients. The secondary aim was to determine AKI prevalence

and whether there was any association between azotemia and AKI with trauma severity and outcome.

**Methods:** A search of the institutional VetCOT trauma registry was performed at a university teaching hospital (April 2017–February 2021). Patients were included if they had a blood creatinine value within 6 hours of presentation. Azotemia was defined as creatinine  $>140$  mmol/L and subgrouped into post-renal causes, intrinsic, and fluid-responsive AKI according to the International Renal Interest Society. Trauma type, animal trauma triage score (ATT score), and survival to discharge were compared between azotemic (AG) and nonazotemic groups (NAG) using Fisher's exact or Mann–Whitney *U*-tests.  $P < 0.05$  was considered statistically significant.

**Results:** Thirty-nine of 397 (9.8%) patients were azotemic at presentation (9/223, 4% dogs; 30/174, 17.2% cats). Eleven out of 39 (28.2%) patients had a post-renal cause of their azotemia, 27 out of 39 (71.0%) had AKI, and 1 out of 39 (2.56%) had a mixed cause of azotemia. Of those patients with AKI where follow-up blood work was available, 9 out of 17 (52.9%) were classified as having fluid-responsive AKI. Median ATT score on presentation was higher in AG than NAG (AG 3 [range: 0–12], NAG 2 [range: 0–10]) ( $P = 0.005$ ). Twenty-nine of 39 (74.3%) AG patients survived to discharge and 312 out of 352 (88.6%) NAG patients survived to discharge. When post-renal causes of azotemia were excluded, azotemic patients were less likely to survive than nonazotemic patients ( $P = 0.03$ ).

**Conclusions:** Azotemia is common in the canine and feline trauma population and appears associated with trauma severity. The presence of AKI in canine and feline trauma patients is associated with nonsurvival.

#### PREVALENCE OF ACUTE KIDNEY INJURY IN CRITICALLY ILL DOGS UNDERGOING PROLONGED POSITIVE-PRESSURE VENTILATION IN AN INTENSIVE CARE UNIT

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**Introduction:** Acute kidney injury (AKI) is a cause of morbidity and mortality among veterinary and human critical patients. Mechanical ventilation (MV) is associated with an increased risk of AKI among human ICU populations; however, the prevalence of MV-associated AKI and its effect on outcome has not been described in a veterinary ICU population. The objective of this study was to assess the prevalence of AKI in dogs undergoing MV in ICU and identify factors associated with its occurrence and survival to discharge.

**Methods:** Retrospective cohort study in client-owned dogs in a veterinary teaching hospital. Medical records for dogs ventilated for  $>24$  hours within the ICU were evaluated for signalment, primary diagnosis, reason for initiating MV, ventilator settings, clinicopathological findings on admission, IRIS AKI grade based on serial blood creatinine and urinary output monitoring, multiorgan dysfunction syndrome (MODS) score, management during MV, and outcome. AKI was defined

according to the IRIS guidelines recommendations for AKI grading. Logistic regression was used to identify independent predictors for development of AKI and survival. In the univariable analysis, variables with a value of  $P \leq 0.10$  were examined by multivariable analysis with significance defined as  $P < 0.05$ .

**Results:** Between December 2016 and September 2021, 142 dogs underwent MV in the ICU, of which 49 required MV >24 hours. Of these, 59% (29/49) demonstrated evidence of AKI with 62% (18/29), 10% (3/29), 24% (7/29), and 4% (1/29) developing grades I, II, III, and IV, respectively. No risk factors were identified for MV-associated AKI. Forty-two percent (21/49) of patients survived to discharge with multivariable logistic regression identifying an increase in age (OR: 0.66; 95% CI, 0.49–0.91,  $P = 0.01$ ) and MODS score (OR: 0.22; 95% CI, 0.06–0.88,  $P = 0.03$ ) inversely correlated with survival.

**Conclusions:** AKI frequently occurs in ICU patients requiring prolonged MV; however, in this population AKI was not a predictor of patient outcome.

#### RETROSPECTIVE EVALUATION OF THE AGREEMENT BETWEEN THORACIC POINT-OF-CARE ULTRASOUND AND THORACIC RADIOGRAPHS IN CATS WITH RECENT TRAUMA: 111 CATS

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**Introduction:** The objectives were to (1) evaluate the agreement between thoracic point-of-care ultrasound (TPOCUS) and thoracic radiographs in cats with recent trauma and (2) correlate TPOCUS findings to ATT scores in a large population of traumatized cats.

**Methods:** Records of cats presenting to the intensive care unit of VetAgro Sup, Lyon between February 2014 and April 2021 were retrospectively reviewed. Cats with suspected or witnessed trauma that had TPOCUS and thoracic radiographs performed within 24 hours of admission were included. Thoracic radiographs and TPOCUS findings were assessed as “positive” or “negative.” Cats positive on TPOCUS and radiographs were assigned 1–5 different suspected diagnoses: pulmonary contusions/hemorrhages, pneumothorax, pleural effusion, pericardial effusion, and diaphragmatic hernia. To express level of agreement between the 2 imaging modalities, the kappa coefficient and 95% CI were calculated with GraphPad. Interpretation of kappa values was based on Cohen values.

