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Abstracts May 2013

Journal of the American Animal Hospital Association

2013 AAHA/AAFP Fluid Therapy Guidelines for Dogs and Cats
Harold Davis, Tracey Jensen, Anthony Johnson, Pamela Knowles, Robert Meyer, Renee Rucinsky, Heidi Shafford

Fluid therapy is important for many medical conditions in veterinary patients. The assessment of patient history, chief complaint, physical exam findings, and indicated additional testing will determine the need for fluid therapy. Fluid selection is dictated by the patient’s needs, including volume, rate, fluid composition required, and location the fluid is needed (e.g., interstitial versus intravascular). Therapy must be individualized, tailored to each patient, and constantly re-evaluated and reformulated according to changes in status. Needs may vary according to the existence of either acute or chronic conditions, patient pathology (e.g., acid-base, oncotic, electrolyte abnormalities), and comorbid conditions. All patients should be assessed for three types of fluid disturbances: changes in volume, changes in content, and/or changes in distribution. The goals of these guidelines are to assist the clinician in prioritizing goals, selecting appropriate fluids and rates of administration, and assessing patient response to therapy. These guidelines provide recommendations for fluid administration for anesthetized patients and patients with fluid disturbances.

Postoperative Complications Following TECA-LBO in the Dog and Cat
Rebecca E. Spivack, A. Derrell Elkins, George E. Moore, Gary C. Lantz

The medical records for 133 total ear canal ablations combined with lateral bulla osteotomies (TECA-LBOs) performed on 82 dogs (121 ears) and 11 cats (12 ears) between 2004 and 2010 were reviewed to determine if the duration of preoperative clinical signs was associated with the incidence of postoperative facial nerve injury and Horner’s syndrome. Other perioperative complications, such as a head tilt, nystagmus, incisional drainage, draining tracts, hearing loss, as well as bacterial culture results, were noted. Postoperative facial nerve paresis occurred in 36 of 133 ears (27.1%), and paralysis occurred in 29 of 133 ears (21.8%), with no significant difference between species. Thus, postoperative facial nerve deficits occurred in 48.9% of ears. The median duration of clinically evident temporary facial nerve deficits was 2 wk for dogs and 4 wk for cats. Dogs had a significantly longer duration of preoperative clinical signs and were less likely than cats to have a mass in the ear canal. Dogs were less likely to have residual (. 1 yr) postoperative facial nerve deficits. The incidence of postoperative Horner’s syndrome was significantly higher in cats than dogs. The duration of preoperative clinical signs of ear disease was not associated with postoperative facial nerve deficits.

Dominique Gagnon, Brigitte Brisson,

The purposes of this retrospective study were to review cases of colonic torsion/volvulus between July 1992 and August 2010 and to determine if any predisposing factors exist for the development of this condition. Six dogs were diagnosed with colonic torsion/volvulus during the study period. Four dogs had a history of previous gastric dilation-volvulus (GDV) with prophylactic gastropexy. Three of six dogs diagnosed with colonic torsion/volvulus had large intestinal entrapment and strangulation around the gastropexy site at the time of surgery. The history, clinical signs, physical examination, and radiologic findings were not specific for colonic torsion/volvulus in any dog. Early exploratory laparotomy was indicated to confirm the diagnosis and perform surgical correction of the affected bowel segments. Three of five dogs that underwent surgery had a left abdominal wall colopexy performed. All five dogs that underwent surgery in this study survived postoperatively. One patient was euthanized without surgical intervention. Results suggest that colonic torsion/volvulus should be considered in any large-breed dog with nonspecific gastrointestinal clinical signs and a history of previous gastropexy. Early recognition and prompt treatment of this condition may result in a good outcome.

Clinicopathologic Significance of Histologic Grade, Pgp, and P53 Expression in Canine Lymphoma
Ravinder S. Dhaliwal, Barbara E. Kitchell, EJ Ehrhart, Victor E. Valli, Nikolaos G. Dervisis

To characterize the expression of P-glycoprotein (Pgp) and p53 in different histologic grades of canine multicentric lymphosarcoma (LSA), 31 cases of LSA without prior treatment were studied. The expression levels of the Pgp and p53 proteins were evaluated for their clinicopathologic significance among standard histologic evaluation. Immunohistochemistry (IHC) was performed on formalin-fixed, paraffin-embedded archival samples of 31 previously untreated LSA cases to detect the expression of Pgp and p53. All dogs were subsequently treated with a combination chemotherapy protocol. Remission and survival durations were
evaluated for correlation with histologic grade and presence of drug resistance markers. Of the 31 cases, 24 (80%) and 7 (22%) were positive for Pgp and p53, respectively. Overall, the median survival and duration of remission in the study was 246 days and 137 days, respectively. The National Cancer Institute working formulation histologic grade was not associated with either survival or duration of first remission (DOR). The Pgp protein expression and DOR and survival was not statistically significant. Expression of p53 was statistically correlated with survival.

Efficacy of Incisional Gastropexy for Prevention of GDV in Dogs
Marian E. Benitez, Chad W. Schmiedt, MaryAnn G. Radlinsky, Karen K. Cornell
Incisional gastropexy (IG) is routinely performed as either a prophylactic procedure to prevent occurrence of gastric dilatation-volvulus (GDV) or at the time of surgical correction of GDV to prevent recurrence. Despite its common use, the long-term efficacy of the IG procedure has not been reported. The hypothesis of this study was that IG performed either during surgical treatment of GDV or as a prophylactic measure would effectively prevent GDV. Medical records of 61 dogs undergoing IG following either gastric derotation for treatment of GDV or as a prophylactic procedure were evaluated retrospectively. Median follow-up time for all dogs was 717 days (range, 49–2,511 days). Of the 61 dogs, 27 had prophylactic IG performed. The remaining 34 dogs presented for GDV and had an IG performed during surgical treatment of GDV. No dog experienced GDV after IG. Recurrence of gastric dilatation (GD) alone was noted in 3 of 34 patients (8.8%) undergoing IG during surgery for GDV and in 3 of 27 patients (11.1%) treated prophylactically with IG. This study confirmed the efficacy of IG for the long-term prevention of GDV in dogs.

Katherine L. Bahr, Leslie C. Sharkey, Tsuyoshi Murakami, Daniel A. Feeney
Medical records from dogs having abdominal ultrasound (US) performed between March 2005 and October 2008 were reviewed for detection of focal liver lesions (FLL) with both cytologic and histologic sampling. Samples were classified as to either the presence or absence of major categories of pathologic processes, including malignant neoplasia, inflammation, hyperplasia/benign neoplasia, vacuolar change, extramedullary hematopoiesis, cholestasis, necrosis, and no microscopic abnormalities. Evaluation of selection bias was performed by review of the relative distribution of cytologic diagnoses for cases with histology compared with cases excluded from the comparison analysis because histology results were not available. Cytology had the highest sensitivity for vacuolar change (57.9%), followed by neoplasia (52.0%). Cytology had the highest positive predictive value (PPV) for neoplasia (86.7%) followed by vacuolar change (51.6%). Cytology had lower sensitivity and PPVs for inflammation, necrosis, and hyperplasia. The ability of cytology to characterize disease in canine FLL varies by pathologic process. Clinicians can have a high degree of confidence when a cytologic diagnosis of neoplasia is given; however, cytology is less reliable for excluding the potential for neoplasia. Cytology has a low sensitivity and PPV for inflammation and a limited diagnostic performance for the diagnosis of vacuolar change.

Clinical and Laboratory Findings in Border Collies with Presumed Hereditary Juvenile Cobalamin Deficiency
Sabina Lutz, Adrian C. Sewell, Claudia E. Reusch, Peter H. Kook,
Juvenile cobalamin deficiency is a rare disease in border collies and its diagnosis requires a high level of clinical suspicion. The goal of this study was to increase awareness of this disease by describing the clinical and laboratory findings in four young border collies with inherited cobalamin deficiency. The median age of the dogs was 11.5 mo (range, 8–42 mo), and two of the four dogs were full siblings. Clinical signs included intermittent lethargy (n ¼ 4), poor body condition (n ¼ 4), odynophagia (n ¼ 2), glossitis (n ¼ 1), and bradyarrhythmia (n ¼ 1). Pertinent laboratory abnormalities were mild to moderate normocytic nonregenerative anemia (n ¼ 3), increased aspartate aminotransferase (AST) activity (n ¼ 3), and mild proteinuria (n ¼ 3). All of the dogs had serum cobalamin levels below the detection limit of the assay, marked methylmalonic aciduria, and hyperhomocysteinemia. Full clinical recovery was achieved in all dogs with regular parenteral cobalamin supplementation, and laboratory abnormalities resolved, except the proteinuria and elevated AST activity persisted. This case series demonstrates the diverse clinical picture of primary cobalamin deficiency in border collies. Young border collies presenting with ambiguous clinical signs should be screened for cobalamin deficiency.

Treatment of E. boehmi Infection in a Mixed-Breed Dog Using Milbemycin Oxime
Gary Conboy, Tonya Stewart, Susan O’Brien,
Numerous bipolar plugged capillarid eggs were detected on a routine centrifugal fecal flotation examination of a 2 yr old castrated male boxer-Chinese shar pei mixed-breed. The eggs were identified as Eucoleus boehmi (E. boehmi), the nasal capillarid, based on size and shell wall surface morphology. The dog had a history of chronic
sneezing (5 times/day) and intermittent postexercise nasal discharge. Currently, there are no anthelminitics approved for use in dogs for the treatment of E. boehmi. Treatment of the dog with 0.5–1 mg/kg milbemycin oxime was ineffective, but treatment with 2 mg/kg milbemycin oxime resulted in negative fecal examinations 7–28 days and 5 mo posttreatment. The dog’s postexertion nasal discharge greatly lessened, and the sneezing behavior improved (it was only noted 2–3 times/wk), but neither the discharge nor sneezing completely resolved following the anthelminthic treatments. Use of milbemycin oxime at an increased dose (2 mg/kg) appeared to be an effective treatment against E. boehmi infection in this dog based on clinical response and the cessation of fecal egg shedding.

Survival After Anaphylaxis Induced by a Bumblebee Sting in a Dog
Emily Thomas, Deborah C. Mandell, Lori S. Waddell
A 3.5 yr old castrated male miniature schnauzer was referred with a history of collapse after a bee sting to the left hind limb. At the time of presentation, 14 hr after the sting, the dog was hypotensive, comatose, seizing, and had a brief period of cardiac arrest. Over the following 48 hr, the dog developed azotemia, severely elevated liver enzyme levels, hypertension, hematochezia, hematemesis, and disseminated intravascular coagulation (DIC). The dog’s neurologic status improved slowly, but significant behavioral abnormalities remained. The dog was discharged after 7 days with ongoing polyuria, polydipsia, and behavioral changes. The polydipsia and polyuria resolved within a few days, but the behavioral changes continued for 6 wk. Reports of anaphylaxis from any cause are sparse in the veterinary literature. This is the first report of suspected anaphylaxis following a bee sting. There are no previous reports of behavioral changes after physical recovery from anaphylaxis.

Prolonged Survival in an Aged Labrador Retriever with a Metastatic Insulinoma
Jessica Rychel, Deanna R. Worley, Christine S. Hardy, Brett T. Webb
This case report highlights an unusually prolonged, asymptomatic, disease-free interval in an aged male Labrador retriever that underwent partial pancreatectomy for a functionally active pancreatic insulinoma with histologically confirmed hepatic metastasis. The patient developed pancreatitis and nonseptic suppurative peritonitis 24 hr after surgical resection of the insulinoma and was managed medically until discharge. Three mo after surgery, the dog was diagnosed with exocrine pancreatic insufficiency (EPI) that was effectively managed with parenteral pancreatic enzymes. Due to normal glucose levels 3 mo postsurgically, liver samples from the initial surgery were resubmitted for immunohistochemistry. Results confirmed insulinoma metastasis with insulin expression. Ten mo postsurgically, the blood glucose was normal and serum insulin levels were slightly above the upper reference limit. The first hypoglycemic episode was documented 23 mo postoperatively, which was effectively managed with prednisone. The cause for the prolonged disease remission and survival was unknown, but was possibly a result of pancreatitis and peritonitis, partial spontaneous regression of metastatic lesions, or idiopathic. Despite life-threatening postoperative complications, this patient enjoyed a profoundly longer than expected survival. This case highlights the importance of removing the primary tumor (insulinoma) despite the presence of metastatic disease.

