Evidence for Canine Rehabilitation and Physical Therapy
Darryl L. Millis, Ionut Alexandru Ciuperca
This article reviews some important studies regarding canine physical rehabilitation. Bones, cartilage, muscles, ligaments, and tendons undergo atrophy if loading is decreased. Knowledge of the changes that occur with immobilization and the time course of events helps in the development of a rehabilitation program to improve tissue integrity. Outcome assessment instruments are clinically useful indicators of patient progress and the success of rehabilitation programs. A number of physical modalities are used in canine rehabilitation, although there are relatively few canine-specific studies. Rehabilitation has specific benefits in the treatment of various orthopedic and neurologic conditions.

Physical Agent Modalities in Physical Therapy and Rehabilitation of Small Animals
June Hanks, David Levine, Barbara Bockstahler
Physical agent modalities can be effective components of the overall rehabilitation of small animals. This article reviews the effects, indications, contraindications, and precautions of cold, superficial heat, therapeutic ultrasound, and electrical stimulation.

Therapeutic Laser in Veterinary Medicine
Brian Pryor, Darryl L. Millis
Laser therapy is an increasingly studied modality that can be a valuable tool for veterinary practitioners. Mechanisms of action have been studied and identified for the reduction of pain and inflammation and healing of tissue. Understanding the basics of light penetration into tissue allows evaluation of the correct dosage to deliver for the appropriate condition, and for a particular patient based on physical properties. New applications are being studied for some of the most challenging health conditions and this field will continue to grow. Additional clinical studies are still needed and collaboration is encouraged for all practitioners using this technology.

Principles and Application of Range of Motion and Stretching in Companion Animals
Denis J. Marcellin-Little, David Levine
Optimal function after injury, surgery, or in patients with chronic conditions requires adequate motion in joints, muscles, tendon, fascia, and skin. Range of motion and stretching exercises are commonly used in companion animal rehabilitation programs to maintain or improve motion of musculoskeletal tissues. Range of motion exercises and stretching prevent adhesions from forming, help scar tissue remodeling, may improve muscle tone, and prevent future injury from occurring. Stretching is used to avoid loss of motion or to regain lost joint motion. Stretching is done manually, using external coaptation, or using therapeutic exercises. Careful documentation of range of motion is necessary.

Principles and Applications of Therapeutic Exercises for Small Animals
Marti G. Drum, Denis J. Marcellin-Little, Michael S. Davis
Therapeutic exercises are the cornerstone of the rehabilitation programs of companion animals. Therapeutic exercises are used to improve active joint range of motion, to improve weight bearing and limb use, to build strength and muscle mass, and to increase conditioning (eg, endurance, speed). Each case is unique as chronicity, type of injury, patient signalment and temperament, owner compliance, and level of required functional recovery vary widely. Therapeutic exercises are also essential for partial return to work or performance and to learn to perform activities of daily living after injury or surgery.

Rehabilitation and Physical Therapy for Selected Orthopedic Conditions in Veterinary Patients
Andrea L. Henderson, Christian Latimer, Darryl L. Millis
A specific diagnosis is needed to perform optimal rehabilitation of orthopedic problems. A well-planned rehabilitation program is important for orthopedic patients when surgical repairs are mechanically weak (eg, when repairing fractures in skeletally immature patients or when repairing tendons or ligaments). Joint immobilization is sometimes used to protect weak surgical repairs. The duration of immobilization should be minimized, particularly in situations with potential loss of joint motion. Evidence-based information regarding specific modalities and techniques for rehabilitation of injured dogs and cats is generally lacking. The choice of modalities and techniques must be based on common sense, knowledge of rehabilitation techniques, and clinical experience.
Rehabilitation and Physical Therapy for the Neurologic Veterinary Patient
Cory Sims, Rennie Waldron, Denis J. Marcellin-Little

A comprehensive physiotherapy plan for neurology patients manages pain, prevents secondary complications, and supports the health and function of musculoskeletal tissues during recovery. Neurologically impaired patients range in ability from complete immobility (tetraplegia/paraplegia), partial mobility (tetraparesis/paraparesis), mild ataxia, to pain only. Important considerations for the design of a physiotherapy program include access to the patient, level of staff support, and safety of staff, patient, and client during treatments. A thorough overview of the treatment plan and expected outcome should be discussed with the client at the onset of therapy and should be reviewed frequently, particularly as the patient's status changes.

Physical Rehabilitation After Total Joint Arthroplasty in Companion Animals
Denis J. Marcellin-Little, Nancy D. Doyle, Joanna Freeman Pyke

Patients who have total joint arthroplasty have varying needs related to rehabilitation. In the short term, rehabilitation should be used in all dogs to identify high-risk patients and to minimize the likelihood of postoperative complications. Many patients undergoing total hip replacement recover uneventfully without needing long-term physiotherapy. All patients undergoing total knee replacement and total elbow replacement need rehabilitation to restore limb use and maximize their functional recovery. This article presents rehabilitation considerations for companion animals undergoing total hip replacement, total knee replacement, and total elbow replacement; postoperative complications and how to mitigate risks; and anticipated patient outcomes.

Orthoses and Exoprostheses for Companion Animals
Denis J. Marcellin-Little, Marti G. Drum, David Levine, Susan S. McDonald

Exoprostheses are devices that are secured to incomplete limbs to enable locomotion. By comparison, orthoses are devices externally applied to support or protect an injured body part. Orthoses also can be used to control, guide, protect, limit motion of, or immobilize an extremity, a joint, or a body segment. Exoprostheses and orthoses are a growing aspect of the physical rehabilitation of companion animals. They require precise design and fabrication. Patients and owners must be trained to use the devices. Exoprostheses and orthoses can have a profound beneficial impact on the mobility and the quality of life of companion animals.