**Results:** One hundred and eleven cats were included (54 confirmed or suspected motor vehicular trauma, 53 high rise syndrome, and 4 canine bite wounds). Suspected TPOCUS diagnoses included 60 out of 111 pulmonary contusions, 19 out of 111 pneumothoraxes, 3 out of 111 pleural effusions, and 3 out of 111 diaphragmatic hernias. Thoracic radiography suspected diagnoses included 62 out of 111 pulmonary contusions, 29 out of 111 pneumothoraxes, 16 out of 111 pleural effusions, and 7 out of 111 diaphragmatic hernias. There was a

moderate level of agreement for general overall comparison between TPOCUS and thoracic radiography (Kappa = 0.480; 95% CI, 0.312–0.649), moderate agreement for pulmonary contusions/hemorrhages (Kappa = 0.454; 95% CI, 0.288–0.621), moderate agreement for pneumothorax (Kappa = 0.527; 95% CI, 0.340–0.714), fair agreement for pleural effusion (Kappa = 0.283; 95% CI, 0.028–0.538), and moderate agreement for diaphragmatic hernia (Kappa = 0.584; 95% CI, 0.220–0.948). Cats with positive TPOCUS had significantly higher median ATT score (4 vs. 3;  $P = 0.0428$ ) and respiratory score (1 vs. 0,  $P = 0.0028$ ) compared to negative TPOCUS cats.

**Conclusions:** This large retrospective study in traumatized cats confirmed previous results: agreement between TPOCUS and thoracic radiography is moderate for contusions/hemorrhages, pneumothoraxes, and diaphragmatic hernias and fair for pleural effusion. Comparison with a reference standard (computed tomography) is needed to determine true specificity and sensitivity of TPOCUS to diagnose these lesions in cats.

#### EFFECT OF BLINDFOLDING LEAD RESUSCITATORS ON CLOSED-LOOP COMMUNICATION IN VETERINARY CARDIOPULMONARY RESUSCITATION TRAINING\*

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\*Winner of the best intern/resident original study

**Introduction:** Closed-loop communication (CLC) is an important skill for cardiopulmonary resuscitation (CPR) leadership, aiding in reducing miscommunication and recommended by RECOVER guidelines. In the authors' experience, CLC is difficult to teach. Human medical studies report CLCs increased when the lead resuscitator was blindfolded during training. To the authors' knowledge, there are no studies examining CLC in veterinary CPR training. The aim of this study is to evaluate the effect of blindfolding during veterinary CPR training on frequency of CLC.

**Methods:** Single-center, prospective, randomized pilot study. Forty volunteers were recruited from a veterinary referral hospital clinical staff (veterinary surgeons, qualified and student nurses, nursing assistants, physiotherapists) and randomly allocated into 10 teams. Exclusion criteria were as follows: CPR practical training within previous 6 months; permanent members of Emergency and Critical Care team. Each team was randomized as control (CG,  $N = 4$ ) or blindfolded (BG,  $N = 6$ ) and underwent 4 consecutive standardized CPR scenarios (S1–S4). The leader role was randomly assigned to a veterinary surgeon in each team and remained consistent throughout scenarios. S1, S2, and S4 were run identically for both groups: S1 was for acclimatization, while S2 and S4 were pre- and postintervention, respectively. During S3, the intervention, BG team leaders were blindfolded. Volunteers were unaware of study aims and methodology. All scenarios were filmed, but only S2 and S4 reviewed for data analysis, performed by an author blinded to group allocation. Primary outcome was number of complete CLCs. Data are presented as median (min–max range).

Mann–Whitney *U*-test was used to compare outcome measures between groups.

**Results:** Preintervention complete CLCs were 5 (3–6) (CG) and 5.5 (2–10) (BG). Postintervention was 6.5 (2–9) (CG) and 9.5 (8–12) (BG). No significant difference was identified between groups preintervention (*S2*,  $P = 0.76$ ), but a significant difference in the number of complete CLCs was seen after intervention (*S4*,  $P = 0.03$ ).

**Conclusions:** Blindfolding lead resuscitators in veterinary CPR training does increase short-term CLCs. Future training may benefit from including this approach to increase CLCs and potentially improve patient safety. Further studies would be required to investigate whether this finding is replicated and also retained in the long term.

## POSTER PRESENTATIONS

### DYSMAGNESEMIA IN DOGS WITH SYSTEMIC INFLAMMATORY RESPONSE SYNDROME

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**Introduction:** Dysmagnesemia has been recently reported to be associated with in-hospital mortality in critically ill human patients. The objectives of this study were to describe the prevalence of dysmagnesemia in a population of canine critically ill patients and assess its association with clinical complications and in-hospital mortality.

**Methods:** A prospective observational study was performed with dogs admitted to the intensive care unit of a university teaching hospital between November 2020 and December 2021. Dogs fulfilling 2 or more criteria for systemic inflammatory response syndrome (SIRS) that had their ionized magnesium measured on admission were included. APPLE full score was calculated retrospectively for patients on admission. Dysmagnesemia was defined as an ionized magnesium level under 0.43 mmol/L or over 0.7 mmol/L as previously described in veterinary literature. Clinical complications associated to dysmagnesemia such as arrhythmias, gastrointestinal ileus, neuromuscular signs, and mortality among others were recorded during hospitalization. Associations between dysmagnesemia and the APPLE score, clinical complications, and mortality were assessed using chi-square tests of independence and unpaired 2-sample Wilcoxon test, with a statistical significance set at a  $P$ -value  $< 0.05$ .

**Results:** In this study, 67 dogs fulfilled criteria for inclusion. The APPLE full score could be calculated in 55 animals and the median was 35 (IQR = 17.5). Dysmagnesemia on admission was detected in 24% of patients (16/67). Hypermagnesemia presented more frequently (13/16) than hypomagnesemia (3/16 dogs). Overall, mortality rate was 31% (21/67). No significant correlations were found between dysmagnesemia and mortality ( $P = 0.54$ ) nor between dysmagnesemia at admission and the probability of developing clinical complica-

tions ( $P = 0.34$ ). APPLE full score did not show significant statistical correlation with mortality ( $P = 0.38$ ) or dysmagnesemia ( $P = 0.17$ ).