Veterinary Clinics of North America (Dentistry issue)
Oral Inflammation in Small Animals
Milinda J. Lommer, DVMa,b,*
KEY POINTS
_ In mammalian tissue, inflammation is a highly integrated, elaborate response to insult or injury.
_ Its primary purpose is to contain and remove offending microorganisms and necrotic tissue, preventing infection and facilitating tissue healing.
_ An aberrant or accentuated inflammatory process can itself cause tissue injury and dysfunction.
_ As ongoing research yields an increasing understanding of the cellular and molecular mechanisms that modulate inflammation, efforts to treat and prevent oral inflammatory diseases can become more specific, targeting the precise cells and molecules responsible.

Anesthesia and Pain Management for Small Animals
Brett Beckman
KEY POINTS
_ Consideration should be given to analgesics as premedications to provide preemptive analgesia and lower the minimum alveolar concentrations of the inhalant.
_ The potential risks of cardiac side effects and the lack of evidence of significant benefits make the routine preanesthetic administration of antimuscarinic agents no longer recommended in human and veterinary patients.
_ Opioids are the basis for effective pain management in veterinary medicine.
_ A complete understanding of nociception and the effect of chronic pain states on signal modulation is important in making appropriate decisions when choosing analgesics.
Patients vary considerably in their analgesic needs based on individual pain tolerance, whether the procedure is regional or generalized, chronicity, existing pain behaviors, the invasiveness of the surgery, and the tissue management skills of the surgeon.

New Zealand Veterinary Journal (no small animal medicine articles)

Australian Veterinary Practitioner
No journal this month.

Compendium

Treatment of Systemic Hypertension Associated With Kidney Disease
Simona Buoncompagni, Mary H. Bowles,
Systemic hypertension is an increasingly diagnosed disorder in dogs and cats and frequently occurs secondary to chronic kidney disease. Prevention of damage to organs such as the kidneys, brain, heart, and eyes is one of the primary concerns in the management of veterinary patients with hypertension. This article reviews the guidelines for antihypertensive therapy in patients with, or at risk for, kidney disease, including the initiation of treatment and currently recommended medications.

Iliopsoas Muscle Injury in Dogs
Quentin Cabon, Christian Bolliger
The iliopsoas muscle is formed by the psoas major and iliacus muscles. Due to its length and diameter, the iliopsoas muscle is an important flexor and stabilizer of the hip joint and the vertebral column. Traumatic acute and chronic myopathies of the iliopsoas muscle are commonly diagnosed by digital palpation during the orthopedic examination. Clinical presentations range from gait abnormalities, lameness, and decreased hip joint extension to irreversible fibrotic contracture of the muscle. Rehabilitation of canine patients has to consider the inciting cause, the severity of pathology, and the presence of muscular imbalances.

Applied Dermatology: Old or New? A Comparison of Mitotane and Trilostane for the Management of Hyperadrenocorticism
Joel D. Griffies
Hyperadrenocorticism (HAC) is a common endocrinopathy in dogs. With better recognition of the disease, more cases are being presented to clinicians for management. Mitotane, a 3- to 4-decade-old therapy, remains a viable and useful option for management of this disease. Thorough education and understanding of the drug are important, however, as the learning curve of how to manage its effects can be significant. Trilostane, a newer option for management of HAC, offers a simplified protocol and, often, smoother and faster control of the disease. It also requires a comfortable knowledge of expected outcome and possible adverse effects. With either drug, careful monitoring and client communication are crucial.

Radiologic Interpretation of Central Venous Catheter Placement
Karine Gendron, Thierry Francey, Chiara Adami, Urs Geissbühler
When used in veterinary medicine, central venous catheters are typically inserted through the external jugular vein, with their caudal extension within the cranial vena cava. Radiographic or fluoroscopic guidance is recommended to assist in correctly placing these catheters. This article provides radiologic examples of common central venous catheter malpositions and complications.

Journal of Feline Medicine and Surgery

Cats with Cancer: Where to start
Laura Blackwood
Practical relevance: Many cats develop cancer and may or may not present with an obvious mass lesion. As our feline patients are living longer and their owners are increasingly seeking veterinary care, the apparent incidence and prevalence of cancer is increasing.
Clinical challenges: Neoplasia is a differential for many clinical presentations in cats. Often tumours are relatively advanced at the point of presentation, and this can make management difficult. In addition, many cats find clinic visits stressful and this can influence owners’ decisions about treatment.

Audience: This review provides an overview of the approach to the feline cancer patient, and is aimed at all veterinary practitioners that see cats. It is intended as a starting point for more detailed discussions in accompanying articles in this special issue on feline oncology.

Evidence base: There is limited data on most feline tumours compared with tumours in canine or human patients, so a robust evidence base is often lacking.

Extranodal Lymphoma in the Cat: Prognostic factors and treatment options
Antony Moore

Practical relevance: The majority of feline lymphoma is extranodal. While the gastrointestinal (GI) tract is the most commonly affected site, non-GI extranodal lymphomas, which are the focus of this review, account for a large proportion of lymphomas in cats. This article discusses prognostic factors for the most common of these extranodal lymphomas, both in general terms and specifically for individual sites.

Clinical challenges: Prognostic factors remain poorly defined for feline lymphoma. Many cats with extranodal lymphoma have stage I disease at an accessible site. A major question for patients with apparently localised extranodal lymphoma is whether the tumour can be treated with localised therapy alone or requires systemic treatment as well. Again there is often no specific information available for a particular site, such as a localised intramuscular lymphoma. Instead, reliance must be placed on careful patient staging, particularly if local therapy alone is planned.

Evidence base: Until such time as further studies looking at stage, anatomic site, histological grade and immunophenotype are available to assist treatment decision making for an individual cat with extranodal lymphoma, it seems reasonable to draw inferences from other common extranodal sites for which more specific information exists, such as nasal lymphoma.

Mammary Tumours in the Cat: Size matters, so early intervention saves lives
Joanna Morris

Practical relevance: Mammary tumours are among the most common neoplasms in both cats and dogs, but the prevalence of malignant histological types is far higher in cats (ratio of malignant:benign is at least 4:1).

Clinical challenges: The more aggressive nature of mammary neoplasia in cats poses challenges for management. Prognosis is affected by tumour size and, therefore, early recognition and treatment of mammary tumours is paramount. Although the primary tumour can be excised surgically, no studies have shown that chemotherapy significantly extends survival time; hence, metastatic spread remains an important clinical problem.

Patient group: Mammary tumours usually affect older female cats, mainly entire females. Siamese and Oriental breeds may be predisposed. Male cats can develop mammary neoplasia, but this is rare.

Evidence base: This review summarises the current literature relating to aetiology, pathology, presentation, diagnosis, staging, treatment and prognosis of feline mammary tumours.

Cutaneous Squamous Cell Carcinoma in the Cat: Current understanding and treatment approaches
Suzanne Murphy

Practical relevance: Squamous cell carcinoma (SCC) is a tumour that commonly involves the skin or oral cavity and is, therefore, an important differential diagnosis for any cutaneous lesion(s), especially any non-healing scabbing lesions on the eyelids, nasal planum or ears of light-coloured cats.

Clinical challenges: Superficial lesions of the nasal planum, discrete small eyelid lesions and lesions on the tips of pinnae are relatively easily treated, but higher stage lesions are more challenging to manage and may compromise the cosmetic appearance of the cat.

Audience: This review article is aimed at all veterinary practitioners that see cats.

Evidence base: The review summarises the peer-reviewed literature relating to our understanding of feline cutaneous SCC. Unfortunately, the literature is limited and in need of updating in areas.
Injection Site-Associated Sarcoma in the Cat: Treatment recommendations and results to date
Jane Ladlow

Practical relevance: Feline injection site-associated sarcomas (FISSs) have been the cause of much controversy and concern since they were first reported in the early 1990s. While not solely associated with vaccination, there are implications for vaccination sites and schedules and, while guidance has been published, this appears to be permeating only slowly through to general practice.

Clinical challenges: Up to one-quarter of cats with this difficult condition have metastatic lung involvement. The mainstay of treatment is aggressive surgery, but even in cases where full excision with clean margins is achieved, tumour recurrence is anticipated in about one-third of cases. The role of radiotherapy and chemotherapy as adjuvant treatments has yet to be clearly defined.

Patient group: FISSs are often seen in younger cats, with a peak presentation at 6–7 years and a second peak at 10–11 years.

Evidence base: This review summarises the diagnosis and management of FISS with reference to the latest published treatment results. It focuses on surgical excision but also covers adjuvant radiotherapy and chemotherapy, and gives median survival times for the different treatment approaches.

Cats and Chemotherapy: Treat as ‘small dogs’ at your peril
Michael Sean Kent

Practical relevance: To safely and effectively treat cats with cancer it is important to understand the drugs being used and some species-specific concerns in relation to chemotherapy.

Clinical challenges: While many of the same principles in treating cats with chemotherapy and targeted agents hold true as for other species, including dogs, cats display altered metabolism of drugs and species-specific toxicities that can present particular challenges for veterinarians.

Audience: This article is aimed at practitioners who treat feline cancer or who help manage cats undergoing cancer therapy.

Evidence base: The article reviews the known literature regarding species differences between dogs and cats relating to the use of chemotherapy and targeted therapies. For many of the drugs mentioned there are limited studies and caution must be exercised when using drugs that have a low therapeutic index.

Journal of Veterinary Internal Medicine: May/June

NOD2 mRNA Expression and NFκB Activation in Dogs with Lymphocytic Plasmacytic Colitis
H. Okanishi1, K. Hayashi1, Y. Sakamoto1, T. Sano1, H. Maruyama2, Y. Kagawa3, T. Watari

Background: Nucleotide Oligomerization Domain Two (NOD2) is suggested to be an intracellular pathogen-associated molecular pattern recognition molecule. NOD2, plays a key role against bacteria by triggering a host defense response through activation of the transcription factor NFκB and subsequent proinflammatory cytokine production. NOD2 recently was reported to be overproduced in inflamed colonic mucosa in Crohn's disease, and to be accompanied by a significant increase in NFκB activity. However, few studies to date have investigated intercellular signaling molecules in dogs with lymphocytic plasmacytic colitis (LPC).

Hypothesis: NOD2 mRNA expression and NFκB activation are increased in mucosal biopsies of LPC dogs as compared with control dogs.

Animals: Five healthy dogs and 19 dogs with LPC.

Methods: Descending colon biopsies were obtained endoscopically. Expression of NOD2 mRNA was evaluated by semiquantitative RT-PCR in the colonic mucosa. NFκB binding activity was assessed by electrophoretic mobility shift assay.

Results: NOD2 mRNA expression was approximately 63% greater in LPC dogs than in healthy controls (P = .019). NFκB binding activity was approximately 45% higher in the inflamed colonic mucosa of the LPC dogs, as compared with healthy controls (P = .011). No correlations were observed among NOD2 mRNA expression levels, NFκB binding activity, and CIBDAI in LPC dogs.

Conclusions and Clinical Importance
NOD2 mRNA and NFκB activity were significantly higher in the inflamed colon of dogs with LPC, as compared with healthy controls. Our data suggest that NOD2 and NFκB play an important role in the pathogenesis of LPC.
Phylogenetic Analysis of Feline Coronavirus Strains in an Epizootic Outbreak of Feline Infectious Peritonitis (pages 445–450)


Background: Feline coronavirus (FCoV) infection is common. In a small percentage of cats, FCoV infection is associated with the fatal disease feline infectious peritonitis (FIP). Genetically distinct virulent and avirulent strains of FCoV might coexist within a cat population.

Objectives: To determine whether the strains of FCoV in FIP-affected cats are closely related or genetically distinct from the fecally derived strains of FCoV in contemporary-asymptomatic cats during an epizootic outbreak of FIP.

Animals: Four cats euthanized because of FIP and 16 asymptomatic cats.

Methods: This prospective outbreak investigation was initiated during an outbreak of FIP in cats within or rehomed from a rescue/rehoming center. Postmortem samples were collected from cats with FIP and contemporaneous fecal samples from asymptomatic cats. RNA was purified from tissue and fecal samples, FCoV gene fragments were reverse transcribed, PCR-amplified using novel primers, and sequenced. Sequences were aligned with ClustalW and compared with published FCoV sequences.

Results: FCoV RNA was detected in all 4 FIP cat postmortem samples and in 9 of the 16 fecal samples from contemporary-asymptomatic cats. Novel primers successfully amplified fragments from 4 regions of the genome for all FCoV-positive samples. Phylogenetic analysis showed that the FIP-associated strains of FCoV from the outbreak were very closely related to the fecally derived strains of FCoV from contemporary-asymptomatic cats.

Conclusions and Clinical Importance
Sequence analysis provided no evidence that genetically distinct virulent and avirulent strains of FCoV were present during this FIP outbreak.

Gastrointestinal Hemodynamics in Dogs with Nonfood Induced Atopic Dermatitis (pages 451–455)

V. Bruet, J. Brune, A. Pastor, L. Imparato, A. Roussel, P. Bourdeau and J.C. Desfontis

Background: Canine atopic dermatitis can be a result of exposure to aeroallergens or trophallergens. Hemodynamic alterations occur in dogs with food hypersensitivity.