Feline Rehabilitation
Marti G. Drum, Barbara Bockstahler, David Levine, Denis J. Marcellin-Little

Cats have orthopedic problems, including osteoarthritis, fractures, and luxations that are positively impacted by physical rehabilitation. Most cats have an independent behavior that requires using a tactful approach to rehabilitation. Cats often do well with manual therapy and electrophysical modalities. Feline rehabilitation sessions may be shorter than canine rehabilitation sessions. Cats do best with therapeutic exercises when these exercises are linked to hunting, playing, or feeding.

Penile Amputation and Scrotal Urethrostomy Followed by Chemotherapy in a Dog with Penile Hemangiosarcoma
Luiz Bolfer, Joanna M. Schmit, Amy L. McNeill, Chantal A. Ragetly, R. Avery Bennett and Maureen McMichael

A 7 yr old castrated male standard poodle weighing 25 kg was presented with a 5 day history of hematuria, dysuria, and the presence of a 2.5 cm, firm swelling within the prepuce. Abdominal radiographs revealed a soft-tissue mass on the distal prepuce and lysis of the cranial margin of the os penis. The patient was sedated and an ulcerated hemorrhagic mass was identified at the tip of the penis. The mass was diagnosed as hemangiosarcoma via incisional biopsy. A penile amputation with scrotal urethrostomy was performed followed by chemotherapy with doxorubicin.

Use of Physical Therapy in a Dog with Bilateral Severe Plantigrade Stance
Jennifer Ree, Kei Hayashi, Jacqueline Wolz, and Sun Young Kim

A 3.5 yr old spayed female Staffordshire terrier weighing 25.5 kg was presented with a 7 wk history of bilateral plantigrade stance in the pelvic limbs directly following an ovariohysterectomy procedure. Upon presentation, the dog had bilateral atrophy of the distal pelvic limb muscles, enlarged popliteal lymph nodes, and ulcerative wounds on the dorsa of her rear paws. Orthopedic examination revealed intact calcaneal tendons bilaterally and
neurologic examination localized the lesion to the distal sciatic nerve. A diagnosis of compressive and stretch neuropathy was made affecting the distal sciatic nerve branches. Physical therapy modalities included neuromuscular electrical stimulation, ultrasound, and low-level laser therapy. Other therapeutic modalities included the use of orthotics and progressive wound care. The dog had increased muscle mass, return of segmental reflexes, return of nociception, and the ability to walk on pelvic limbs with higher carriage of the hock 15 mo following presentation. The use of custom orthotics greatly increased the quality of life and other physical therapy modalities may have improved the prognosis in this dog with severe bilateral plantigrade stance due to neuropathy.

Perioperative and Anesthetic Management of Complete Tracheal Rupture in One Dog and One Cat
Ute Morath, Karine Gendron, Nuria Vizcaíno Revés, and Chiara Adami,
The authors describe two animals (one dog and one cat) that were presented with severe respiratory distress after trauma. Computerized tomographic imaging under general anesthesia revealed, in both cases, complete tracheal transection. Hypoxic episodes during anesthesia were relieved by keeping the endotracheal tube (ETT) positioned in the cranial part of the transected trachea and by allowing spontaneous breathing. Surgical preparation was performed quickly, and patients were kept in a sternal position to improve ventilation and oxygenation, and were only turned into dorsal recumbency shortly before surgical incision. A sterile ETT was guided into the distal part of the transected trachea by the surgeon, at which point mechanical ventilation was started. Both animals were successfully discharged from hospital a few days after surgery. Rapid and well-coordinated teamwork seemed to contribute to the good outcome. Precise planning and communication between anesthetists, surgeons, and technicians, as well as a quick course of action prior to correct ETT positioning helped to overcome critical phases.

The Successful Use of Negative-Pressure Wound Therapy in Two Cases of Canine Necrotizing Fasciitis
Patrick Maguire, Joseph M. Azagrar, Allan Carb, and Arnold Lesser
A 5 mo old female Akita and a 1 yr, 5 mo old male German shorthaired pointer were both evaluated for soft-tissue lesions characterized by rapidly expanding edema, erythema, and pain. Ultrasound was utilized to locate and sample fluid accumulations, and β-hemolytic Streptococcus was isolated from the wounds. Development of systemic symptoms including fever, tachycardia, and tachypnea as well as a lack of response to medical management prompted surgical intervention in both cases. During surgical exploration and debridement, disruption of intermuscular tissue planes was appreciated and necrotizing fasciitis (NF) was suspected. Negative-pressure wound therapy systems utilizing 120 mm Hg of continual negative pressure were applied to wounds for 5 and 4 days for the Akita and German shorthaired pointer, respectively. Resolution of infection was achieved and although the lesions were associated with limbs, amputation was avoided. In both cases, the results of histopathology were consistent with NF. NF is recognized as a rapidly progressive infection associated with high rates of morbidity and mortality. Timely use of negative-pressure wound therapy appears to be a viable management tool to accompany surgical debridement, appropriate antibiotics, and analgesics.

Staged Orthodontic Movement of Mesiolinguoversion of the Mandibular Canine Tooth in a Dog
Chun-Geun Kim, So-Young Lee, and Hee-Myung Park
A 10 mo old Sapsaree dog presented for evaluation and treatment of malocclusion causing palatal trauma. A class III malocclusion with mesiolinguoversion of the 404 and enamel hypoplasia was diagnosed based on oral examination. It was decided to attempt orthodontic correction of the mesiolinguverted tooth using an elastic chain and inclined bite plane technique with crown restoration of the enamel hypoplasia teeth. One year after the orthodontic correction and composite removal, the mesiolinguverted right mandibular canine tooth was moved to an acceptable location within the dental arch and the locally discolored right maxillary canine tooth was vital.