**Conclusions:** Dysmagnesemia occurred in approximately one fourth of dogs with SIRS, being hypermagnesemia more common than hypomagnesemia. This study did not find an association between dysmagnesemia and outcome, APPLE score, or significant clinical complications. The small number of animals with dysmagnesemia included, particularly with hypomagnesemia, could have limited the study results. Further studies including more animals are warranted.

### ARTERIAL BLOOD GAS MONITORING IN DOGS DURING HEMODIALYSIS

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**Introduction:** In human dialyzed patients, several functional pulmonary abnormalities have been described. The aim of this study is to evaluate arterial blood gas parameters (Ph, PaO<sub>2</sub>, PCO<sub>2</sub>, SO<sub>2</sub> P/F ratio, P[A–a]O<sub>2</sub> gradient, and HCO<sub>3</sub><sup>–</sup>) in azotemic dogs during hemodialysis (HD).

**Materials and Methods:** Arterial blood samples were obtained from the dorsal pedal artery at room air (FiO<sub>2</sub> 21%) at hospital admission (T0) and serially from an arterial catheter placed on the dorsal pedal artery at T1 (3 min after starting HD), T2 (2 h into treatment), T3 (end of HD), and T4 (2 h after the end of HD). Dogs were then divided according to outcome: survivors (S) and nonsurvivors (NS). Normal distribution was assessed using D'Agostino–Pearson test. One-way ANOVA was used to compare Ph, PaCO<sub>2</sub>, PaO<sub>2</sub>, P[A–a]O<sub>2</sub> gradient, PaO<sub>2</sub>/FiO<sub>2</sub>, and HCO<sub>3</sub><sup>–</sup> at different times, and Mann–Whitney test was used to compare (S) and (NS).

**Results:** Twenty-two azotemic dogs referred for HD were enrolled. Fifteen of 22 (46.8%) did not survive and 7 of 22 (32%) survived. A statistically significant difference ( $P < 0.0001$ ) in pH was found among T0 ( $7.28 \pm 0.085$ ) versus T2 ( $7.36 \pm 0.06$ ) versus T3 ( $7.38 \pm 0.06$ ) versus T4 ( $7.37 \pm 0.06$ ) and for pH at T1 ( $7.26 \pm 0.067$ ) versus T2, T3, and T4. A statistically significant difference in PaCO<sub>2</sub> was found between T0 ( $28.9 \pm 4.43$  mm Hg) and T2 ( $33.83 \pm 3.18$  mm Hg), T3 ( $35.5 \pm 2.67$  mm Hg) and T4 ( $36.5 \pm 2.8$  mm Hg), and between T1 ( $32 \pm 3.18$  mm Hg) and T4 ( $36.54 \pm 2.8$  mm Hg). A statistically significant difference in HCO<sub>3</sub><sup>–</sup> was found between T0 ( $13.8 \pm 4.7$  mEq/L) and T2 ( $18 \pm 3.1$  mEq/L), T3 ( $20 \pm 3.62$  mEq/L) and T4 ( $19.21 \pm 3.84$  mEq/L), and between T1 ( $14.4 \pm 4.2$  mEq/L) and T2, T3, and T4. No significant differences in PaO<sub>2</sub>, P[A–a]O<sub>2</sub>, and %SaO<sub>2</sub> were found at any timepoint. No significant differences were found between survivors and nonsurvivors.

**Conclusions:** To the authors' knowledge, this is the first study evaluating oxygen tension indices during hemodialysis in dogs. A statistically significant increase in pH, PaCO<sub>2</sub>, and HCO<sub>3</sub><sup>–</sup> as a beneficial effect of hemodialysis in restoring acid–base balance was found. Ventilation to perfusion (V/Q) inequalities are the main cause of arterial hypoxemia

during HD. No significant changes in oxygen tension-based indices were found. Further evaluations are recommended.

### IMPACT OF A CELL SAVER MACHINE ON BLOOD TRANSFUSIONS TO DOGS UNDERGOING SURGERY AT A REFERRAL VETERINARY HOSPITAL

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**Objective:** To determine the impact of a cell saver machine (CSM) on the number of blood transfusions administered to surgical patients in a veterinary referral hospital.

**Methods:** Retrospective review of medical records of dogs that received a blood transfusion at surgery or in the postoperative period, divided into whether the transfusion was autologous or homologous and divided into prior to and after acquiring a CSM. The surgeries performed were classified by type and whether or not they were considered to have a risk of hemorrhage. Data are presented as mean (min–max range).

**Results:** Blood transfusions were administered to 123 dogs in a population of 3654 dogs undergoing surgical procedures between November 2015 and February 2021. A mean of 52 (22–87) surgeries per month were performed in the first study period and a mean of 66 (45–97) surgeries per month were performed after the acquisition of the CSM. Of these, a mean of 15 (3–26) and 18 (10–30) surgeries per month were considered to be at risk of hemorrhage during the first and second periods, respectively. Since the acquisition of a CSM (Cell Saver Elite, Haemonetics, Boston, MA) in September 2019, 37 autologous blood transfusions (ABT) were administered, representing a mean of 2 (1–4) ABT per month. A total of 86 homologous blood transfusions (HBT) were performed during the study length, with a mean of 1.4 HBT per month during the first study period and a mean of 1.3 HBT per month during the second study period. Before the acquisition of the CSM, 0.026 HBT were performed per each surgery and 0.09 HBT per each surgery classified as hemorrhagic. After the acquisition of the CSM, 0.015 HBT and 0.024 ABT were performed per each surgery and 0.058 HBT and 0.093 ABT were performed per each surgery classified as hemorrhagic. Blood transfusion reactions were not observed in the ABT group, compared to 6 of 86 (7%) recorded in the HBT group.

**Conclusions:** The introduction of a CSM was suggested to allow accommodating the increase of overall blood transfusions by ABT instead of using extra units of blood from a commercial animal blood bank.