Hypothesis/Objectives: To evaluate if hemodynamic alterations occur in dogs with NFICAD with lowered resistance to diastolic flow at fasting, after feeding, or both.

Animals: Ten healthy dogs and 22 dogs with NFICAD were included from the hospital population.

Methods: Blinded prospective study. Peak systolic velocity (PSV), end diastolic velocity (EDV), mean velocity (MV), pulsatility index (PI), resistive index (RI) and PSV/EDV ratio were measured at fasting for both arteries (cranial mesenteric artery [CMA], celiac artery [CA]) and at 40 minutes after feeding in CMA and at 60 minutes in CA. The results were analyzed statistically with a mixed model.

Results: There was no difference detected between groups of dogs for any variable except EDV during fasting ($P = .01$).

Conclusions and Clinical Importance
There is no decrease in resistance in NFICAD to diastolic flow. This observation could be explained by the absence intestinal inflammation in NFICAD.

Effect of Endoscopic Forceps on Quality of Duodenal Mucosal Biopsy in Healthy Dogs (pages 456–461)

C.M. Goutal-Landry, J. Mansell, K.A. Ryan and F.P. Gaschen

Background: Limited data exist regarding influence of endoscopic forceps on duodenal mucosal biopsy quality and adequacy for histologic examination/assessment in dogs.

Hypothesis/Objectives: Hypothesizing that larger forceps would procure superior specimens, we evaluated effect of 6 disposable forceps on duodenal biopsy weight, depth, crush artifact, and adequacy for histologic examination/assessment.

Animals: Seventeen healthy adult dogs.

Methods: Prospective study. Two operators each obtained 4 duodenal specimens from each dog with each forceps. Lightest sample discarded. One pathologist evaluated blindly other 3 specimens. A total of 612 specimens evaluated. Results analyzed by one-way ANOVA of forceps effects with dog as blocking factor. Posthoc pairwise comparisons examined with Tukey's test when indicated.

Results: Biopsies performed with large capacity forceps heavier (10.56 ± 0.90 and 11.6 ± 0.62 mg (mean ± SD) versus 5.55 ± 0.53 to 8.61 ± 0.49; $P < .0001$) and adequacy for histologic examination/assessment superior to standard oval and ‘pediatric’ (scores 2.52 ± 0.41 and 2.58 ± 0.37 versus 2.08 ± 0.33 and 2.14 ± 0.29; $P < .0001$).

No statistically significant difference in depth scores. Large capacity forceps with spike associated with less crush artifact than all smaller forceps (scores 1.19 ± 0.16 versus 1.38 ± 0.21 to 1.52 ± 0.21; $P < .0001$). In same size forceps, presence of spike had no effect on crush artifact and adequacy for histologic examination/assessment ($P < .0001$).
Conclusions and Clinical Importance: Large capacity forceps are superior, providing higher quality and greater numbers of samples achieving adequacy for histologic examination/assessment. Choice of endoscopic biopsy forceps for duodenal samples influences sample volume and diagnostic utility.

Hypercoagulability in Dogs with Protein-Losing Nephropathy as Assessed by thromboelastography (pages 462–468)
E.M. Lennon, R.M. Hanel, J.M. Walker and S.L. Vaden

Background: Dogs with protein-losing nephropathy (PLN) are at risk of thromboembolic disease, but the mechanism leading to hypercoagulability and the population of dogs at risk are unknown.

Objectives: To characterize thromboelastography (TEG) and its association with serum albumin (SALB), UPC, and antithrombin activity in dogs with PLN.

Animals: Twenty-eight client-owned dogs with PLN (urine protein:creatinine ratio [UPC] > 2.0) and 8 control dogs were prospectively enrolled in this observational study.

Methods: TEG parameters, antithrombin activity, serum biochemical profiles, and UPC were measured. TEG analyses were run in duplicate with kaolin activation; reaction time (R), clot formation time (K), α-angle (α), maximal amplitude (MA), and global clot strength (G) were analyzed.

Results: Dogs with PLN had lower K (P = .004), and higher α (P = .001), MA (P < .001), and G (P < .001) values than controls. No significant correlation between TEG parameters and UPC, SALB, or antithrombin was noted. Twelve PLN dogs (42.8%) were azotemic and 19 (67.8%) were hypoalbuminemic (SALB < 3.0 g/dL); 11 had SALB < 2.5 g/dL.

Conclusions and Clinical Importance: These results indicate that dogs with PLN have TEG values that demonstrate hypercoagulability compared with a control population but that antithrombin, SALB, or UPC cannot be used in isolation to predict this result. A comprehensive evaluation of the coagulation system in individual patients may be necessary to predict the point at which anti-thrombotic therapy is indicated.

Comparison of 2 Retrieval Devices for Heartworm Removal in 52 Dogs with Heavy Worm Burden (pages 469–473)
W.K. Yoon, R. Choi, S.G. Lee and C. Hyun

Background: For treating dogs with heavy heartworm infection, mechanical removal using various retrieval devices is useful. However, the efficacy and safety of retrieval devices have rarely been studied.

Hypothesis: Catheter-based heartworm removal using 2 retrieval devices (basket and tripod grasping forceps) is efficient and safe for treating dogs with heavy worm burden.

Animals: Fifty-two client-owned dogs with heavy (Class III and IV) worm burden.

Methods: A retrospective study was performed on 52 dogs, using a catheter-based heartworm removal approach using 2 types of retrieval devices (ie, the basket and the tripod grasping forceps). The efficacy and complications associated with the 2 devices were assessed.

Results: The basket device was used on 22 of the study group dogs, and the tripod grasping forceps was used on 30 of the dogs. The postoperative survival rate was 95.5% for the basket device and 80% for the tripod grasping forceps, but the difference was not statistically significant. The worm number captured per attempt was 3.5 ± 1.7 using the basket device and 1.9 ± 0.85 for the tripod grasping forceps (P < .05). Various complications associated with heartworm removal were noticed with both retrieval devices.

Conclusions and Clinical Importance: This study suggests that catheter-based heartworm removal is not only a relatively safe and efficient therapeutic method in dogs with heavy worm burden, but more efficient using the basket device. Our data do not indicate a clear safety advantage between the 2 devices evaluated, although the survival rate was numerically higher in dogs undergoing a basket intervention.

Feline Musculoskeletal Pain Index: Responsiveness and Testing of Criterion Validity(pages 474–482)

Background: Progress in establishing if therapies provide relief to cats with degenerative joint disease (DJD)-associated pain is hampered by a lack of validated owner-administered assessment methods.

Hypothesis: That an appropriately developed subjective owner-completed instrument (Feline Musculoskeletal Pain Index-FMPI) to assess DJD-associated impairment would have responsiveness and criterion validity.

Animals: Twenty-five client-owned cats with DJD-associated pain.

Methods: FMPI responsiveness (ability to detect the effect of an analgesic treatment) and validity (correlation with an objective measure) were explored through a stratified, randomized, double blinded, placebo-controlled, crossover 10-week clinical study. Meloxicam was administered to effect pain relief. A linear mixed model, backward stepwise regression, and Pearson correlations were used to assess responsiveness and criterion validity with the assumption that the NSAID would increase activity.
Results: Positive responses of cats to placebo ($P = .0001$) and meloxicam treatment ($P = .0004$) were detected; however, the instrument did not detect any difference between placebo and meloxicam (linear mixed model), even for the high impairment cases. Percent meloxicam target dose administered, temperament, and total baseline FMPI score were covariates that most affected FMPI scores. Controlling for significant covariates, most positive effects were seen for placebo treatment. Positive treatment effects on activity were detected, but only for the cases designated as most highly impaired.

Conclusions and Clinical Importance: Neither responsiveness nor criterion validity were detected by the inclusion criteria for cases in this study. The data suggest that further work is indicated to understand factors affecting activity in cats to optimize inclusion criteria.

**Prospective Evaluation of Biweekly Streptozotocin in 19 Dogs with Insulinoma (pages 483–490)**


Background: Administration of streptozotocin (STZ) at a 21-day interval has been described in dogs with stage II and III insulinoma. Myelosuppression was not observed, suggesting the possibility of increasing dose intensity by decreasing the interval between doses.

Objective: To describe the tolerability of a biweekly STZ protocol. A secondary objective was to describe the outcome of dogs treated with this protocol.

Animals: Nineteen dogs with residual local, metastatic, or recurrent insulinoma.

Methods: After surgery for insulinoma, or at the time of recurrence, dogs were treated with a previously described STZ and saline diuresis protocol. Treatments were administered every 14 days. All dogs received antiemetic treatment. Adverse events (AEs) were recorded and graded. Outcome endpoints assessed were progression-free survival (PFS) and survival.

Results: None of the dogs experienced neutropenia or thrombocytopenia. Mild to moderate gastrointestinal toxicity was the most common AE. Diabetes mellitus was observed in 8 dogs and, in 6, resulted in euthanasia or death. Two dogs developed nephrotoxicity manifested as Fanconi syndrome in 1 and nephrogenic diabetes insipidus in the other. Six dogs developed increased alanine amino transferase activity. Hypoglycemia at the end of the STZ infusion, resulted in collapse in 1 dog and a generalized seizure in another. The median overall PFS and survival time were 196 and 308 days, respectively.

Conclusions and Clinical Importance: Streptozotocin can be safely administered to dogs with insulinoma, but serious AEs are possible. Additional investigation is required to better define the role of STZ in managing dogs with insulinoma.

**Acquired Proximal Renal Tubular Dysfunction in 9 Labrador Retrievers with Copper-Associated Hepatitis (2006–2012) (pages 491–499)**

D.K. Langlois, R.C. Smedley, W.D. Schall and J.M. Kruger

Background: Copper-associated hepatitis (CAH) has been well described in Labrador Retrievers. However, the association of CAH with proximal renal tubular dysfunction in this breed has not been characterized.

Objectives: To report clinical features, hepatic and renal histopathologic findings, tissue copper concentrations, and outcome of Labradors with CAH and proximal renal tubular disease.

Animals: Nine Labrador Retrievers with renal glucosuria and biopsy-confirmed CAH.

Methods: Clinical, clinicopathologic, and light microscopic findings were retrospectively reviewed. Rhodanine staining or atomic emission spectroscopy was performed on all hepatic samples and available renal tissue (4 dogs) to assess copper concentrations.

Results: Eight dogs had a history of polyuria and polydipsia, and all dogs had increased serum bilirubin concentrations. Five dogs had hyperchloremic metabolic acidosis. Three dogs with acidaemia had paradoxical alkaliniuria. All renal specimens had increased copper concentrations. Renal tubular vacuolization, degeneration, and regeneration were observed on light microscopy. Four dogs died within 10 days of diagnosis. One dog survived 2 months; 4 dogs survived more than 1 year. In long-term survivors, including 2 that did not undergo immediate copper chelation, resolution of renal tubular dysfunction occurred within weeks to months.

Conclusions and Clinical Importance: Labrador Retrievers with CAH can develop clinical and laboratory evidence of renal tubular dysfunction in association with increased renal copper concentrations. Given the rarity of renal tubular disorders, detection of renal glucosuria and increased ALT activity in a Labrador Retriever is suggestive of CAH. Although renal tubular dysfunction may indicate advanced disease, successful long-term outcome is possible with a variety of therapies.

**Cardiac Troponin-I Concentration, Myocardial Arteriosclerosis, and Fibrosis in Dogs with Congestive Heart Failure because of Myxomatous Mitral Valve Disease (pages 500–506)**


Background: Few previous studies have investigated the association between biomarkers and cardiac disease findings in dogs with naturally occurring myxomatous mitral valve disease (MMVD).
Aim: To investigate if histopathological changes at necropsy could be reflected by in vivo circulating concentrations of cTnI and aldosterone, and renin activity, in dogs with naturally occurring congestive heart failure because of MMVD.

Animals: Fifty privately owned dogs with MMVD and heart failure.

Methods: Longitudinal Study. Dogs were prospectively recruited and examined by clinical and echocardiographical examination twice yearly until time of death. Blood was stored for batched analysis of concentrations of cTnI and aldosterone, and renin activity. All dogs underwent a standardized necropsy protocol.

Results: cTnI were associated with echocardiographic left ventricular end-diastolic dimension ($P < .0001$) and proximal isovolumetric surface area radius ($P < .004$). Furthermore, in vivo cTnI concentrations reflected postmortem findings of global myocardial fibrosis ($P < .001$), fibrosis in the papillary muscles ($P < .001$), and degree of arterial luminal narrowing ($P < .001$). Aldosterone or renin activity did not reflect any of the cardiac disease variables investigated.