Canine Pemphigus Foliaceus with Concurrent Immune-Mediated Thrombocytopenia
Shinpei Kawarai, Masaharu Hisasue, Shinobu Matsuura, Tetsuro Ito, Yukari Inoue, Sakurako Neo, Yoko Fujii, Hiroo Madarame, Kinji Shirota, Ryo Tsuchiya
A 3 yr old wirehaired fox terrier was presented to his primary care veterinarian with fever, thrombocytopenia, and generalized crusting dermatitis. The skin lesion had progressed for at least 18 days, and thrombocytopenia had developed 3 days before presentation. Histopathology and direct immunofluorescence studies of the skin were consistent with pemphigus foliaceus (PF). Immunofluorescence revealed immunoglobulin G deposition around the keratinocytes in the stratum spinosum. A diagnosis of immune-mediated thrombocytopenia (IMT) was confirmed by the presence of platelet surface-associated immunoglobulin using flow cytometry. Systemic immunosuppressive therapy with cyclosporine and azathioprine was effective, and the dog survived for >2 years from the initial presentation. IMT is rarely associated with PF. This appears to be the first detailed report of a definitive diagnosis of concurrent PF and IMT in a dog. The authors’ findings indicate that canine PF could be complicated by hematologic immune-mediated diseases such as IMT.
New Zealand Veterinary Journal (Jan/Feb)
No relevant articles

Journal of Veterinary Internal Medicine (Jan/Feb)

P-Glycoprotein Mediated Drug Interactions in Animals and Humans with Cancer
K.L. Mealey and J. Fidel.
Drug–drug interactions can cause unanticipated patient morbidity and mortality. The consequences of drug–drug interactions can be especially severe when anticancer drugs are involved because of their narrow therapeutic index. Veterinary clinicians have traditionally been taught that drug–drug interactions result from alterations in drug metabolism, renal excretion or protein binding. More recently, drug–drug interactions resulting from inhibition of P-glycoprotein-mediated drug transport have been identified in both human and veterinary patients. Many drugs commonly used in veterinary patients are capable of inhibiting P-glycoprotein function and thereby causing an interaction that results in severe chemotherapeutic drug toxicity. The intent of this review is to describe the mechanism and clinical implications of drug–drug interactions involving P-glycoprotein and anticancer drugs. Equipped with this information, veterinarians can prevent serious drug–drug interactions by selecting alternate drugs or adjusting the dose of interacting drugs.

Systematic Review of Prognostic Factors for Mortality in Dogs with Immune-mediated Hemolytic Anemia.
Background Treatment of dogs with primary immune-mediated hemolytic anemia (IMHA) is difficult and frequently unrewarding. Prognostic factors have been evaluated in a number of previous studies, and identification of such factors would be beneficial to enable selection of appropriate therapeutic regimens and supportive care. Objectives The aim of the current study was to undertake a critical appraisal of the risk of bias in evidence relating to prognostic indicators for mortality in dogs with IMHA. Animals Three hundred and eighty client-owned dogs with spontaneous primary idiopathic IMHA reported in 6 previous studies. Methods A systematic review was conducted to evaluate evidence relating to prognostic factors for mortality in dogs with primary IMHA. Search tools were employed to identify articles and a validated appraisal tool was used to assess the quality of individual studies by considering inclusion and exclusion criteria, measurement of prognostic, outcome and confounding variables, and statistical methods. Results Few studies evaluated prognostic indicators for IMHA in dogs, and all of these suffered from methodologic flaws in at least 1 major area. Fifteen different variables were identified as prognostic indicators, with 2 variables identified by >1 study. Conclusions and Clinical Importance There are few pieces of high-quality evidence available to enable estimation of prognosis for dogs presenting with primary IMHA.

Evaluation and Diagnostic Potential of Serum Ghrelin in Feline Hypersomatotropism and Diabetes Mellitus
K.B. Jensen, Y. Forcada, D.B. Church and S.J.M. Niessen
Background Ghrelin is a growth hormone secretagogue. It is a potent regulator of energy homeostasis. Ghrelin concentration is down-regulated in humans with hypersomatotropism (HS) and increases after successful treatment. Additionally, ghrelin secretion seems impaired in human diabetes mellitus (DM). Hypothesis Serum ghrelin concentration is down-regulated in cats with HS-induced DM (HSDM) compared to healthy control cats or cats with DM unrelated to HS and increases after radiotherapy. Animals Cats with DM (n = 20) and with HSDM (n = 32), 13 of which underwent radiotherapy (RT-group); age-matched controls (n = 20). Methods Retrospective cross-sectional study. Analytical performance of a serum total ghrelin ELISA was assessed and validated for use in cats. Differences in serum ghrelin, fructosamine, IGF-1 and insulin were evaluated. Results Ghrelin was significantly higher (P < .001) in control cats (mean ± SD: 12.9 ± 6.8 ng/mL) compared to HSDM- (7.9 ± 3.3 ng/mL) and DM-cats (6.7 ± 2.3 ng/mL), although not different between the HSDM- and DM-cats. After RT ghrelin increased significantly (P = .003) in HSDM-cats undergoing RT (from 6.6 ± 1.9 ng/mL to 9.0 ± 2.2 ng/mL) and the after RT ghrelin concentrations of HSDM cats were no longer significantly different from the serum ghrelin concentration of control cats. Serum IGF-1 did not significantly change in HSDM-cats after RT, despite significant decreases in fructosamine and insulin dose. Conclusion and Clinical Importance Ghrelin appears suppressed in cats with DM and HSDM, although increases after RT in HSDM, suggesting possible presence of a direct or indirect negative feedback system between growth hormone and ghrelin. Serum ghrelin might therefore represent a marker of treatment effect.
**Relationship Between Degenerative Joint Disease, Pain, and Bartonella spp. Seroreactivity in Domesticated Cats**