### PREVALENCE OF TRANSMISSIBLE CANINE BLOOD PATHOGENS IN A BLOOD DONOR POPULATION TESTED ON EVERY DONATION

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**Introduction:** This study aimed to evaluate the prevalence of core blood infectious agents in healthy, client-owned dogs from a blood donor population in Portugal and Spain, and to address the importance of a screening protocol on every donation. Currently, guidelines indicate the need to test donors annually.

**Methods:** Client-owned healthy dogs, dewormed, and following strict donor acceptance criteria were tested before each donation at a veterinary blood bank. Blood samples from new potential donors, and from regular donors, were tested by real-time PCR (LightCycler 480II, Roche) for *Leishmania* spp., *Ehrlichia* spp., *Brucella* spp., *Babesia* spp., and *Anaplasma* spp. Serological tests were also performed for *Leishmania* spp., *Ehrlichia* spp., and *Dirofilaria immitis* (ELISA, Gemini Stratec, Novatec). All donors were tested for every agent. Some donors donated more than once. Animals tested positive for RT-PCR and/or serology were excluded from the donor program.

**Results:** Overall, samples from a total of 5970 donations performed in 4170 dogs were tested between May 2021 and January 2022. For RT-PCR, 1.51% (90 screenings) tested positive for at least 1 of the agents: 0.12% ( $n = 7$ ) for *Leishmania* spp., 0.40% ( $n = 24$ ) for *Ehrlichia* spp., 0.18% ( $n = 11$ ) for *Babesia* spp., and 0.80% ( $n = 48$ ) for *Anaplasma* spp. No positive dogs were identified for *Brucella* spp. Serologies revealed positive in 5.13% (306) screenings. A total of 3.18% ( $n = 190$ ) detected antibodies to *Leishmania* spp.; 1.46% ( $n = 87$ ) to *Ehrlichia* spp., and 0.49% ( $n = 29$ ) revealed antigens to *Dirofilaria immitis*. Some of these positive results were from dogs with negative results in donations performed 3–8 months before: *Leishmania* spp. ( $n = 59$ ), *Ehrlichia* spp. ( $n = 21$ ), *Babesia* spp. ( $n = 7$ ), *Anaplasma* spp. ( $n = 24$ ), or for *Dirofilaria immitis* ( $n = 9$ ).

**Conclusions:** The results obtained in this study evidenced a low prevalence of infectious agents in canine blood donors. Considering that only nonsymptomatic dogs were involved, this study highlights the importance of performing a strict blood screening protocol in donor programs. The evidence of positive results in donors with negative results in the previous donations emphasizes the importance of testing the blood donors on every donation instead annually.

### CANINE BLOOD DONATION ADVERSE REACTIONS: CLASSIFICATION AND DESCRIPTION OF REACTIONS IN A DONOR POPULATION

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**Introduction:** This study aims to analyze the safety of canine blood donation by describing the frequency and causes of any adverse reactions.

**Methods:** In this prospective study, any blood donor adverse reactions detected by the clinical staff during and immediately after donation were recorded. Postdonation, a minimum of 30 minutes of monitoring was recorded and a complete physical exam was performed before the donor left the room. The owners of the dogs were also surveyed by a veterinary practitioner or veterinary nurse 3 days after donation, using a predefined questionnaire to assess for any clinical or behavioral changes. Data were collected between December 2020 and December 2021 from blood donors enrolled in an animal blood bank program. The information regarding 4439 blood donations from 2776 canine donors was recorded.

**Results:** From the 4439 donations, 37 (0.83%) adverse postdonation reactions were reported with no other reactions identified in the remaining 4402 donations (99.17%). Of the total donations in the study period, 0.63% ( $n = 28$ ) of canine donors presented a hematoma in the puncture area, 0.11% ( $n = 5$ ) presented mild bleeding at the puncture site during the monitoring period, and 0.045% ( $n = 2$ ) presented a skin rash after clipping for donation and 0.045% ( $n = 2$ ) presented weakness and pallor during the 30 minutes monitoring period, with mild tachypnea and tachycardia consistent with hypotension. In both cases showing signs of hypotension, all parameters stabilized and clinical signs resolved within 10–15 minutes upon administration of a 10-ml/kg bolus over 10 minutes of IV NaCl. No other delayed reactions were reported by the owners other than the evolution of the acute reactions already registered by the donations team.

**Conclusions:** The low incidence of postdonation reactions in this study is encouraging, suggesting that a high level of safety can be achieved in a structured canine donor program, therefore increasing the confidence of dog owners in the donation process.

#### EVALUATION OF TREATMENT PROTOCOLS FOR PRIMARY IMMUNE-MEDIATED THROMBOCYTOPENIA IN 54 DOGS (2010–2022)

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**Introduction:** The objectives of this study were to describe different treatment protocols, survival to discharge, and relapse in dogs diagnosed with primary immune-mediated thrombocytopenia (IMTP).

**Methods:** A retrospective observational study was conducted. A search of computerized records of a university teaching hospital was performed for dogs diagnosed with IMTP between January 2010 and January 2022. The inclusion criteria were a complete medical record and severe thrombocytopenia ( $<50,000$  platelets) with no evidence of an underlying cause found on investigations. Patients were excluded if they were treated with immunosuppressive medications in the 48 hours prior to presentation. Data collected included signalment, clinical signs, results of initial diagnostic tests, treatment, reason for treatment choice, survival to discharge, and relapse. Due to small group sizes, a statistical analysis was not possible.