Conclusion and clinical importance: Cardiac fibrosis and arteriosclerosis in dogs with MMVD are reflected by circulating cTnI concentration, but not by aldosterone concentration or renin activity. Cardiac troponin I could be a valuable biomarker for myocardial fibrosis in dogs with chronic cardiac diseases.

Effects of Dietary Salt Intake on Renal Function: A 2-Year Study in Healthy Aged Cats

B.S. Reynolds, V. Chetboul, P. Nguyen, I. Testault, D.V. Concordet, C. Carlos Sampedrano, J. Elliott, E. Trehiou-Sechi, J. Abadie, V. Biourge and H.P. Lefebvre

Background: Increasing salt intake to promote diuresis has been suggested in the management of feline lower urinary tract disease. However, high dietary salt intake might adversely affect blood pressure and renal function.

Objectives: The objective of this study was to assess the long-term effects of increased salt intake on renal function in healthy aged cats.

Methods: This study was controlled, randomized, and blinded. Twenty healthy neutered cats (10.1 ± 2.4 years) were randomly allocated into 2 matched groups. One group was fed a high salt diet (3.1 g/Mcal sodium, 5.5 g/Mcal chloride) and the other a control diet of same composition except for salt content (1.0 g/Mcal sodium, 2.2 g/Mcal chloride). Clinical examination, glomerular filtration rate, blood pressure measurement, cardiac and kidney ultrasonography, and urinary and blood tests were performed before and over 24 months after diet implementation. Statistics were performed using a general linear model.

Results: Sixteen cats completed the 2 year study. The only variables affected by dietary salt intake were plasma aldosterone and urinary sodium/creatinine ratio, respectively, higher and lower in the control group all over the study period and urinary specific gravity, lower in the high salt diet group at 3 months.

Conclusions and Clinical Importance: Glomerular filtration rate (GFR), blood pressure, and other routine clinical pathological variables in healthy aged cats were not affected by dietary salt content. The results of this 2 year study do not support the suggestion that chronic increases in dietary salt intake are harmful to renal function in older cats.

Comparison of Intravenous versus Intramuscular Administration of Corticotropin-Releasing Hormone in Healthy Cats

K.C. Eiler, D.S. Bruyette, E.N. Behrend, R.J. Kemppainen and P.H. Kass

Background: Because of the lack of a current validated assay for feline endogenous adrenocorticotropic hormone (ACTH) in response to administration of currently available ovine corticotropin-releasing hormone (oCRH) preparations, a complete evaluation of the hypothalamic-pituitary-adrenal axis in cats has not been possible.

Objective: This study was undertaken to (1) determine the pituitary (ACTH) and adrenal (cortisol) response to both IV and IM administration of a currently available oCRH product in healthy cats, and (2) validate an endogenous ACTH assay for use in cats.

Animals: Seventeen healthy cats receiving oCRH (n = 11) or placebo (n = 6).

Methods: Prospective, randomized, placebo-controlled study. oCRH at 1 μg/kg or placebo was given either IM or IV. Endogenous cortisol and ACTH concentrations were evaluated after the injection. A comparison of IM versus IV and placebo versus treatment was made.

Results: The DiaSorin immunoradiometric assay (IRMA) assay for ACTH performed well, showing both parallelism and acceptable intra- and interassay coefficients of variation. There was a significant difference between groups ($P = .025$) and a significant difference between times ($P = .025$) when endogenous ACTH concentrations were compared after oCRH IV or IM. No significant differences were observed in cortisol concentrations comparing IV to IM oCRH.

Conclusions: IM administration of oCRH results in significantly greater ACTH concentrations but not cortisol concentrations when compared with IV administration. Samples should be drawn before and at 60 minutes after the injection. The Diasorin IRMA is valid for feline endogenous ACTH measurements.
Renin-Angiotensin-Aldosterone System Activity in Hyperthyroid Cats with and without Concurrent Hypertension (pages 522–529)

T.L. Williams, J. Elliott and H.M. Syme

Background: Hypertension is present in some hyperthyroid cats at diagnosis or can develop after treatment for hyperthyroidism. Activation of the renin-angiotensin-aldosterone system (RAAS) could be involved in the pathogenesis of hypertension.

Hypothesis: Hyperthyroid cats that develop hypertension before or after treatment for hyperthyroidism will have greater RAAS activation than normotensive cats.

Animals: Ninety-nine hyperthyroid cats.

Methods: Retrospective case-control study. Plasma renin activity (PRA) and plasma aldosterone concentration (PAC) were measured in untreated hyperthyroid hypertensive cats (HT-Pre group), initially normotensive hyperthyroid cats that develop hypertension after treatment (HT-Post group), and hyperthyroid cats that are normotensive (NT group). Data are presented as median [25th, 75th percentile].

Results: Baseline PRA was not significantly different among the 3 groups (HT-Pre group 1.50 [0.05, 2.37] ng/mL/h, HT-Post group 0.66 [0.17, 2.31] ng/mL/h, NT group 1.11 [0.57, 2.18] ng/mL/h; P = .44). PRA decreased significantly after treatment in the NT group (1.09 [0.53, 2.47] versus 0.22 [0.05, 0.76] ng/mL/h; P < .001) and the HT-Post group (0.71 [0.17, 2.33] versus 0.28 [0.07, 0.57] ng/mL/h; P = .006). Baseline PAC was not significantly different among the 3 groups (HT-Pre group 72.2 [40.0, 145.6] pg/mL, HT-Post group 69.7 [43.3, 142.6] pg/mL, NT group 109.0 [68.2, 184.6] pg/mL; P = .10). PAC decreased significantly after treatment in the NT group (114.4 [56.6, 204.1] versus 59.5 [32.4, 98.2] pg/mL; P < .001) but did not change significantly in the HT-Post group (61.2 [44.9, 124.0] versus 58.4 [42.0, 97.7] pg/mL; P = .59).

Conclusions and Clinical Importance: RAAS activation occurs in hyperthyroid cats, but is not associated with the development of hypertension. PAC is not influenced by changes in PRA in hyperthyroid cats that develop hypertension after treatment, perhaps indicating RAAS dysfunction in these cats.

A Potential Role for Substance P and Interleukin-6 in the Cerebrospinal Fluid of Cavalier King Charles Spaniels with Neuropathic Pain (pages 530–535)

M.J. Schmidt, J. Roth, N. Ondreka, M. Kramer and C. Rummel

Background: Neuropathic pain can be a clinical sign in Cavalier King Charles Spaniels (CKCS) with syringomyelia. The pathophysiology of this pain is not fully understood.

Hypothesis: Neuropathic pain in CKCS is a result of a neuroinflammatory process.

Animals: Twenty-six client-owned dogs: 15 dogs with clinical signs of cervical hyperesthesia (group 1), and 11 dogs without of clinical signs (group 2).

Methods: Dogs were examined by magnetic resonance imaging (MRI). Interleukin-6, tumor necrosis factor alpha, and substance P were measured in CSF and compared with morphological findings on MRI and clinical pain scores.

Results: All dogs without clinical signs had symmetrical syringomyelia, whereas in the group with pain, 6 dogs had symmetrical and 9 dogs had asymmetrical syringomyelia. Pain and syringomyelia asymmetry were correlated, and a strong association between pain and dorsal horn involvement of syringomyelia was observed. There was no significant difference between the mean width of the syringomyelia in dogs with or without pain. The concentrations of interleukin-6 and substance P were significantly higher in dogs with neuropathic pain. Tumor necrosis factor alpha was not detected in either group. Concentrations of substance P were significantly higher in dogs with asymmetrical syringomyelia or dorsal horn involvement, whereas interleukin-6 concentrations were not significantly different between groups.

Conclusion: Release of interleukin-6 and substance P may initiate proinflammatory effects leading to development of persistent pain in CKCSs with syringomyelia.

A Prospective Randomized Clinical Trial of Vincristine versus Human Intravenous Immunoglobulin for Acute Adjunctive Management of Presumptive Primary Immune-Mediated Thrombocytopenia in Dogs (pages 536–541)


Background: Dogs with immune-mediated thrombocytopenia (ITP) are at risk of hemorrhage when platelet count is <50,000/μL. Treatment with vincristine (VINC) or human intravenous immunoglobulin (hIVIG) decreases platelet recovery time compared with treatment with corticosteroids alone.

Objectives: To compare the effect of hIVIG versus VINC on platelet recovery in dogs with ITP.

Methods: Prospective, randomized study. Twenty dogs with idiopathic ITP (platelet count <16,000/μL) were enrolled. All dogs were treated with corticosteroids. Dogs were randomly assigned to receive a single dose of hIVIG (0.5 g/kg) or VINC (0.02 mg/kg). Outcome measures were platelet recovery time, duration of hospitalization, and survival to discharge.
Results: There was no significant difference in age, sex, weight, or initial platelet count between dogs treated with hIVIG (n = 10) and dogs treated with VINC (n = 10). Median platelet recovery time for both groups was 2.5 days (P = .51). Median hospitalization time for all dogs that survived to discharge was 4 days and not different between groups (P = .29). Seven of 10 dogs in the hIVIG group and 10 of 10 in the VINC group survived to discharge. Survival analysis did not identify any significant difference between the groups at discharge, 6 months, and 1 year after entry into the study. No adverse effects were reported in either group. Conclusions and Clinical Importance: Vincristine should be the first-line adjunctive treatment for the acute management of canine ITP because of lower cost and ease of administration compared with human intravenous immunoglobulin (hIVIG).

Identification and Surgical Ligation of Aortopulmonic Vascular Malformation Causing Left Heart Volume Overload in 4 Dogs (pages 583–587)

Suspected Isolated Pancreatic Enzyme Deficiencies in Dogs (pages 588–591)
K.R. Viviano and V. Ziglioli

The Veterinary Record

Evaluation of fecal α1-proteinase inhibitor concentrations in cats with idiopathic inflammatory bowel disease and cats with gastrointestinal neoplasia
Kathrin F. Burke, John D. Broussard, Craig G. Ruaux, Jan S. Suchodolski, David A. Williams, Jörg M. Steiner

Idiopathic inflammatory bowel disease (IBD) and gastrointestinal lymphoma are common disorders in cats. The aim of this study was to evaluate fecal α1-PI concentrations, a marker of gastrointestinal protein loss, in cats with histopathological evidence of gastrointestinal inflammation or gastrointestinal neoplasia. Fecal and serum samples were obtained from 20 cats with chronic gastrointestinal disease in which endoscopic biopsies were performed. Two groups of cats were assembled based on histopathology: Group A (n = 8), mild to moderate IBD; Group B (n = 12), severe IBD or gastrointestinal neoplasia. Fecal α1-PI concentrations and serum concentrations of total protein, albumin, globulin, cobalamin, folate, pancreatic lipase immunoreactivity, and trypsin-like immunoreactivity were determined. Nineteen of the 20 diseased cats had elevated fecal α1-PI concentrations, ranging from 1.9 to 233.6 μg/g compared to 20 healthy control cats (normal range: ≤ 1.6 μg/g). Fecal α1-PI concentrations were statistically significantly different between healthy cats and cats of Group A (median: 3.9 μg/g, range: 1.3–9.2 μg/g, P < 0.001) or cats of Group B (median: 20.6 μg/g, 4.3–233.6 μg/g; P < 0.001), and between cats of Groups A and B (P < 0.01). Hypoalbuminemia, hypoproteinemia, and hypocobalaminemia were detected in 88%, 83%, and 56% of the diseased cats, respectively.

This study suggests that increased fecal α1-PI concentrations in association with low serum albumin and total protein concentrations may be a common finding in cats with IBD or gastrointestinal neoplasia. Furthermore, fecal α1-PI concentrations appear to be higher in cats with severe IBD or confirmed gastrointestinal neoplasia when compared to cats with mild to moderate IBD.

Augmented reality intravenous injection simulator based 3D medical imaging for veterinary medicine

Augmented reality (AR) is a technology which enables users to see the real world, with virtual objects superimposed upon or composited with it. AR simulators have been developed and used in human medicine, but not in veterinary medicine. The aim of this study was to develop an AR intravenous (IV) injection simulator to train veterinary and pre-veterinary students to perform canine venipuncture. Computed tomographic (CT) images of a beagle dog were scanned using a 64-channel multidetector. The CT images were transformed into volumetric data sets using an image segmentation method and were converted into a stereolithography format for creating 3D models. An AR-based interface was developed for an AR simulator for IV injection. Veterinary and pre-veterinary student volunteers were randomly assigned to an AR-trained group or a control group trained using more traditional methods (n = 20/group; n = 8 pre-veterinary students and n = 12 veterinary students in each group) and their proficiency at IV injection technique in live dogs was assessed after training was completed. Students were also asked to complete a questionnaire which was administered after using the simulator. The group that was trained using an AR simulator were more proficient at IV injection technique using real dogs than the control group (P < 0.01). The students agreed that they learned the IV injection technique through the AR simulator. Although the system used in this study needs to be modified before it can be adopted for veterinary educational use, AR simulation has been shown to be a very effective tool for training medical
personnel. Using the technology reported here, veterinary AR simulators could be developed for future use in veterinary education.