A. Tomas, E.L. Pultorak, M.E. Gruen, E.B. Breitschwerdt and B.D.X. Lascelles

**Background**
Recently, a potential association was identified between Bartonella exposure and arthritides in mammalian species other than cats. Hypothesis/Objectives

We hypothesized that Bartonella exposure is associated with more severe degenerative joint disease (DJD) and a greater burden of DJD-associated pain in client-owned cats. Animals
Ninety-four client-owned cats (6 months to 20 years old), ranging from clinically unaffected to severely lame because of DJD. Methods
Using physical examination and radiography, pain and radiographic scores were assigned to each part of the bony skeleton. Sera were tested for Bartonella henselae, B. koehlerae, and B. vinsonii subsp. berkhoffii (genotypes I, II, and III) antibodies using immunofluorescence antibody assays. Variables were categorized and logistic regression used to explore associations. Results
Seropositivity to Bartonella was identified in 33 (35.1%) cats. After multivariate analysis controlling for age, total DJD score (OR, 0.51; 95% CI, 0.26–0.97; P = .042), appendicular pain score (OR, 0.33; 95% CI, 0.17–0.65; P = .0011), and total pain score (OR, 0.35; 95% CI, 0.17–0.72; P = .0045) were significantly inversely associated with Bartonella seroreactivity status, indicating that cats with higher DJD and pain scores were less likely to be Bartonella seropositive. Conclusions and Clinical Importance
Based upon this preliminary study, Bartonella spp. seropositivity was associated with decreased severity of DJD and decreased DJD-associated pain in cats. Additional studies are needed to verify these findings, and if verified, to explore potential mechanisms.

**Glomerular Filtration Rate, Urine Production, and Fractional Clearance of Electrolytes in Acute Kidney Injury in Dogs and Their Association with Survival**


**Objective**
To document sequential changes of conventional indices of renal function, to better define the course of AKI, and to identify a candidate marker for recovery. Animals
Ten dogs with AKI. Methods
Dogs were prospectively enrolled and divided into surviving and nonsurviving dogs. Urine production was measured with a closed system for 7 days. One and 24-hour urinary clearances were performed daily to estimate solute excretion and glomerular filtration rate (GFR). Solute excretion was calculated as an excretion ratio (ER) and fractional clearance (FC) based on both the 1- and 24-hour urine collections. Results
Four dogs survived and 6 died. At presentation, GFR was not significantly different between the outcome groups, but significantly (P = .03) increased over time in the surviving, but not in the nonsurviving dogs. Fractional clearance of Na decreased significantly over time (20.2–9.4%, P < .0001) in the surviving, but not in the nonsurviving dogs. The ER and FC of solutes were highly correlated (r, 0.70–0.95). Conclusion and Clinical Impact
Excretion ratio might be used in the clinical setting as a surrogate marker to follow trends in solute excretion. Increased GFR, urine production, and decreased FC of Na were markers of renal recovery. The FC of Na is a simple, noninvasive, and cost-effective method that can be used to evaluate recovery of renal function.

**Determination of Extracellular Fluid Volume in Healthy and Azotemic Cats**


**Background**
Methods for determining extracellular fluid volume (ECFV) are important clinically for cats. Bromide dilution has been studied in cats to estimate ECFV. Markers of GFR also distribute in ECFV and can be used for its measurement. Hypothesis/Objectives
The primary objective was to develop a method of determining ECFV from iohexol clearance in cats and evaluate agreement with that determined using bromide dilution. Additional objectives were to compare ECFV between azotemic and nonazotemic cats and evaluate appropriate methods of standardizing ECFV. Animals
Client-owned cats with varying renal function. Methods
Validation of ECFV determined from slope-intercept iohexol clearance was performed in 18 healthy nonazotemic cats. ECFV was then determined using the validated method and bromide dilution and agreement assessed. Appropriateness of standardization to body weight (BW) and body surface area (BSA) was evaluated. Results
Extracellular fluid volume determined from slope-intercept iohexol clearance and bromide dilution was 0.84 ± 0.32 L and 0.85 ± 0.19 L (mean ± SD), respectively. There were wide limits of agreement between the methods (–0.58 to 0.54 L) and therefore, agreement was considered to be poor. ECFV did not differ significantly between azotemic and nonazotemic cats (P = .177). BSA was found to be the best method for standardizing ECFV measurement in cats. Conclusions and Clinical Importance
This study developed a method for determining ECFV from slope-intercept iohexol clearance which provides simultaneous assessment of renal function and an estimate of ECFV. ECFV does not differ between azotemic and nonazotemic cats, which

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suggests fluid volume loss or overload is not an important clinical feature in cats with mild chronic kidney disease.