**Results:** A total of 54 dogs were included. Their age ranged from 1.2 to 15 years (mean: 7.7). Mean hospitalization time was 6.3 days (range: 2–19). Choice of treatment was at the discretion of the attending clinician. All dogs received glucocorticoids. Six of all dogs (11%) received only glucocorticoids, 66.7% (36/54) received a second immunosuppressive agent, 79.6% (43/54) received vincristine, and 22.2% (12/54) received IV immunoglobulins. The majority of dogs (19/54, 35.2%) were treated with a combination of glucocorticoids, vincristine, and mycophenolate. In 16 out of 19, both mycophenolate and vincristine were started within the first 48 hours. When stated, the most common reasons for adding a second immunosuppressive agent to the treatment were lack of response to current treatment and perceived severity of the clinical signs. Twenty-nine dogs (53.7%) required 1 or more blood transfusions. Forty-two dogs (77.8%) survived to discharge. Of the patients that survived to discharge, 4 (11.4%) experienced a relapse.

**Conclusions:** The majority of dogs in this study received a second immunosuppressive agent and vincristine early in the course of treatment. The choice of treatment was mainly based on clinician preference and on subjective assessment of disease severity. Future prospective studies are required to determine which treatment protocol reduces length of hospital stay, improves outcome, and prevents relapse.

#### SHORT- AND LONG-TERM OUTCOMES OF UNLICENSED GS-441524-LIKE ANTIVIRAL THERAPY AT-HOME TREATMENT OF FELINE INFECTIOUS PERITONITIS

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**Introduction:** Prognosis of cats with feline infectious peritonitis (FIP), hitherto an invariably fatal disease, has purportedly improved with the introduction of the unlicensed nucleoside analog GS-441524 (GS).

**Methods:** A prospective observational study. Inclusion criteria comprised a complete medical record, characteristic clinical signs and laboratory changes, and a confirmatory RT-PCR test for the presence of feline coronavirus and FIP pathogenic strains in pleural/peritoneal/cerebrospinal fluid samples. Clinical signs, laboratory parameters, and adverse effects were recorded at diagnosis, during treatment, and at the end of a 12-week observation period. Remission was defined as completion of 12 weeks or more of treatment and resolution of clinical signs.

**Results:** Overall, 175 medical files were reviewed but only 38 cases met the inclusion criteria. Samples of used vials were analyzed by high-performance liquid chromatography and identified GS-441524 as the active component. Twenty-one cats (55%) were considered in full remission, 7 (18 %) cats are currently treated, and 4 cats are in the 12-week observation period. Two cats experienced a relapse, 1 and 6 weeks after completion of treatment. Six (15%) cats died. Anemia (65%), jaundice (50%), thrombocytopenia (50%), and an albumin globulin ratio under 0.6 (81%) were common findings. Clinical manifestation included effusive ( $n = 30$ ), noneffusive ( $n = 3$ ), and neurological ( $n = 6$ )



forms. Adverse effects included injection site reactions (52% of cats) and pain (95% of cats), and temporary creatinine increase (64%).

**Conclusions:** Short-term efficacy against FIP disease, using an unlicensed nucleotide analog, was observed herein. The unknown purity or biological activity of these unlicensed compounds is a major limitation of this treatment.

#### ERYTHROCYTE SEDIMENTATION RATE AS A MONITORING MARKER IN CANINE INTENSIVE CARE UNIT

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**Introduction:** In people, the higher the erythrocyte sedimentation rate (ESR), the higher the mortality rate in hospitalized patients. In dogs, clinical application of ESR has been abandoned due to long processing time and discovery of new acute-phase proteins. However, a new rapid ESR method has been recently released and validated in dogs. Clinical application of ESR in canine emergency medicine has not been evaluated yet. We aimed to evaluate ESR in hospitalized dogs at admission (T0) and during hospitalization for 48 hours to observe its trend and to relate ESR with mortality.

**Methods:** Prospective study on hospitalized dogs at University of Pisa Veterinary Teaching Hospital between September 2021 and February 2022. Only hospitalized dogs with CBCs performed for their routine monitoring were included, and left-over blood collected for routine CBCs was used. Each owner signed an informed consent to use left-over samples for research. Dogs had a full clinical evaluation, complete hematobiochemical profile, and diagnostic workup necessary to a final diagnosis. ESR was performed using MINI-PET, an automatic continuous-loading instrument, according to the manufacturer's instructions using fresh blood collected in 1-ml K3-EDTA tubes. The ESR was evaluated at admission (T0), and after approximately 24 and 48 hours (T1 and T2, respectively), based on clinicians' decision. Dogs were divided into survivors and nonsurvivors according to their short-term outcome (48 h). T0 ESR between survivor and nonsurvivors was compared using Mann-Whitney *U*-test and T0-T1-T2 ESR in survivors and nonsurvivors were compared using Friedman test with pairwise comparisons.

**Results:** Twenty hospitalized dogs were prospectively included. Ten dogs died within 48 hours from admission and the other 10 survived. T0 ESR was not significantly different between survivors and nonsurvivors (median: 15.5 vs. 17.5 mm/h;  $P = 0.9$ ). Nonsurvivors showed a significant increase in ESR from T0 to T1, and from T1 to T2 ( $P < 0.001$ ; medians: T0 17.5, T1 39.5, and T2 46 mm/h, respectively), whereas survivors showed a significant decrease from T0 to T2 (medians: T0 15.5 and T2 4.5 mm/h, respectively).

**Conclusions:** Although ESR at admission did not predict mortality of hospitalized dogs, its monitoring during hospitalization may add prognostic information.

#### THROMBOLYTIC THERAPY WITH RETEPLASE IN CATS WITH ARTERIAL THROMBOEMBOLISM

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**Introduction:** Feline arterial thromboembolism (FATE) represents a life-threatening disease. There are different protocols published concerning thrombolytic therapy in this indication. Reteplase is a third-generation tissue plasminogen activator used in people as bolus injection for thrombolysis, which has not yet been described in cats.