**Mortality in virulent canine babesiosis is associated with a consumptive coagulopathy**
Amelia Goddard, Bo Wuinberg, Johan P. Schoeman, Annemarie T. Kristensen, Mads Kjelgaard-Hansen

The inflammatory response to infection can activate the coagulation system via complex interactions. If uncontrolled, this may lead to a consumptive coagulopathy, a major risk factor for a poor clinical outcome. This prospective observational study was conducted to determine whether consumptive coagulopathy in dogs with *Babesia rossi* infection is related to mortality. Seventy-two client-owned dogs diagnosed with canine babesiosis were included. Diagnosis was confirmed by polymerase chain reaction and reverse line blot and dogs co-infected with *Babesia vogeli* or *Ehrlichia canis* were excluded. Blood samples were collected at admission. Coagulation factor-, antithrombin (AT)-, and protein C (PC)-activity, prothrombin time (PT), activated partial thromboplastin time (aPTT), fibrinogen and D-dimer concentrations were measured.

The mortality rate was 18% (13/72 dogs) and the median activities of all the coagulation factors were significantly lower in the non-survivors compared to the survivors. Median PT and aPTT were significantly longer in the non-survivors compared to the survivors. Median AT activity was not significantly different but median PC activity was significantly decreased in the non-survivors. Median D-dimer concentrations were significantly higher in non-survivors compared to survivors. This study showed that dogs that died from *B. rossi* infection had a more severe consumptive coagulopathy compared to survivors, characterized by procoagulant activation, inhibitor consumption, and increased fibrinolytic activity.

**KIT gene exon 11 mutations in canine malignant melanoma**
Pei-Yi Chu, Siou-Li Pan, Chen-Hsuan Liu, Jihjong Lee, Lili-Seng Yeh, Albert T. Liao

The proto-oncogene *KIT* encodes a receptor tyrosine kinase which has been shown to be upregulated in canine melanomas. *KIT* mutations lead to constitutive phosphorylation and activation of KIT in the absence of ligand binding. The presence of *KIT* mutations and KIT protein expression was examined in a cohort of 49 dogs with canine malignant melanoma. An exon 11 synonymous nucleotide 1743C → T mutation was identified in five cases in which one also harbored a L579P mutation. Tumors that harbored the *KIT* exon 11 mutation(s) correlated significantly with disease recurrence (*P* = 0.05). All 36 melanomas available for immunohistochemical analysis showed either weak (16 cases, 44.4%) or strong (20 cases, 55.6%) expression of the KIT protein. The five *KIT* mutation carriers were all strongly positive for KIT by immunohistochemical staining. These findings suggest that a subset of canine malignant melanomas harbors a *KIT* exon 11 mutation.

**Peripheral blood biomarkers of solid tumor angiogenesis in dogs: A polychromatic flow cytometry pilot study**
R. Timothy Bentley, Julie A. Mund, Karen E. Pollok, Michael O. Childress, Jamie Case

A subset of peripheral blood hematopoietic stem and progenitor cells of bone marrow origin is elevated in humans with solid cancers before treatment and declines with therapy. This biomarker of angiogenesis is not specific to tumor type and has great potential in the objective assessment of treatment response in clinical trials. This pilot study was designed to develop a biomarker of neoangiogenesis in dogs for the diagnosis of cancer, the measurement of treatment response, and the provision of objective data in clinical trials. Polychromatic flow cytometry was used to quantify two subsets of circulating hematopoietic stem and progenitor cells in dogs with spontaneous solid tumors before (*n* = 8) and after (*n* = 3) treatment, and normal controls (*n* = 6).

Pro-angiogenic peripheral blood cells of bone marrow origin were detected in all eight cases and the six normal controls; however, there was no statistically significant difference between the two groups. Interestingly, an apparent decline in pro-angiogenic cells was observed after treatment. Bone marrow derived hematopoietic cells appear to contribute to tumor angiogenesis in dogs, as has been previously reported in humans. While the methodology for pro-angiogenic cell quantification in a small number of dogs in the current study did not result in a significant difference from normal controls, an optimized canine polychromatic flow cytometry protocol holds great promise in the development of a canine cancer model and for the objective measurements of treatment response in clinical trials.

**Histopathological and immunohistochemical assessment of invasive micropapillary mammary carcinoma in dogs: A retrospective study**

Invasive micropapillary carcinoma (IMPC) of the mammary gland, despite its rare occurrence in humans and dogs, is an important neoplasm due to its aggressive behaviour. The aim of this study was to evaluate the clinicopathological and immunophenotypical characteristics of IMPC and to determine the overall survival of dogs with this tumour. Of the selected cases, the majority had >3 cm neoplasms (15/19, 78.95%) and lymph node metastases (16/16, 100%), but only two cases (2/9, 22.2%) had distant metastases.
The IMPCs were classified as either pure (15/22, 68.18%) or mixed (7/22, 31.82%) types. There was a predominance of moderate histological grade tumours (16 grade II) and the average overall survival was 120 days. Positive immunohistochemical staining for epithelial membrane antigen and negative staining for CD31, p63 and cytokeratin (CK) AE1AE3 in cystic formations confirmed the micropapillary nature of these neoplasms. A proportion of cases exhibited positive epithelial staining for p63 (4/20, 20%) and CK34βE12 (20/22, 90.9%). Most cases were positive for oestrogen (19/20, 95%) and progesterone (19/20, 95%) receptors, but lacked HER-2 (16/22, 72.72%) and epidermal growth factor receptor (15/22, 68.18%) over-expression. The mean proliferation index was 14.8%. The findings demonstrate that, similar to humans, canine IMPCs behave aggressively with high rates of metastasis to regional lymph nodes and short overall survival times.

Matrix metalloproteinases and vascular endothelial growth factor expression in canine leukaemias
Arianna Aricò, Mery Giantin, Mariaelena Gelain, Fulvio Riondato, Michele Mortarino, Stefano Comazzi, Mauro Dacasto, Massimo Castagnaro, Luca Aresu
Matrix metalloproteinases (MMPs) and vascular endothelial growth factor (VEGF) play a coordinated role during neoplastic invasion and proliferation. VEGF and MMPs expression was investigated in canine leukaemias by immunocytochemistry (MMP-9, MMP-2, VEGF-A) and quantitative RT-PCR (MMP-2, MMP-9, MT1-MMP, TIMP-1, TIMP-2, RECK, VEGF-A, VEGF-164). Blood samples were obtained from dogs with acute leukaemia (AL; n = 11) and chronic lymphocytic leukaemia (CLL; n = 12). Levels of MMP-9, TIMP-1 and VEGF-A were higher in CLL than AL and controls. Expression of TIMP-2 and MT1-MMP mRNA was significantly higher in AL than CLL. Significant positive correlations were found between MMP-9 and TIMP-1 and between MMP-9 and VEGF-A in CLL. These results suggest a potential role of MMP-9, MT1-MMP, TIMP-1, TIMP-2 and VEGF in tissue migration and angiogenesis in canine leukaemia.

Pharmacokinetics of hydrocodone and hydromorphone after oral hydrocodone in healthy Greyhound dogs
Butch KuKanich, Julia Spade
The purpose of this study was to determine the pharmacokinetics of hydrocodone and its active metabolite hydromorphone in six healthy Greyhound dogs. Hydrocodone bitartrate was administered at a targeted dose of 0.5 mg/kg PO. Plasma concentrations of hydrocodone and hydromorphone were determined by liquid chromatography triple quadrupole mass spectrometry. The mean hydrocodone CMAX was 11.73 ng/mL at 0.74 h with a terminal half-life of 1.60 h. The mean hydromorphone CMAX was 5.2 ng/mL at 1.37 h with a terminal half-life of 3.07 h. Mean plasma hydromorphone concentrations exceeded 2 ng/mL from 0.5 to 8 h after hydrocodone administration. Further studies assessing the antinociceptive effects of oral hydrocodone are needed.

Journal of Small Animal Practice
Development, validation and reliability of a web-based questionnaire to measure health-related quality of life in dogs.
J. Reid, M. L. Wiseman-Orr, E. M. Scott and A. M. Nolan
Objectives- To describe the development, preliminary validation and reliability testing of a shortened web-based form of GUVQuest, a structured questionnaire to measure health-related quality of life in dogs. Methods - The original 109 items were reduced using expert judgement and factor analysis. Validity was established by factor analysis and in a subsequent field trial using a “known groups” approach and classical test theory. Test–retest reliability was assessed using intraclass correlation coefficients. Results - The instrument comprises 46 items each of which is rated by dog owners using a 7-point Likert scale. Factor analysis revealed a sensible structure containing four health-related quality of life domains (vitality, pain, distress and anxiety) accounting for 64·1% of the variability in the data. The field test involving 125 dogs demonstrated very good discriminative properties and intraclass correlation coefficient values of greater than 0.6. Clinical Significance - This is the first report of a valid and reliable companion animal health-related quality of life instrument, the contemporary approach to animal welfare measurement, which is presented in a web-based format, with automated production of a health-related quality of life profile. It offers major advantages to dog owners, practitioners and researchers.

Left ventricular geometrical differences in dogs with various stages of myxomatous mitral valve disease
R. Suzuki, H. Matsumoto, T. Teshima, Y. Mochizuki and H. Koyama
Objectives- To evaluate left ventricular geometry in dogs with various stages of myxomatous mitral valve disease. Methods - Ninety-seven dogs with myxomatous mitral valve disease classified by the International Small Animal Cardiac Health Council system and 20 weight- and age-matched healthy dogs. Left ventricular long-axis to short-axis ratio, sphericity index in end-diastole and end-systole, left ventricular wall thickness to internal dimension ratio and relative wall thickness were assessed. Results - The diastolic sphericity index was
lower in classes Ib, II and III than in healthy dogs (P<0.003, P<0.001 and P<0.001) and was also lower in class III than in classes Ia, Ib and class II dogs (P<0.001, P<0.001 and P<0.002). The relative wall thickness was lower in classes II and III than in class Ia (P<0.003 and P<0.001), class Ib (P=0.004 and P<0.001), and healthy dogs (P<0.001 and P<0.001) and was also lower in class III than in class II (P=0.005). Clinical Significance - Sphericity index and relative wall thickness are simple methods for assessing left ventricular geometry using two-dimensional echocardiography that may be useful in myxomatous mitral valve disease dogs as part of risk stratification.

The vacuum phenomenon in intervertebral disc disease of dogs based on computed tomography images
M. K. Müller, E. Ludewig, G. Oechtering, M. Scholz and T. Flegel
Objectives - Vacuum phenomenon is suspected to be indicative of disc degeneration and subsequent herniation. The objective of this study was to assess the reliability of vacuum phenomenon for identification of herniated discs causing neurological signs. Prevalence of vacuum phenomenon and influencing factors in dogs with disc herniation were determined.

Methods - Retrospective review of computed tomography scans from dogs with suspected disc herniation for the presence of gas within intervertebral disc space with subsequent comparison of vacuum phenomenon and herniated disc as confirmed by surgery. Subgroups were created (chondrodystrophic, non-chondrodystrophic and unknown classification) to analyse prevalence and influencing factors (age, breed and gender) for vacuum phenomenon and agreement with herniated disc. Results - Prevalence of vacuum phenomenon in all dogs, chondrodystrophic, non-chondrodystrophic dogs and those with unknown classification was 19.8, 14.9, 35.7 and 24.5%, respectively. Corresponding correlation rate between vacuum phenomenon and herniated disc was 64, 67, 40 and 82%. Prevalence of vacuum phenomenon was significantly higher in nonchondrodystrophic dogs (P=0.04). Age was the only factor influencing prevalence of vacuum phenomenon (P=0.04). Clinical Significance - In dogs with intervertebral disc disease, vacuum phenomenon is a frequent but inconsistent finding. Although helpful to identify degenerated discs, it is not suitable to identify currently herniated disc with sufficient accuracy.