**Association of Obesity with Serum Leptin, Adiponectin, and Serotonin and Gut Microflora in Beagle Dogs**


Background Serotonin (5-hydroxytryptamine, 5HT) is involved in hypothalamic regulation of energy consumption. Also, the gut microbiome can influence neuronal signaling to the brain through vagal afferent neurons. Therefore, serotonin concentrations in the central nervous system and the composition of the microbiota can be related to obesity. Objective To examine adipokine, and, serotonin concentrations, and the gut microbiota in lean dogs and dogs with experimentally induced obesity. Animals Fourteen healthy Beagle dogs were used in this study. Methods Seven Beagle dogs in the obese group were fed commercial food ad libitum, over a period of 6 months to increase their weight and seven Beagle dogs in lean group were fed a restricted amount of the same diet to maintain optimal body condition over a period of 6 months. Peripheral leptin, adiponectin, 5HT, and cerebrospinal fluid (CSF-5HT) levels were measured by ELISA. Fecal samples were collected in lean and obese groups 6 months after obesity was induced. Targeted pyrosequencing of the 16S rRNA gene was performed using a Genome Sequencer FLX plus system. Results Leptin concentrations were higher in the obese group (1.98 ± 1.00) compared to those of the lean group (1.12 ± 0.07, P = .025). Adiponectin and 5-hydroxytryptamine of cerebrospinal fluid (CSF-5HT) concentrations were higher in the lean group (27.1 ± 7.28) than in the obese group (14.4 ± 5.40, P = .018). Analysis of the microbiome revealed that the diversity of the microbial community was lower in the obese group. Microbes from the phylum Firmicutes (85%) were predominant group in the gut microbiota of lean dogs. However, bacteria from the phylum Proteobacteria (76%) were the predominant group in the gut microbiota of dogs in the obese group. Conclusions and Clinical Importance Decreased 5HT levels in obese group might increase the risk of obesity because of increased appetite. Microflora enriched with gram-negative might be related with chronic inflammation status in obese dogs.

**A Comparison of Liver Sampling Techniques in Dogs**


Background The liver sampling technique in dogs that consistently provides samples adequate for accurate histopathologic interpretation is not known. Hypothesis/Objectives To compare histopathologic results of liver samples obtained by punch, cup, and 14 gauge needle to large wedge samples collected at necropsy. Animals Seventy dogs undergoing necropsy. Methods Prospective study. Liver specimens were obtained from the left lateral liver lobe with an 8 mm punch, a 5 mm cup, and a 14 gauge needle. After sample acquisition, two larger tissue samples were collected near the center of the left lateral lobe to be used as a histologic standard for comparison. Histopathologic features and numbers of portal triads in each sample were recorded. Results The mean number of portal triads obtained by each sampling method were 2.9 in needle samples, 3.4 in cup samples, 12 in punch samples, and 30.7 in the necropsy samples. The diagnoses in 66% of needle samples, 60% of cup samples, and 69% of punch samples were in agreement with the necropsy samples, and these proportions were not significantly different from each other. The corresponding kappa coefficients were 0.59 for needle biopsies, 0.52 for cup biopsies, and 0.62 for punch biopsies. Conclusion and Clinical Importance The histopathologic interpretation of a liver sample in the dog is unlikely to vary if the liver biopsy specimen contains at least 3–12 portal triads. However, in comparison large necropsy samples, the accuracy of all tested methods was relatively low.

**Histopathologic Variation between Liver Lobes in Dogs**


Background Biopsy of the liver evaluates a small portion of tissue, with inferences made to the entire organ. The method and number of biopsies obtained are tempered by consideration of the risks and benefits. Recommendations often include biopsy of more than one liver lobe, although the consistency of histopathology among lobes in dogs is unknown. Hypothesis/Objectives To describe the distribution of histopathologic abnormalities between liver lobes. We hypothesized that discordant results would be evenly distributed among all liver lobes. Animals Seventy dogs undergoing necropsy. Methods Prospective study. Liver samples were obtained from all lobes. A primary diagnosis was assigned to each liver sample based on the predominant histopathologic abnormality. Results In this population of dogs, biopsy of at least 2 liver lobes identified the predominant histologic abnormality in 98.6% of the cases. Ten (14%) of the dogs had ≤3 lobes in agreement and
could not be assigned a predominant diagnosis. The same diagnosis was present in 6/6 lobes in 39 (56.5%) dogs, 5/6 lobes in 10 (14.5%) dogs, 4/6 lobes in 10 (14.5%) dogs, 3/6 lobes in 7 (10.1%) dogs, and 2/6 in 3 (4.3%) dogs. The number of discordant results did not differ between the liver lobes. Conclusion and Clinical Importance The likelihood of obtaining a sample that is reflective of the predominant histologic abnormality in the liver is increased when multiple liver lobes are biopsied.