**Methods:** This retrospective observational study examines the use of reteplase as therapy for FATE. In cats presented with arterial thromboembolism, reteplase was administered at a dose of 1 unit per cat every 8 hours until there were signs of regain of perfusion in the affected legs. Application of reteplase was stopped or interrupted if imminent reperfusion injury was suspected or bleeding occurred. Cats were additionally treated with enoxaparin, clopidogrel, analgesia, and cardiac therapy as needed. Medical data of these cats were reviewed and evaluated concerning success and complications. Data were analyzed with a commercial statistical software program.

**Results:** Between December 2018 and November 2020, 12 cats were included in this study. Most common breed was domestic shorthair in 9 out of 12 cats. Nine animals were male neutered, 1 was male, and 2 were female neutered. The mean age was 9.8 years (standard deviation [SD]: 3.3 years). Mean weight was 5.1 kg (SD 1.5 kg). In 10 out of 12 cases, FATE was related to cardiac disease. Thoracic radiographs of 2 other cats were suspicious for pulmonary neoplastic disease; additionally, 1 of these cats had cardiomyopathy with left atrial dilation. In 8 of 12 cats, both hind legs were affected, in 3 cats the left foreleg, and in 1 cat the right hind leg. A median of 5 units reteplase per cat was administered over time (range: 1–13). Hyperkalemia ( $\geq 5.0$  mmol/L) was not detected in any of the patients. Most cats developed a decrease in hematocrit during the hospital stay; anemia with a hematocrit below 20% was detected in 2 out of 12 patients. Overall, 9 of 12 cats and 7 of 8 cats with both hind legs affected were treated successfully and discharged from the hospital.

**Conclusions:** Reteplase appears to be a promising therapy in the treatment of FATE and although no evidence of reperfusion injury was noted, larger prospective studies are needed to confirm these findings.

#### ESTABLISHMENT OF REFERENCE INTERVALS FOR ULTRASONOGRAPHY-DERIVED CAUDAL VENA CAVA PARAMETERS IN HEALTHY LIGHTLY SEDATED CATS—PRELIMINARY RESULTS

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**Introduction:** The aim of the study was to establish reference intervals (RI) for ultrasonographically derived caudal vena cava (CVC) parameters in healthy cats.

**Methods:** Prospective, observational, experimental single-center study involving 110 cats. Two trained operators scanned cats placed in lateral recumbency, in a randomized order. Two sets of cine-loops per cat were recorded by each operator. A blinded observer measured the narrowest inspiratory (CVC<sub>insp</sub>) and widest expiratory (CVC<sub>exp</sub>) CVC diameter over 2 separate breath cycles for each operator (4 measurements total) at the point the CVC crosses the diaphragm. The CVC collapsibility index (CVC-CI) was calculated. Outliers were identified and removed. A D'Agostino–Pearson test was used to assess normality. Reference intervals were calculated according to CLSI guidelines.

**Results:** A total of 384 measurements were included for each parameter. CVC<sub>insp</sub> and CVC<sub>exp</sub> were normally distributed; CVC-CI was not. The calculated RIs were 0.7–5.1 mm (90% CI lower limit = 0.5–0.8 mm, upper limit = 4.9–5.2 mm), 1.9–6.1 mm (90% CI lower limit = 1.8–2.1 mm, upper limit = 5.9–6.2 mm), and 2.8%–71% (90% CI lower limit = 2.0%–3.3%, upper limit = 64.2–76.5%) for CVC<sub>insp</sub>, CVC<sub>exp</sub>, and CVC-CI, respectively.

**Conclusions:** Based on this study, the CVC RIs determined from the subxiphoid site in cats appear to be wider than those reported in dogs, particularly for the CVC-CI. Further data analysis is needed to determine inter- and intrarater variability, and to determine the clinical value of these RIs to identify hyper and hypovolemic cats.

## HYPOCOBALAMINEMIA IN DOGS WITH ACUTE GASTROINTESTINAL DISEASES

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**Introduction:** Hypocobalaminemia is reported in dogs and cats with chronic gastrointestinal diseases and is a risk factor for a negative outcome. Adequate cobalamin supplementation appears to be essential for therapeutic success. The prevalence of hypocobalaminemia in dogs with acute gastrointestinal disease (AGID) has not been described. The objectives of this study were to investigate the prevalence of hypocobalaminemia in dogs with AGID and to evaluate its relationship with disease severity and outcome.

**Methods:** A retrospective observational study between September 2019 and September 2021 was conducted. Dogs were included if they presented for AGID (onset of clinical signs less than 3 weeks) and the serum vitamin B12 concentrations were measured. Dogs with diagnosis of inflammatory bowel disease, gastrointestinal neoplasia, exocrine pancreatic insufficiency, chronic history of gastrointestinal signs, treatment with cobalamin or corticosteroids prior to serum vitamin B12 measurements, and relapse of clinical signs 3–12 months following discharge were excluded. Hypocobalaminemia was defined as serum vitamin B12 concentrations <200 pmol/L, based on the laboratory reference interval, and low-normal cobalamin was defined as

serum vitamin B12 concentrations of 200–295 pmol/L, the latter still required supplementation based on the Texas A&M gastrointestinal laboratory guidelines. Acute Patient Physiologic and Laboratory Evaluation (APPLE) fast score on admission was recorded. Conventional statistical analyses were used.

**Results:** Thirty-three dogs were included. The median age was 42 months (range: 2–174). Seventeen dogs were diagnosed with AGID of unknown etiology, 7 dogs with parvoviral enteritis, 3 dogs with acute hemorrhagic diarrhea syndrome, and 2 dogs with acute pancreatitis. The prevalence of hypocobalaminemia in this population was 30.3% (10/33) and low-normal cobalamin level was detected in 18.2% (6/33) of dogs. There was no statistically significant relationship between the detection of hypocobalaminemia and the duration of symptoms prior to presentation ( $P = 0.77$ ), length of hospitalization ( $P = 0.88$ ), or APPLE fast score on admission ( $P = 0.20$ ). Mortality rate was 3% ( $n = 1$ ), due to natural death. Follow-up was available for 13 dogs only.