Correlation of bronchoalveolar eosinophilic percentage with airway responsiveness in cats with chronic bronchial disease
F. J. W. Allerton, J. Leemans, C. Tual, F. Bernaerts, N. Kirschvink and C. Clercx
Objectives - To retrospectively assess the relationship between bronchoalveolar lavage fluid analysis and lung function parameters as assessed by means of barometric whole body plethysmography and airway responsiveness testing in cats with chronic bronchial disease and to evaluate the potential application of barometric whole body plethysmography and airway responsiveness testing to distinguish between eosinophilic and non-eosinophilic bronchitis. Methods - Twelve cats presented for chronic bronchial disease with complete bronchoalveolar lavage fluid and barometric whole body plethysmography data were identified. Cats were retrospectively assigned to eosinophilic bronchitis or non-eosinophilic bronchitis groups on the basis of bronchoalveolar lavage fluid eosinophil percentage (threshold 17%). Airway responsiveness was quantified by calculating the concentration of carbachol-inducing bronchoconstriction (C-Penh-300), defined as a 300% increase of basal enhanced pause (Penh). Results - Log Penh was significantly higher and C-Penh-300 significantly lower in eosinophilic bronchitis cats compared to non-eosinophilic bronchitis cats (P<0.031 and P=0.032, respectively). Bronchoalveolar lavage fluid eosinophil percentage was moderately correlated with log Penh (P=0.012, r=0.70) and showed a weak inverse correlation with C-Penh-300 (P=0.047, r=−0.58). Clinical Significance - This study provides supportive evidence of a correlation between airway eosinophilic inflammation and plethysmographic measures of bronchoconstriction and airway responsiveness. Further investigation of the use of barometric whole body plethysmography to differentiate between forms of chronic bronchial disease in cats is indicated.

Multiple inflammatory gastric polyps treated by endoscopic polypectomy with argon plasma coagulation in a dog
T. Teshima, H. Matsumoto, M. Michishita, K. Takahashi and H. Koyama
An 11-year-old spayed female miniature dachshund was evaluated for a 2-month history of chronic vomiting. Abdominal ultrasonography revealed a heterogeneous mass in the pyloric region. Contrast upper gastrointestinal radiography demonstrated impairment of gastric outflow. Endoscopic examination revealed multiple polyps at the gastric pylorus. The pyloric polyps were variable in size, sessile-shaped and pedunculated. Initially, endoscopic polypectomy was attempted, but all the polyps could not be completely resected. Thus, endoscopic polypectomy with argon plasma coagulation was performed to cauterise the lesions. The histopathological diagnosis of the lesions was inflammatory polyps, and a moderate number of Helicobacter spp. was revealed. After the argon plasma coagulation treatment, the dog did not vomit, and improvement of clinical signs was maintained for 13 months. Endoscopic polypectomy with argon plasma coagulation may be useful for mixtures
of sessile and pedunculated polyps. The present report may provide a basis for further studies of argon plasma coagulation treatment for canine gastrointestinal polyps.

Mushroom toxicosis in dogs in general practice causing gastroenteritis, ptyalism and elevated serum lipase activity
J. Hall and L. Barton
Mushroom toxicosis is rarely diagnosed in dogs and is poorly reported in the veterinary literature. This report suggests that mushroom toxicosis is a potentially under-diagnosed condition in first opinion practice in the UK. Nine dogs with clinical signs consistent with mushroom toxicosis were identified from the records of an out-of-hours emergency service between August 2010 and January 2011. Four dogs were later excluded because of clinical inconsistencies. Clinical signs included acute profuse ptyalism (5/5), diarrhoea (5/5), vomiting (4/5), hypovolaemia (4/5), stuporous (3/5) or obtunded mentation (1/5), miosis (2/5) and hypothermia (2/5). Serum lipase activity was elevated in 4/4 dogs; canine-specific pancreatic lipase was elevated in the remaining dog. Four dogs recovered with aggressive intravenous fluid therapy, analgesia and supportive care; the remaining dog was euthanased due to severe clinical signs and financial constraints.

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Effects of isoflurane with and without dexmedetomidine or remifentanil on heart rate variability before and after nociceptive stimulation at different multiples of minimum alveolar concentration in dogs
Anne M. Voigt, Carina Bergfeld, Martin Beyerbach, Sabine B. R. Kästner, and after nociceptive stimulation at different multiples of minimum alveolar concentration (MAC) on heart rate variability (HRV) with and without nociceptive stimulation in dogs. Animals—6 healthy adult Beagles. Procedures—Each dog was anesthetized 3 times: with isoflurane alone, with isoflurane and a constant rate infusion of dexmedetomidine (IsoD; 3 μg/kg/h, IV), and with isoflurane and a constant rate infusion of remifentanil (IsoR; 18 μg/kg/h, IV). Individual MAC was determined via supramaximal electrical stimulation. Sinus rhythm–derived intervals between 2 adjacent R-R intervals were exported from ECG recordings. Selected HRV time and frequency domain variables were obtained (at 2-minute intervals) and analyzed offline with signed rank tests before and after stimulation at 0.75, 1.0, and 1.5 MAC for each anesthetic session. Results—The isoflurane session had the overall lowest prestimulation SDNN (SD of all R-R intervals) values. Prestimulation SDNN values decreased significantly with increasing MAC in all sessions. For the IsoD session, SDNN (milliseconds) or high-frequency power (milliseconds2) was inversely correlated with MAC (Spearman rank correlation coefficient for both variables, −0.77). In the isoflurane and IsoR sessions, heart rate increased significantly after stimulation. In the IsoD session, poststimulation SDNN was increased significantly, compared with prestimulation values, at 0.75 and 1.0 MAC.
Conclusions and Clinical Relevance—On the basis of SDNN and high-frequency power values, anesthetic levels between 0.75 and 1.5 MAC within the same anesthetic protocol could be differentiated, but with a large overlap among protocols. Usefulness of standard HRV variables for assessment of anesthetic depth and nociception in dogs is questionable.

Cardiopulmonary effects of intravenous fentanyl infusion in dogs during isoflurane anesthesia and with concurrent acepromazine or dexmedetomidine administration during anesthetic recovery
Stephanie C. J. Keating, Carolyn L. Kerr, Alexander Valverde, Ron J. Johnson, Wayne N. McDonell
Objective—To evaluate the cardiopulmonary effects of IV fentanyl administration in dogs during isoflurane anesthesia and during anesthetic recovery with or without dexmedetomidine or acepromazine. Animals—7 sexually intact male purpose-bred hound-type dogs aged 11 to 12 months. Procedures—Dogs received a loading dose of fentanyl (5 μg/kg, IV) followed by an IV infusion (5 μg/kg/h) for 120 minutes while anesthetized with isoflurane and for an additional 60 minutes after anesthesia was discontinued. Dogs were randomly assigned in a crossover design to receive dexmedetomidine (2.5 μg/kg), acepromazine (0.05 mg/kg), or saline (0.9% NaCl) solution (1 mL) IV after anesthesia ceased. Cardiopulmonary data were obtained during anesthesia and for 90 minutes after treatment administration during anesthetic recovery. Results—Concurrent administration of fentanyl and isoflurane resulted in significant decreases in mean arterial blood pressure, heart rate, and cardiac index and a significant increase in Paco2. All but Paco2 returned to pretreatment values before isoflurane anesthesia was discontinued. During recovery, dexmedetomidine administration resulted in significant decreases in heart rate, cardiac index, and mixed venous oxygen tension and a significant increase in arterial blood pressure, compared with values for saline solution and acepromazine treatments. Acepromazine administration resulted in significantly lower blood pressure and higher cardiac index and Po2 in mixed venous blood than did the other treatments. Dexmedetomidine treatment resulted in significantly lower values for Paco2 and arterial pH and higher Paco2 values than both other treatments. Conclusions and Clinical Relevance—Fentanyl resulted in transient pronounced cardiorespiratory effects when administered during isoflurane anesthesia. During
anesthetic recovery, when administered concurrently with an IV fentanyl infusion, dexmedetomidine resulted in evidence of cardiopulmonary compromise and acepromazine transiently improved cardiopulmonary performance.

**Fecal calprotectin concentrations in adult dogs with chronic diarrhea**

Aurélien Grelet, Romy M. Heilmann, Patrick Lecoindre, Alexandre Feugier, Michael J. Day, Dominique Peeters, Valérie Freiche, Juan Hernandez, Dominique Grandjean, Jan S. Suchodolski, Jorg M. Steiner.

Objective—To evaluate fecal calprotectin concentrations in healthy dogs and dogs with chronic diarrhea, to identify cutoff values for fecal calprotectin concentrations for use in differentiating dogs with chronic diarrhea and a canine chronic enteropathy clinical activity index (CCECAI) < 12 from dogs with chronic diarrhea and a CCECAI ≥ 12, and to evaluate the association between histologic evidence of intestinal mucosal changes and fecal calprotectin concentrations in dogs with chronic diarrhea. Sample—Fecal samples from 96 adult dogs (27 dogs with chronic diarrhea and 69 healthy control dogs). Procedures—Severity of clinical signs was evaluated on the basis of the CCECAI scoring system. Endoscopy was performed in all dogs with chronic diarrhea, and mucosal biopsy specimens were evaluated histologically. Fecal calprotectin concentration was quantified via radioimmunoassay. Results—Fecal calprotectin concentrations were significantly higher in dogs with chronic diarrhea than in healthy control dogs. Fecal calprotectin concentrations were also significantly higher in dogs with a CCECAI ≥ 12, compared with concentrations for dogs with a CCECAI between 4 and 11. Fecal calprotectin concentrations were significantly higher in dogs with chronic diarrhea associated with histologic lesions, compared with concentrations in control dogs, and were significantly correlated with the severity of histologic intestinal lesions. Among dogs with chronic diarrhea, the best cutoff fecal calprotectin concentration for predicting a CCECAI ≥ 12 was 48.9 μg/g (sensitivity, 53.3%; specificity, 91.7%). Conclusions and Clinical Relevance—Fecal calprotectin may be a useful biomarker in dogs with chronic diarrhea, especially dogs with histologic lesions.

**Noninvasive measurements of body composition and body water via quantitative magnetic resonance, deuterium water, and dual-energy x-ray absorptiometry in cats**


Objective—To compare quantitative magnetic resonance (QMR), dual-energy x-ray absorptiometry (DXA), and deuterium oxide (D2O) dilution methods for measurement of total body water (TBW), lean body mass (LBM), and fat mass (FM) in healthy cats and to assess QMR precision and accuracy. Animals—Domestic shorthair cats (58 and 32 cats for trials 1 and 2, respectively). Procedures—QMR scans of awake cats performed with 2 units were followed by administration of D2O tracer (100 mg/kg, PO). Cats then were anesthetized, which was followed by QMR and DXA scans. Jugular blood samples were collected before and 120 minutes after D2O administration. Results—QMR precision was similar between units (coefficient of variation < 2.9% for all measures). Fat mass, LBM, and TBW were similar for awake or sedated cats and differed by 4.0%, 3.4%, and 3.9%, respectively, depending on the unit. The QMR minimally underestimated TBW (1.4%) and LBM (4.4%) but significantly underestimated FM (29%), whereas DXA significantly underestimated LBM (9.2%) and quantitatively underestimated FM (9.3%). A significant relationship with D2O measurement was detected for all QMR (r² > 0.84) and DXA (r² > 0.84) measurements. Conclusions and Clinical Relevance—QMR was useful for determining body composition in cats; precision was improved over DXA. Quantitative magnetic resonance can be used to safely and rapidly acquire data without the need for anesthesia, facilitating frequent monitoring of weight changes in geriatric, extremely young, or ill pets. Compared with the D2O dilution method, QMR correction equations provided accurate data over a range of body compositions.

**Noninvasive measurements of body composition and body water via quantitative magnetic resonance, deuterium water, and dual-energy x-ray absorptiometry in awake and sedated dogs**


Objective—To compare quantitative magnetic resonance (QMR), dual-energy x-ray absorptiometry (DXA), and deuterium oxide (D2O) methods for measurement of total body water (TBW), lean body mass (LBM), and fat mass (FM) in healthy dogs and to assess QMR accuracy. Animals—58 Beagles (9 months to 11.5 years old). Procedures—QMR scans were performed on awake dogs. A D2O tracer was administered (100 mg/kg, PO) immediately before dogs were sedated, which was followed by a second QMR or DXA scan. Jugular blood samples were collected before and 120 minutes after D2O administration. Results—TBW, LBM, and FM determined via QMR were not significantly different between awake or sedated dogs, and means differed by only 2.0%, 2.2%, and 4.3%, respectively. Compared with results for D2O dilution, QMR significantly underestimated TBW (10.2%), LBM (13.4%), and FM (15.4%). Similarly, DXA underestimated LBM (7.3%) and FM (8.4%). A significant relationship was detected between FM measured via D2O dilution and QMR (r² > 0.84) and DXA (r² > 0.84) measurements. Conclusions and Clinical Relevance—QMR was useful for determining body composition in awake and sedated dogs.
endothelial growth factor and associated proinflammatory cytokine production may accelerate seizure-induced neuronal death in the cerebral cortex of Shetland Sheepdogs with familial epilepsy. Microglial activation induced by vascular endothelial growth factor and associated proinflammatory cytokines may contribute to neuronal death in the cerebral cortex of Shetland Sheepdogs with familial epilepsy.