Clinical Presentation and Outcome of Cats with Circumcaval Ureters Associated with a Ureteral Obstruction
J. Steinhaus, A.C. Berent, C. Weisse, A. Eatroff, T. Donovan, J. Haddad and D. Bagley
Background Circumcaval ureters (CU) are a rare embryological malformation resulting in ventral displacement of the caudal vena cava, which crosses the ureter, potentially causing a ureteral stricture. Objectives To evaluate cats with obstructed CU(s) and report the presenting signs, diagnostics, treatment(s), and outcomes. Cats with obstructed CU(s) were compared to ureterally obstructed cats without CU(s). Animals 193 cats; 22 circumcaval obstructed (Group 1); 106 non-circumcaval obstructed (Group 2); 65 non-obstructed necropsy cases (Group 3).
Methods Retrospective study, review of medical records for cats treated for benign ureteral obstructions from AMC and University of Pennsylvania between 2009 and 2013. Inclusion criteria: surgical treatment of benign ureteral obstruction, complete medical record including radiographic, ultrasonographic, biochemistry, and surgical findings. Results Seventeen percent (22/128) of obstructed cats had a CU (80% right-sided) compared to 14% (9/65) non-obstructed necropsy cats (89% right-sided). Clinical presentation, radiographic findings, and creatinine were not statistically different between Groups 1 and 2. Strictures were a statistically more common (40%) cause of ureteral obstruction in Group 1 compared to Group 2 (17%) (P = .01). The MST for Groups 1 and 2 after ureteral decompression was 923 and 762 days, respectively (P = .62), with the MST for death secondary to kidney disease in both groups being >1,442 days. Re-obstruction was the most common complication in Group 1 (24%) occurring more commonly in ureters of cats treated with a ureteral stent(s) (44%) compared to the subcutaneous ureteral bypass (SUB) device (8%) (P = .01). Conclusions and Clinical Importance Ureteral obstructions in cats with a CU(s) have a similar outcome to those cats with a ureteral obstruction and normal ureteral anatomy. Long-term prognosis is good for benign ureteral obstructions treated with a double pigtail stent or a SUB device. The SUB device re-obstructed less commonly than the ureteral stent, especially when a ureteral stricture was present.

Quantitative Contrast-enhanced Ultrasonographic Assessment of Naturally Occurring Pancreatitis in Dogs
Background Quantitative contrast-enhanced ultrasonography (CEUS) can detect pancreatic perfusion changes in experimentally induced canine pancreatitis. However, its usefulness in detecting perfusion changes in naturally occurring pancreatitis is unclear. Hypothesis/Objectives To determine the feasibility of using CEUS to detect pancreatic and duodenal perfusion changes in naturally occurring canine pancreatitis. Animals Twenty-three client-owned dogs with pancreatitis, 12 healthy control dogs. Methods Dogs diagnosed with pancreatitis were prospectively included. CEUS of the pancreas and duodenum were performed. Time-intensity curves were created from regions of interest in the pancreas and duodenum. Five perfusion parameters were obtained for statistical analyses: time to initial up-slope, peak time (Tp), time to wash-out (TTW), peak intensity (PI), and area under the curve (AUC). Results For the pancreas, Tp of the pancreatitis group was prolonged when compared to controls (62 ± 11 seconds versus 39 ± 13 seconds; P < .001). TTW also was prolonged but not significantly (268 ± 69 seconds versus 228 ± 47 seconds; P = .47). PI and AUC were increased when compared to controls (95 ± 15 versus 78 ± 13 MPV; P = .009 and 14,900 ± 3,400 versus 11,000 ± 2,800 MPV*s; P = .013, respectively). For the duodenum, PI and AUC were significantly increased in the pancreatitis group when compared to controls. Conclusions and Clinical Importance Contrast-enhanced ultrasonography can detect pancreatic perfusion changes in naturally occurring canine pancreatitis characterized by delayed peak with prolonged hyperechoic enhancement of the pancreas on CEUS. Additionally, duodenal perfusion changes secondary to pancreatitis were observed.

Use of Multidetector Computed Tomography in the Assessment of Dogs with Pericardial Effusion
K.F. Scollan, B. Bottorff, S. Stieger-Vanegas, S. Nemanic and D. Sisson
Background Contrast-enhanced multidetector computed tomography (MDCT) allows high spatial and temporal resolution imaging of cardiac, thoracic, and abdominal structures. Accurate determination of the cause of
pericardial effusion (PE) is essential to providing appropriate treatment and prognosis. Echocardiography and pericardial fluid analysis may not differentiate between causes of PE and cannot identify extracardiac metastasis. Hypothesis/Objectives Describe the thoracic and abdominal MDCT findings and evaluate the utility of MDCT to differentiate between neoplastic and nonneoplastic causes of PE in dogs. Animals Eleven client-owned dogs with PE diagnosed by echocardiography. Methods Prospective observational study. Transthoracic echocardiography (TTE), 3-view thoracic radiography, and contrast-enhanced thoracic and abdominal MDCT images were evaluated for the presence of cardiac masses, pulmonary metastases, and abdominal masses. Histopathology in 5 dogs and survival analysis in all dogs were evaluated. Results A neoplastic cause was identified in 6/11 dogs and a nonneoplastic cause was identified in 5/11. Cardiac MDCT findings were consistent with TTE findings in all dogs with right atrial (5/5) and heart base masses (1/1). Pulmonary metastases were identified in 1/11 dogs by thoracic radiography and in 2/11 dogs by MDCT. MDCT identified splenic or hepatic lesions consistent with neoplasia in 6/11 and 5/11 dogs, respectively. Focal MDCT pericardial changes at the pericardiocentesis site were noted in 3/11 dogs. Conclusions and Clinical Importance Multidetector computed tomography did not improve the detection of cardiac masses in dogs with PE over echocardiography. The benefit of MDCT was primarily in the detection of pulmonary metastases and extracardiac lesions using a single imaging modality.