**Conclusions:** Hypocobalaminemia and low-normal cobalamin is a common finding, present in 48.5% of dogs with AGID in this study. The therapeutic and prognostic significance of hypocobalaminemia in AGID requires further investigation.

## FELINE ARTERIAL PRESSURES EVALUATION IN SEDATED AND NONSEDATED BLOOD DONORS

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**Introduction:** The aim of this study is to determine the effect of blood donation on arterial blood pressure in sedated and nonsedated feline donors.

**Methods:** A total of 38 client-owned healthy cats were enrolled in this study. Group 1 (G1) included 24 sedated cats (mixture of 0.1–0.2 mg/kg diazepam, 0.02–0.04 mg/kg butorphanol, and 0.5–1 mg/kg ketamine, IV) and group 2 (G2) included 14 nonsedated cats. Donations took place in a cat-friendly controlled environment. Blood pressure was measured on the caudal ventral artery (VetHDO—High Definition Oscillometry) immediately before and immediately after a blood donation of 10–12 ml/kg. Five consistent (<20% variability) measurements of SBP, DBP, MAP (mm Hg), and pulse rate (ppm) were performed per evaluation after discarding the first one. Then, mean values were calculated for each parameter. Due to the sample size, nonparametric tests were used. The Wilcoxon test was used to compare the values pre- and postdonation, and the Mann–Whitney test was used to compare the values obtained between sedated and nonsedated cat donors.

**Results:** In G1, predonation blood pressures (SBP  $162.53 \pm 14.2^{**}$ , DBP  $85.94 \pm 15.34^{**}$ , and MAP  $112.16 \pm 11.95^{*}$ ) were significantly higher ( $*P < 0.001$  or  $**P < 0.05$ ) than postdonation (SBP  $156.52 \pm 9.37$ , DBP  $79.84 \pm 14.57$ , and MAP  $104.67 \pm 8.49$ ). Pulse was significantly lower predonation ( $191.84 \pm 30.63^{*}$ ) than postdonation ( $237.15 \pm 33.64$ ). In G2, no significant differences were found in SPB (predonation



158.83 ± 18.63 vs. postdonation 152.19 ± 17.86) and pulse (predonation 189.47 ± 26.54 vs. postdonation 199.29 ± 47.34); on the contrary, predonation DBP (81.70 ± 10.33) and MAP (109.33 ± 11.11) were significantly higher ( $P < 0.05$ ) than postdonation (DBP 73.91 ± 13.19; MAP 100.79 ± 12.77). Comparison between G1 and G2 revealed significant differences only in postdonation pulse rate ( $P < 0.05$ ), with higher values on G1 (237.15 ± 33.64) than G2 (199.29 ± 47.34). The lowest postdonation measurements were 140.8 SBP, 57.2 DBP, and 94.3 MAP in G1 and 118.6 SBP, 55.4 DBP, and 83.8 MAP in G2. No clinical signs of hypotension were registered.

**Conclusions:** This study suggests that in both sedated and nonsedated cats, differences in blood pressure are mild and not clinically relevant. Additional studies with a higher population and different sedative protocols may be useful.

### INTERRATER RELIABILITY OF THE ICU VETERINARY COMA SCALE

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**Introduction:** In veterinary medicine, the Modified Glasgow Coma Scale (MGCS) is used for evaluating the neurological status of dogs. Due to the difficulty in evaluating patients undergoing ventilation, Platt suggested the application of the FOUR scale in veterinary medicine. This rating scale is considered the most accurate in assessing the state of consciousness in people undergoing mechanical ventilation. Andrade et al. tested the Pediatric Glasgow Coma Scale (pGCS) in adult dogs, showing good reliability. We have therefore created the ICU Veterinary Coma Scale (ICU VeCS) for the evaluation of the state of consciousness, integrating the MGCS with the “breathing pattern” (BP) of the FOUR scale, with the “eye opening” (EO) and “motor activity” (MA) of the pGCS modifying MA to simplify its application. This study aims to compare the interrater reliability of the MGCS and the ICU VeCS among unselected patients hospitalized in the ICU department of the Veterinary Teaching Hospital of the University of Teramo from January to May 2021.

**Methods:** Thirty-three patients (16 cats, 17 dogs) of different ages and with different pathologies have been assessed by 2 operators (a veterinarian and a veterinary student) applying the MGCS and ICU VeCS at arrival ( $t_0$ ), after 12 hours ( $t_{12}$ ), and 24 hours ( $t_{24}$ ). Cronbach's alpha coefficient for the assessment of the level of agreement between observers and Spearman rho test correlation analysis for nonparametric data were used for the statistical analysis (*Jamovi*).

**Results:** Reliability and correlation analyses have been performed on the total evaluations ( $t_0$ ,  $t_{12}$ , and  $t_{24}$ ) of both the ICU VeCS and the MGCS ( $t_0$ ,  $t_{12}$ , and  $t_{24}$ ) of both the ICU VeCS and the MGCS, conducted by the 2 raters, respectively, resulting in ICU VeCS alpha 0.951 and MGCS alpha 0.959, regarding reliability; ICU VeCS rho 0.920 and MGCS rho 0.902, regarding correlation.