Robert B. Brady, Alexis N. Sidiropoulos, Hunter J. Bennett, Patrick M. Rider, Denis J. Marcellin-Little, Paul DeVita.

Objective—To assess differences in sagittal plane joint kinematics and ground reaction forces between lean and obese adult dogs of similar sizes at 2 trotting velocities. Animals—16 adult dogs. Procedures—Dogs with body condition score (BCS) of 8 or 9 (obese dogs; n = 8) and dogs with BCS of 4 or 5 (lean dogs; 8) on a 9-point scale were evaluated. Sagittal plane joint kinematic and ground reaction force data were obtained from dogs trotting at 1.8 and 2.5 m/s with a 3-D motion capture system, a force platform, and 12 infrared markers placed on bony landmarks. Results—Mean stride lengths for forelimbs and hind limbs at both velocities were shorter in obese than in lean dogs. Stance phase range of motion (ROM) was greater in obese dogs than in lean dogs for shoulder (28.2° vs 20.6°), elbow (23.6° vs 16.4°), hip (27.2° vs 22.9°), and tarsal (38.9° vs 27.9°) joints at both velocities. Swing phase ROM was greater in obese dogs than in lean dogs for elbow (61.2° vs 53.7°) and hip (34.4° vs 29.8°) joints. Increased velocity was associated with increased stance ROM in elbow joints and increased stance and swing ROM in hip joints of obese dogs. Obese dogs exerted greater peak vertical and horizontal ground reaction forces than did lean dogs. Body mass and peak vertical ground reaction force were significantly correlated. Conclusions and Clinical Relevance—Greater ROM detected during the stance phase and greater ground reaction forces in the gait of obese dogs, compared with lean dogs, may cause greater compressive forces within joints and could influence the development of osteoarthritis.

Evaluation of gait-related variables in lean and obese dogs at a trot

Robert B. Brady, Alexis N. Sidiropoulos, Hunter J. Bennett, Patrick M. Rider, Denis J. Marcellin-Little, Paul DeVita.

Objective—To assess differences in sagittal plane joint kinematics and ground reaction forces between lean and obese adult dogs of similar sizes at 2 trotting velocities. Animals—16 adult dogs. Procedures—Dogs with body condition score (BCS) of 8 or 9 (obese dogs; n = 8) and dogs with BCS of 4 or 5 (lean dogs; 8) on a 9-point scale were evaluated. Sagittal plane joint kinematic and ground reaction force data were obtained from dogs trotting at 1.8 and 2.5 m/s with a 3-D motion capture system, a force platform, and 12 infrared markers placed on bony landmarks. Results—Mean stride lengths for forelimbs and hind limbs at both velocities were shorter in obese than in lean dogs. Stance phase range of motion (ROM) was greater in obese dogs than in lean dogs for shoulder (28.2° vs 20.6°), elbow (23.6° vs 16.4°), hip (27.2° vs 22.9°), and tarsal (38.9° vs 27.9°) joints at both velocities. Swing phase ROM was greater in obese dogs than in lean dogs for elbow (61.2° vs 53.7°) and hip (34.4° vs 29.8°) joints. Increased velocity was associated with increased stance ROM in elbow joints and increased stance and swing ROM in hip joints of obese dogs. Obese dogs exerted greater peak vertical and horizontal ground reaction forces than did lean dogs. Body mass and peak vertical ground reaction force were significantly correlated. Conclusions and Clinical Relevance—Greater ROM detected during the stance phase and greater ground reaction forces in the gait of obese dogs, compared with lean dogs, may cause greater compressive forces within joints and could influence the development of osteoarthritis.

Relationship of angiogenesis and microglial activation to seizure-induced neuronal death in the cerebral cortex of Shetland Sheepdogs with familial epilepsy

Masashi Sakurai, Takehito Morita, Takashi Takeuchi, Akinori Shimada.

Objective—To determine whether angiogenesis and microglial activation were related to seizure-induced neuronal death in the cerebral cortex of Shetland Sheepdogs with familial epilepsy. Animals—Cadavers of 10 Shetland Sheepdogs from the same family (6 dogs with seizures and 4 dogs without seizures) and 4 age-matched unrelated Shetland Sheepdogs. Procedures—Samples of brain tissues were collected after euthanasia and then fixed in neutral phosphate–buffered 10% formalin and routinely embedded in paraffin. The fixed samples were sectioned for H&E staining and immunohistochemical analysis. Results—Evidence of seizure-induced neuronal death was detected exclusively in samples of cerebral cortical tissue from the dogs with familial epilepsy in which seizures had been observed. The seizure-induced neuronal death was restricted to tissues from the cingulate cortex and sulci surrounding the cerebral cortex. In almost the same locations as where seizure-induced neuronal death was identified, microvessels appeared longer and more tortuous and the number of microvessels was greater than in the dogs without seizures and control dogs. Occasionally, the microvessels were surrounded by oval to flat cells, which had positive immunohistochemical results for von Willebrand factor. Immunohistochemical results for neurons and glial cells (astrocytes and microglia) were positive for vascular endothelial growth factor, and microglia positive for ionized calcium–binding adapter molecule 1 were activated (ie, had swollen cell bodies and long processes) in almost all the same locations as where seizure-induced neuronal death was detected. Double-label immunofluorescence techniques revealed that the activated microglia had positive results for tumor necrosis factor-α, interleukin-6, and vascular endothelial growth factor receptor 1. These findings were not observed in the cerebrum of dogs without seizures, whether the dogs were from the same family as those with epilepsy or were unrelated to them. Conclusions and Clinical Relevance—Signs of angiogenesis and microglial activation corresponded with seizure-induced neuronal death in the cerebral cortex of Shetland Sheepdogs with familial epilepsy. Microglial activation induced by vascular endothelial growth factor and associated proinflammatory cytokine production may accelerate seizure-induced neuronal death in dogs with epilepsy.

Effect of bevacizumab on angiogenesis and growth of canine osteosarcoma cells xenografted in athymic mice


Objective—To investigate the effects of bevacizumab, a human monoclonal antibody against vascular endothelial growth factor, on the angiogenesis and growth of canine osteosarcoma cells xenografted in mice. Animals—27 athymic nude mice. Procedures—To each mouse, highly metastasizing parent osteosarcoma cells...
of canine origin were injected into the left gastrocnemius muscle. Each mouse was then randomly allocated to 1
of 3 treatment groups: high-dose bevacizumab (4 mg/kg, IP), low-dose bevacizumab (2 mg/kg, IP), or control
(no treatment). Tumor growth (the number of days required for the tumor to grow from 8 to 13 mm),
vasculature, histomorphology, necrosis, and pulmonary metastasis were evaluated.
Results—Mice in the high-dose bevacizumab group had significantly delayed tumor growth (mean ± SD, 13.4 ±
3.8 days; range, 9 to 21 days), compared with that for mice in the low-dose bevacizumab group (mean ± SD, 9.4
± 1.5 days; range, 7 to 11 days) or control group (mean ± SD, 7.2 ± 1.5 days; range, 4 to 9 days). Mice in the
low-dose bevacizumab group also had significantly delayed tumor growth, compared with that for mice in the
control group.
Conclusions and Clinical Relevance—Results indicated that bevacizumab inhibited growth of canine
osteosarcoma cells xenografted in mice, which suggested that vascular endothelial growth factor inhibitors may
be clinically useful for the treatment of osteosarcoma in dogs.
Impact for Human Medicine—Canine osteosarcoma is used as a research model for human osteosarcoma;
therefore, bevacizumab may be clinically beneficial for the treatment of osteosarcoma in humans.

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Serum feline-specific pancreatic lipase immunoreactivity concentrations and abdominal ultrasonographic
findings in cats with trauma resulting from high-rise syndrome
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M. Steiner, Dr med vet, PhD, DACVIM; Alexander Tichy, Dr rer nat; Gilles Dupré, Dr med vet
Objective—To evaluate serum feline-specific pancreatic lipase immunoreactivity (fPLI) concentrations and
abdominal ultrasonographic findings in cats with trauma resulting from high-rise syndrome.
Design—Prospective case series.
Animals—34 client-owned cats.
Procedures—From cats evaluated because of high-rise syndrome between March and October 2009, a blood
sample was obtained for measurement of serum fPLI concentration within 12 hours after the fall and at 24, 48,
and 72 hours after the first blood collection. Pancreatitis was diagnosed in cats with an fPLI concentration > 5.4
μg/L. Each cat had abdominal ultrasonography performed twice 48 hours apart, and pancreatic trauma was
assessed via detection of pancreatic enlargement, hypoechoic or heteroechoic pancreatic parenchyma,
hyperechoic mesentery, and peritoneal effusion. Cats were assigned 1 point for each abnormality present, and a
cumulative score ≥ 3 was considered suggestive of traumatic pancreatitis.
Results—Traumatic pancreatitis was diagnosed in 9 and 8 cats on the basis of serum fPLI concentration and
ultrasonographic findings, respectively. For cats with pancreatitis, fPLI concentration was significantly higher at
12 and 24 hours after the fall than at 48 and 72 hours after the fall, and serum fPLI concentration decreased as
time after the fall increased. Significant agreement existed between the use of serum fPLI concentration and
abdominal ultrasonography for the diagnosis of traumatic pancreatitis.
Conclusions and Clinical Relevance—Cats with high-rise syndrome often had serum fPLI concentrations > 5.4
μg/L within 12 hours after the fall, and concurrent evaluation of those cats via abdominal ultrasonography twice,
48 hours apart, improved detection of traumatic pancreatitis.

Reports of metaldehyde and iron phosphate exposures in animals and characterization of suspected iron
toxicosis in dogs
Kaci J. Buhl, MS; Frederick W. Berman, DVM, PhD; David L. Stone, PhD
Objective—To describe reports of animals exposed to metaldehyde- and iron phosphate–containing
molluscicides and characterize iron phosphate exposure incidents in dogs with clinical signs compatible with
iron toxicosis.
Design—2-part retrospective case series.
Sample—1,500 reports of animals exposed to metaldehyde-containing molluscicides and 215 reports of animals
exposed to iron phosphate–containing molluscicides between 2001 and 2011 (n = 1,285) or iron
phosphate between 2001 and 2011 (n = 215; part 1) and a subset of 56 reports involving 61 dogs with
suspected iron toxicosis (part 2).
Procedures—In part 1, a National Pesticide Information Center database was searched to identify reported
exposures to metaldehyde- and iron phosphate–containing molluscicides before, during, and after a regulatory
transition affecting metaldehyde product labeling beginning in 2006. Source of the report, number of animals,
clinical signs, and deaths were evaluated. In part 2, reports involving potential iron toxicosis in dogs were
additionally reviewed for signalment, circumstances of exposure, and product identification.
Results—Reports of metaldehyde exposures decreased each year between 2006 (n = 193) and 2011 (21),
whereas reports of iron phosphate exposures increased between 2006 (n = 4) and 2010 (73); changes were not
evaluated statistically. Animals had no clinical signs at the time of the call in 130 of 215 (60%) and 675 of 1,285
(53%) reports of iron phosphate and metaldehyde exposure, respectively. In dogs, 35 deaths were associated with metaldehyde exposure and no deaths were associated with iron phosphate exposure.

Conclusions and Clinical Relevance—Veterinary professionals should be aware of the potential for iron toxicosis following exposure to iron phosphate–containing molluscicides.


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Objective—To determine the incidence of adverse events within 24 hours after contrast-enhanced ultrasonography (CEUS) in dogs and cats and compare the risk of death within 24 hours after imaging for animals that underwent ultrasonography with and without injection of a contrast agent.

Design—Retrospective case-control study.

Animals—750 animals (411 case dogs, 238 control dogs, 77 case cats, and 24 control cats).

Procedures—At 11 institutions, medical records were reviewed of dogs and cats that had CEUS performed (cases) as were medical records of dogs and cats with clinical signs similar to those of case animals that had ultrasonography performed without injection of a contrast agent (controls). Information regarding signalment; preexisting disease; type, dose, and administration route of contrast agent used; immediate (within 1 hour after CEUS) and delayed (>1 and ≤24 hours after CEUS) adverse events; and occurrence and cause of death (when available) was extracted from each medical record. Risk of death within 24 hours after ultrasonography was compared between case and control animals.

Results—Of the 411 case dogs, 3 had immediate adverse events (vomiting or syncope) and 1 had a delayed adverse event (vomiting). No adverse events were recorded for case cats. Twenty-three of 357 (6.4%) clinically ill case animals and 14 of 262 (5.3%) clinically ill control animals died within 24 hours after ultrasonography; risk of death did not differ between cases and controls.

Conclusions and Clinical Relevance—Results indicated that CEUS was safe in dogs and cats.