Functional Phenotype and its Correlation with Therapeutic Response and Inflammatory Type of Bronchoalveolar Lavage Fluid in Feline Lower Airway Disease
Background Currently, functional assessment to monitor therapeutic response in feline lower airway disease (FLAD) has limited application. Objectives To evaluate if expiratory indices derived from pseudo-tidal breathing flow-volume loop (pTBFV) representing lower airway obstruction would decrease after clinical improvement and to investigate the correlation between functional phenotype and inflammatory cell type in bronchoalveolar lavage (BAL) fluid. Animals Nineteen client-owned cats with FLAD. Methods Prospective observational study. Functional assessment with pTBFVL indices (eg, peak to mid-expiratory flow; PEF/EF50) and conventional barometric whole body plethysmography (BWBP) parameters (eg, enhanced pause) was carried out before receiving treatment. BAL was performed to analyze inflammatory cell types. Signs were assessed by scoring. The cats were treated with glucocorticoids daily and functional testing was repeated. Results Loop indices PEF/EF50 and PEF/EF25 were significantly decreased after treatment (P < .001). Conventional BWBP parameters were not significantly different before and after treatment. Cats with PEF/EF50 > 1.51 before treatment had a significantly higher granulocyte (eosinophil plus neutrophil) percentage in BAL fluid (P = .014). Granulocyte percentage in BAL fluid was strongly correlated with PEF/EF25 (P = .001, rs = 0.74) and moderately correlated with PEF/EF50 (P = .022, rs = 0.57), whereas eosinophil or neutrophil percentage alone had no significant correlation with functional parameters. Conclusions and Clinical Importance Functional parameters including PEF/EF50 and PEF/EF25 can be used for monitoring therapeutic response. The presence of airflow limitation during mid- to late expiration is affected by the overall extent of granulocyte infiltration.

Computed Tomographic Angiography under Sedation in the Diagnosis of Suspected Canine Pancreatitis: A Pilot Study
Background Computed tomography (CT) is highly accurate for diagnosing pancreatitis in humans. The diagnosis of pancreatitis in dogs is based on clinical signs, laboratory findings, and ultrasonographic (US) changes. There are, however, inherent limitations in relying on laboratory and ultrasound findings for the clinical diagnosis of pancreatitis in dogs. Hypothesis/Objectives We hypothesized that CT angiography would be a rapid and reliable method to confirm pancreatitis in dogs compared to ultrasonography. The aim was to describe the CT characteristics and compare them to ultrasound findings and correlate the CT appearance to the severity of the patients’ clinical course. Animals A prospective pilot case series; 10 dogs with pancreatitis were enrolled if the history, clinical signs, laboratory, and ultrasonographic findings were indicative of pancreatitis. Methods A 3-phase angiographic CT was performed under sedation. Afterward, each dog had US-guided aspirates of the pancreas collected and blood drawn for cPLi assay. Images were evaluated for portion of visible pancreas, pancreatic size and margin, pancreatic parenchyma, presence of peripancreatic changes and contrast enhancement pattern. The results were compared with outcome. Results An enlarged, homogeneously to heterogeneously attenuating and contrast-enhancing pancreas with ill-defined borders was identified in all dogs. CT identified more features characterizing pancreatic abnormalities compared to US. Thrombi were found in
3/10 dogs. Three dogs with heterogeneous contrast enhancement had an overall poorer outcome than those with homogenous enhancement. Conclusions and Clinical Importance CT angiography under sedation was used in dogs to confirm clinically suspected pancreatitis and identified clinically relevant and potentially prognostic features of pancreatitis in dogs.

**Evaluation of the Effect of Orally Administered Acid Suppressants On Intragastric pH in Cats**

S. Parkinson, K. Tolbert, K. Messenger, A. Odunayo, M. Brand, G. Davidson, E. Peters, A. Reed and M.G. Papich.

Background Acid suppressant drugs are a mainstay of treatment for cats with gastrointestinal erosion and ulceration. However, clinical studies have not been performed to compare the efficacy of commonly PO administered acid suppressants in cats. Hypothesis/Objectives To compare the effect of PO administered famotidine, fractionated omeprazole tablet (fOT), and omeprazole reformulated paste (ORP) on intragastric pH in cats. We hypothesized that both omeprazole formulations would be superior to famotidine and placebo.

Animals Six healthy adult DSH colony cats. Methods Utilizing a randomized, 4-way crossover design, cats received 0.88–1.26 mg/kg PO q12h fOT, ORP, famotidine, and placebo (lactose capsules). Intragastric pH monitoring was used to continuously record intragastric pH for 96 hours beginning on day 4 of treatment. Plasma omeprazole concentrations at steady state (day 7) were determined by high performance liquid chromatography (HPLC) with ultraviolet detection. Mean percentage time that intragastric pH was ≥3 and ≥4 were compared among groups using ANOVA with a posthoc Tukey-Kramer test (α = 0.05). Results The mean percentage time ± SD that intragastric pH was ≥3 was 68.4 ± 35.0% for fOT, 73.9 ± 23.2% for ORP, 42.8 ± 18.6% for famotidine, and 16.0 ± 14.2% for placebo. Mean ± SD plasma omeprazole concentrations were similar in cats receiving fOT compared to those receiving ORP and in a range associated with acid suppression reported in other studies. Conclusions and Clinical Importance These results suggest that both omeprazole formulations provide superior acid suppression in cats compared to famotidine or placebo. Fractionated enteric-coated OT is an effective acid suppressant despite disruption of the enteric coating.