**Conclusions:** Both scales can be considered to have excellent interrater reliability and a very strong relationship.

### THROMBOELASTOMETRY AS A TOOL FOR ASSESSMENT OF HEMOSTASIS AND DISEASE SEVERITY IN DOGS WITH NATURALLY OCCURRING HEATSTROKE

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**Introduction:** Heatstroke (HS) is a devastating condition, with reported mortality rates of 40%–50%. Excessive activation of the coagulation system, potentially culminating in overt DIC, is a prominent feature of HS. Thromboelastometry (TEM) is a viscoelastic diagnostic modality providing global assessment of the clotting process, enabling determination of hyper-, normo-, or hypocoagulable states.

**Objectives:** To investigate changes in TEM and its utility as a prognostic tool in dogs with naturally occurring HS at different timepoints during the initial 48 hours.

**Methods:** Forty-two client-owned dogs presented to the emergency service for HS were included. Blood samples for CBC, serum biochemistry, coagulation panel, and TEM were performed at presentation and every 12–24 hours postpresentation. A previously reported HS severity score was calculated. Complications, namely, AKI, DIC, and death, were recorded. Dogs euthanized on presentation based on a no-treatment intent were excluded.

**Results:** Median time from heat insult to presentation was significantly longer in nonsurvivors (2 vs. 4.5 h,  $P < 0.05$ ), while prior cooling did not affect survival. Mortality rate was 31% and a higher HS severity score accurately predicted nonsurvival. Significant differences between survivors and nonsurvivors were apparent mainly on intrinsic TEM and included prolongations in clotting times, a lower alpha angle, and increases in maximal lysis in nonsurvivors, on presentation and/or 12–24 hours postpresentation ( $P < 0.05$  for all). Based on the AUC value (area under the curve from test start until maximal clot formation is reached), nonsurvivors were significantly more likely to have a hypocoagulable TEM tracing compared to survivors, both on presentation (55% vs. 15%, respectively,  $P = 0.029$ ) and 12–24 hours postpresentation (41% vs. 0%, respectively,  $P = 0.026$ ). A hypocoagulable TEM tracing was significantly associated with AKI, DIC, and a higher HS severity score ( $P < 0.05$  for all).

**Conclusions:** In dogs with HS, changes in TEM indicated that nonsurvivors were significantly more likely to develop a hypocoagulable state, as reflected by their AUC value. In 21% of the dogs, coagulation derangements were minimal on presentation, and became apparent over the first 12–24 hours, highlighting the need for close monitoring and serial measurements of coagulation parameters. A hypocoagulable AUC value was significantly associated with mortality, severity score, and complications.

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### SURGICAL INTERVENTIONS AND OUTCOME IN A POPULATION OF FELINE TRAUMA PATIENTS

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**Introduction:** Trauma is a major cause of morbidity and mortality in human and veterinary patients. Despite the frequency and severity of trauma, relatively little data are available for cats.

**Objectives:** To determine signalment, injury type, trauma severity, and outcome of feline trauma patients undergoing surgical and nonsurgical treatment in addition to time to surgery, specialty services involved, and cost in the operating room (OR) surgery population.

**Methods:** Retrospective evaluation of medical records and the Veterinary Committee on Trauma registry data on 251 feline trauma cases presented to a university teaching hospital between May 2017 and July 2020. Demographics and outcome were compared for cats undergoing surgery in OR and emergency room (ER) settings and cats without surgery. For the OR cohort, specialty service involved, time to and duration of anesthesia and surgery, and visit costs were compared.

**Results:** Of the study population, 12% (31/251) underwent OR surgery and 23% (58/251) had ER surgery, while 65% (162/251) did not have surgical intervention. Among surgical groups, 99% survived to discharge compared to 73.5% of the nonsurgical group ( $P < 0.0001$ ). ATT score was significantly higher in the OR than the ER surgical group ( $P < 0.0001$ ). The most common OR services involved were orthopedics (41%, 12/29) and dentistry (38%, 11/29).

**Conclusions:** Surgical intervention in feline trauma appears to be associated with higher survival rates, but no difference in mortality was found across OR surgery services. Among OR surgery, orthopedics was associated with increased length of hospitalization, increased cost, and increased use of blood products.

### A RETROSPECTIVE ANALYSIS OF HEAD INJURY AND TRAUMATIC BRAIN INJURY IN CANINE TRAUMA PATIENTS

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**Introduction:** Head injury is common in canine trauma patients, but the epidemiology is poorly described.

**Objective:** Describe head injury, signalment, select diagnostic results, interventions, and outcome in a canine trauma population.

**Methods:** Retrospective analysis of data collected from April 2017 to October 2021. Dogs were categorized by head injury status (Yes/No) and subsequently by modified Glasgow coma score (MGCS) and presence of traumatic brain injury (TBI): MGCS = 18, TBI = No versus MGCS < 18, TBI = Yes. Dogs were also categorized by degree of TBI (mild/moderate, severe), size (toy, small, medium, large, giant), age (young, middle-age, old), gender, type of injury (blunt, penetrating, both), diagnostics performed (blood glucose, base excess, lactate, PCV/TS, iCa), interventions (surgery, blood product), and outcome (survived to discharge, died, euthanized).

**Results:** Of 2040 traumatized dogs, 296 had head injury (14.5%). The mean MGCS score differed significantly between those with (15.6, SD 4.2) and without (17.5, SD 2.1) head injury ( $P < 0.0001$ ). Smaller dogs were more likely to have head injury. Toy and small dogs had a higher likelihood of developing TBI than medium, large, and giant dogs. The likelihood of developing TBI increased with each increase in age. Head injury was most common from combined blunt and penetrating injuries. Blood parameters were significantly altered with head injury. The likelihood of death or euthanasia was significantly higher in patients with head injury. Survival to discharge was lower in dogs with (85%) than without (97%) head injury ( $P < 0.0001$ ).

**Conclusions:** Head injury and associated TBI worsen prognosis for trauma in dogs.