**Clinical manifestations, response to treatment, and clinical outcome for Weimaraners with hypertrophic osteodystrophy: 53 cases (2009–2011)**

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Objective—To evaluate clinical manifestations, response to treatment, and outcome for Weimaraners with hypertrophic osteodystrophy (HOD).

Design—Retrospective case series.

Animals—53 dogs.

Procedures—Medical records were reviewed for signalment, vaccination history, clinical signs, laboratory test results, response to treatment, and relapses. Radiographs were reviewed.

Results—Clinical signs included pyrexia, lethargy, and ostealgia; signs involving the gastrointestinal, ocular, or cutaneous systems were detected. Of the 53 dogs, 28 (52.8%) had HOD-affected littermates. Dogs with HOD-affected littermates were more likely to relapse, compared with the likelihood of relapse for dogs with no HOD-affected littermates. All 53 dogs had been vaccinated 1 to 30 days before HOD onset; no difference was found between the number of dogs with a history of vaccination with a recombinant vaccine (n = 21) versus a nonrecombinant vaccine (32). Fifty (94.3%) dogs had radiographic lesions compatible with HOD at disease onset, and the other 3 (5.7%) had HOD lesions 48 to 72 hours after the onset of clinical signs. Twelve of 22 (54.5%) dogs treated with NSAIDs did not achieve remission by 7 days after initiation of treatment. All dogs treated initially with corticosteroids achieved remission within 8 to 48 hours. Of the 33 dogs that reached adulthood, 28 (84.8%) were healthy and 5 (15.2%) had episodes of pyrexia and malaise.

Conclusions and Clinical Relevance—Treatment with corticosteroids was superior to treatment with NSAIDs in Weimaraners with HOD. It may be necessary to evaluate repeated radiographs to establish a diagnosis of HOD. Most HOD-affected Weimaraners had resolution of the condition with physeal closure.
Evaluation of the diagnostic value of serologic microagglutination testing and a polymerase chain reaction assay for diagnosis of acute leptospirosis in dogs in a referral center
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Objective—To determine the diagnostic value of a serologic microagglutination test (MAT) and a PCR assay on urine and blood for the diagnosis of leptospirosis in dogs with acute kidney injury (AKI).

Design—Cross-sectional study.

Animals—76 dogs with AKI in a referral hospital (2008 to 2009).

Procedures—Dogs’ leptospirosis status was defined with a paired serologic MAT against a panel of 11 Leptospira serovars as leptospirosis-associated (n = 30) or nonleptospirosis-associated AKI (12). In 34 dogs, convalescent serologic testing was not possible, and leptospirosis status was classified as undetermined. The diagnostic value of the MAT single acute or convalescent blood sample was determined in dogs in which leptospirosis status could be classified. The diagnostic value of a commercially available genus-specific PCR assay was evaluated by use of 36 blood samples and 20 urine samples.

Results—Serologic acute testing of an acute blood sample had a specificity of 100% (95% CI, 76% to 100%), a sensitivity of 50% (33% to 67%), and an accuracy of 64% (49% to 77%). Serologic testing of a convalescent blood sample had a specificity of 92% (65% to 99%), a sensitivity of 100% (87% to 100%), and an accuracy of 98% (88% to 100%). Results of the Leptospira PCR assay were negative for all samples from dogs for which leptospirosis status could be classified.

Conclusions and Clinical Relevance—Serologic MAT results were highly accurate for diagnosis of leptospirosis in dogs, despite a low sensitivity for early diagnosis. In this referral setting of dogs pretreated with antimicrobials, testing of blood and urine samples with a commercially available genus-specific PCR assay did not improve early diagnosis.

Association between previous splenectomy and gastric dilatation-volvulus in dogs: 453 cases (2004–2009)
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Objective—To evaluate the association between previous splenectomy and gastric dilatation-volvulus (GDV) in dogs.

Design—Multi-institutional retrospective case-control study.

Animals—151 dogs treated surgically for GDV and 302 control dogs with no history of GDV.

Procedures—Computerized records of dogs evaluated via exploratory laparotomy or abdominal ultrasonography were searched, and dogs with GDV and dogs without GDV (control dogs) were identified. Two control dogs were matched with respect to age, body weight, sex, neuter status, and breed to each dog with GDV. Data were collected on the presence or absence of the spleen for both dogs with GDV and control dogs. Conditional logistic regression analysis was used to investigate the association of previous splenectomy with GDV.

Results—6 (4%) dogs in the GDV group and 3 (1%) dogs in the control group had a history of previous splenectomy. The odds of GDV in dogs with a history of previous splenectomy in this population of dogs were 5.3 times those of dogs without a history of previous splenectomy (95% confidence interval, 1.1 to 26.8).

Conclusions and Clinical Relevance—For the patients in the present study, there was an increased odds of GDV in dogs with a history of splenectomy. Prophylactic gastropexy may be considered in dogs undergoing a splenectomy, particularly if other risk factors for GDV are present.

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Objective—To characterize the clinical course of dogs with hemoperitoneum in the perioperative setting and to determine risk factors that may affect short-term outcome.

Design—Retrospective case series.

Animals—83 client-owned dogs.

Procedures—The medical records of dogs with hemoperitoneum that underwent surgery between 2005 and 2010 were reviewed. Data were analyzed to determine risk factors associated with perioperative outcome. The perioperative period was defined as the time from admission to the hospital for treatment of hemoperitoneum until the time of discharge or euthanasia (within the same visit).

Results—13 of 83 (16%) dogs died or were euthanized in the perioperative period. The median hospitalization time for surviving dogs was 2 days (range, 1 to 5 days). The requirement for a massive transfusion with blood products was a negative prognostic indicator for hospital discharge. The source of bleeding was isolated to the spleen in 75 of 83 (90%) dogs; a splenic source of hemorrhage was determined to be a positive predictor of survival to discharge from the hospital.
Conclusions and Clinical Relevance—In the present study, factors associated with death and failure to be discharged from the hospital included tachycardia, a requirement for massive transfusion with blood products, and the development of respiratory disease secondary to suspected pulmonary thromboembolism or acute respiratory distress syndrome. The presence of disease within the spleen was positively associated with survival to discharge. Surgical intervention for treatment of hemoperitoneum, regardless of etiology, resulted in discharge from the hospital for 70 of the 83 (84%) dogs in this series.

**Results of surgical excision and evaluation of factors associated with survival time in dogs with lingual neoplasia: 97 cases (1995–2008)**

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Objective—To describe the clinical characteristics, treatments, outcomes, and factors associated with survival time in a cohort of dogs with lingual neoplasia that underwent surgical excision.

Design—Retrospective case series.

Animals—97 client-owned dogs.

Procedures—Medical records of dogs with a lingual tumor examined between 1995 and 2008 were reviewed. Records were included if a lingual tumor was confirmed by histologic examination and surgical excision of the mass was attempted. Data were recorded and analyzed to identify prognostic factors.

Results—Clinical signs were mostly related to the oral cavity. For 93 dogs, marginal excision, subtotal glossectomy, and near-total glossectomy were performed in 35 (38%), 55 (59%), and 3 (3%), respectively. Surgery-related complications were rare, but 27 (28%) dogs had tumor recurrence. The most common histopathologic diagnoses for the 97 dogs were squamous cell carcinoma (31 [32%]) and malignant melanoma (29 [30%]). Eighteen (19%) dogs developed metastatic disease, and the overall median survival time was 483 days. Median survival time was 216 days for dogs with squamous cell carcinoma and 241 days for dogs with malignant melanoma. Dogs with lingual tumors ≥ 2 cm in diameter at diagnosis had a significantly shorter survival time than did dogs with tumors < 2 cm.

Conclusions and Clinical Relevance—Similar to previous studies, results indicated that lingual tumors are most commonly malignant, and squamous cell carcinoma and malignant melanoma predominate. A thorough physical examination to identify lingual tumors at an early stage and surgical treatment after tumor identification are recommended because tumor size significantly affected survival time.

**Adrenal gland function in a dog following unilateral complete adrenalectomy and contralateral partial adrenalectomy**

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Case Description—A 40.3-kg (88.7-lb) 6-year-old spayed female Labrador Retriever was evaluated because of acute unilateral epistaxis.

Clinical Findings—During the initial evaluation of the dog, systemic hypertension and a left adrenal gland mass were detected. The left adrenal gland mass was surgically removed; results of histologic examination of the mass indicated it was a pheochromocytoma. Ten months later, the dog was evaluated because of persistent systemic hypertension and development of polyuria, polydipsia, and excessive panting. Abdominal ultrasonography revealed a mass in the cranial aspect of the right adrenal gland; results of MRI suggested the mass was a malignant tumor.

Treatment and Outcome—Epistaxis resolved after treatment and resolution of severe systemic hypertension. A partial right adrenalectomy was performed to remove the right adrenal gland mass. Results of histologic examination of the mass indicated it was a well-differentiated carcinoma of the cortex of the adrenal gland. Results of ACTH stimulation tests after surgery indicated the dog had adequate adrenal gland function.

Clinical Relevance—Partial adrenalectomy may be a safe and feasible treatment option to preserve adrenal gland function in dogs with small eccentrically located adrenal gland masses, particularly for dogs that have undergone removal of the contralateral adrenal gland.

**Idiopathic sterile inflammation of the epidural fat and epaxial muscles causing paraplegia in a mixed-breed dog**

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Case Description—A 4-year-old sexually intact male mixed-breed dog was evaluated because of clinical signs of acute-onset pelvic limb ataxia, rapidly progressing to paraplegia with severe spinal hyperesthesia. Clinical Findings—General physical examination revealed pyrexia, tachycardia, and tachypnea. Neurologic examination demonstrated severe spinal hyperesthesia and paraplegia with decreased nociception. Magnetic resonance imaging revealed extradural spinal cord compression at T13-L1 and hyperintense lesions on T1- and T2-weighted images in the epaxial musculature and epidural space. Treatment and Outcome—Decompressive surgery, consisting of a continuous dorsal laminectomy, with copious lavage of the vertebral canal was performed. Cultures of blood, urine, and surgical site samples were negative. Histologic examination results for samples obtained during surgery demonstrated suppurative myositis and steatitis. These findings confirmed a diagnosis of sterile idiopathic inflammation of the epidural fat and epaxial muscles with spinal cord compression. The dog's neurologic status started to improve 1 week after surgery. After surgery, the dog received supportive care including antimicrobials and NSAIDs. The dog was ambulatory 1 month after surgery and was fully ambulatory despite signs of mild bilateral pelvic limb ataxia 3 years after surgery. Clinical Relevance—Although idiopathic sterile inflammation of adipose tissue, referred to as panniculitis, more commonly affects subcutaneous tissue, its presence in the vertebral canal is rare. Specific MRI findings described in this report may help in reaching a presumptive diagnosis of this neurologic disorder. A definitive diagnosis and successful long-term outcome in affected patients can be achieved by decompressive surgery and histologic examination of surgical biopsy samples.

**Australian Veterinary Journal**

In vitro susceptibilities of feline and canine *Escherichia coli* and *Pseudomonas* spp. isolates to ticarcillin and ticarcillin–clavulanic acid

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Objectives: To investigate in vitro susceptibilities of canine and feline *Escherichia coli* and canine *Pseudomonas* spp. isolates to ticarcillin and ticarcillin–clavulanic acid (T/C).

Design: In vitro susceptibility testing of bacterial isolates collected from infections.

Methods: We tested 148 (83 canine and 65 feline) *E. coli* and 61 canine *Pseudomonas* spp. isolates for susceptibility to T/C using both disc diffusion and Epilometer tests (E-tests). Additionally, susceptibilities of 96 *E. coli* and 23 canine *Pseudomonas* spp. isolates were tested via disc diffusion to ticarcillin alone.

Results: Of the *E. coli* isolates obtained from canine and feline urine, 92% by disc diffusion and 91% by E-tests were susceptible to T/C. Of the canine *Pseudomonas* isolates, 90% by disc diffusion and 82% by E-tests were susceptible to T/C. Of the *Pseudomonas* spp. isolates from the canine ear canal or tympanic bullae, 12% of isolates tested via disc diffusion and 23% via E-tests were found to be resistant to T/C. The 50% minimum inhibitory concentration of T/C for all feline *E. coli* isolates was significantly lower than that for all canine *E. coli* isolates (P = 0.0031). The addition of clavulanic acid significantly increased the efficacy of ticarcillin against *E. coli* (P< 0.0001), but had negligible effect against canine *Pseudomonas* spp. isolates.

Conclusion: Ticarcillin-clavulanic acid has reasonable in vitro efficacy against canine and feline *E. coli*, and canine *Pseudomonas* spp. isolates. However, decisions to use this drug therapeutically must be made on prudent considerations to minimise selection for bacterial resistance.

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