**Fasting Urinary Calcium-to-Creatinine and Oxalate-to-Creatinine Ratios in Dogs with Calcium Oxalate Urolithiasis and Breed-Matched Controls**

E. Furrow, E.E. Patterson, P.J. Armstrong, C.A. Osborne and J.P. Lulich

Background Hypercalciuria and hyperoxaluria are risk factors for calcium oxalate (CaOx) urolithiasis, but breed-specific reports of urinary metabolites and their relationship with stone status are lacking. Objective To compare urinary metabolites (calcium and oxalate) and blood ionized calcium (iCa) concentrations between CaOx stone formers and breed-matched stone-free controls for the Miniature Schnauzer, Bichon Frise, and Shih Tzu breeds. Animals Forty-seven Miniature Schnauzers (23 cases and 24 controls), 27 Bichons Frise (14 cases and 13 controls), and 15 Shih Tzus (7 cases and 8 controls). Methods Prospective study. Fasting spot urinary calcium-to-creatinine and oxalate-to-creatinine ratios (UCa/Cr and UOx/Cr, respectively) and blood iCa concentrations were measured and compared between cases and controls within and across breeds. Regression models were used to test the effect of patient and environmental factors on these variables. Results UCa/Cr was higher in cases than controls for each of the 3 breeds. In addition to stone status, being on a therapeutic food designed to prevent CaOx stone recurrence was associated with higher UCa/Cr. UOx/Cr did not differ between cases and controls for any of the breeds. Blood iCa was higher in cases than controls in the Miniature Schnauzer and Bichon Frise breeds and had a moderate correlation with UCa/Cr. Conclusions and Clinical Importance Hypercalciuria is associated with CaOx stone status in the Miniature Schnauzer, Bichon Frise, and Shih Tzu breeds. UOx/Cr did not correlate with stone status in these 3 breeds. These findings may influence breed-specific stone prevention recommendations.

**Feline Cystinuria Caused by a Missense Mutation in the SLC3A1 Gene**

K. Mizukami, K. Raj and U. Giger

Background Cystinuria is an inherited metabolic disease that is relatively common in dogs, but rare in cats and is characterized by defective amino acid reabsorption, leading to cystine urolithiasis. Objectives The aim of this study was to report on a mutation in a cystinuric cat. Animals A male domestic shorthair (DSH) cat with cystine calculi, 11 control cats from Wyoming, and 54 DSH and purebred control cats from elsewhere in the United States. Methods Exons of the SLC3A1 gene were sequenced from genomic DNA of the cystinuric cat and a healthy cat. Genetic screening for the discovered polymorphisms was conducted on all cats. Results A DSH cat showed stranguria beginning at 2 months of age, and cystine calculi were removed at 4 months of age. The cat was euthanized at 6 months of age because of neurological signs possibly related to arginine deficiency.
Twenty-five SLC3A1 polymorphisms were observed in the sequenced cats when compared to the feline reference sequence. The cystinuric cat was homozygous for 5 exonic and 8 noncoding SLC3A1 polymorphisms, and 1 of them was a unique missense mutation (c.1342C>T). This mutation results in a deleterious amino acid substitution (p.Arg448Trp) of a highly conserved arginine residue in the rBAT protein encoded by the SLC3A1 gene. This mutation was found previously in cystinuric human patients, but was not seen in any other tested cats. Conclusions and Clinical Importance This study is the first report of an SLC3A1 mutation causing cystinuria in a cat, and could be used to characterize other cystinuric cats at the molecular level.

Echocardiographic Evaluation of Myocardial Changes Observed After Closure of Patent Ductus Arteriosus in Dogs
Background Closure of PDA can be associated with echocardiographic changes including deterioration of LV systolic function. Although PDA is commonly encountered in dogs, few comprehensive reports of echocardiographic changes in dogs with PDA closure are available. Objectives To evaluate the short-term echocardiographic changes observed after PDA closure in dogs using strain analysis. Animals Seventeen client-owned dogs with left-to-right PDA. Methods Echocardiographic evaluations, including standard echocardiography and two-dimensional tissue tracking (2DTT), were performed before and within 3 days of PDA closure. Results Preclusion examination showed LV and left atrial dilatation indicating volume overload as a result of PDA. Closure of PDA resulted in significant reduction of LVIDd (>0.001) and LA/Ao (0.01) without change in LVIDs, suggestive of decreased preload. Postclosure LV systolic dysfunction was observed with significant decreased in FS (<0.001) and strain values (P = .0039 for radial strains, P = .0005 for circumferential strains). Additionally, significant LV dyssynchrony (P = .0162) was observed after closure of PDA. Conclusions and Clinical Importance Closure of PDA resulted in decreased preload as a result of alleviation of LV volume overload, which in turn caused transient deterioration of LV systolic function. Additionally, this study demonstrated that strain analysis is load dependent. Therefore, care should be taken when interpreting strain measurements as an indicator of LV systolic function.

Usefulness of Conventional and Tissue Doppler Echocardiography to Predict Congestive Heart Failure in Dogs with Myxomatous Mitral Valve Disease
J.-H. Kim and H.-M. Park
Background Systolic and diastolic functions have been evaluated to predict outcome in congestive heart failure (CHF). Recently, tissue Doppler imaging (TDI) has become useful for the estimation of myocardial function in cardiac diseases of humans and animals. Objective This study was designed to assess whether myocardial function as assessed by TDI is associated with the occurrence of CHF in dogs with myxomatous mitral valve disease (MMVD) and whether additional information is gained over conventional Doppler variables. Animals Forty-one privately owned dogs (15 healthy dogs and 26 dogs with MMVD) were included. Dogs with MMVD were divided into non-CHF (n = 10) and CHF groups (n = 16). Methods Conventional echocardiographic examinations were performed. In addition, TDI-derived variables, including radial and longitudinal velocities, strain, and strain rate were assessed. Results Several (12 of 47, 26%) conventional and tissue Doppler echocardiography variables were significant predictors of CHF in a univariate analysis (P < .05). However, TDI-derived E/Em sept was the only load-independent significant predictor of CHF (P < .05) after multivariate logistic regression analysis. The E/Em sept cut-off value of >18.7 had a sensitivity of 56% and specificity of 90% in predicting CHF in dogs with MMVD. Conclusions and Clinical Importance The combination of TDI of the mitral annulus and mitral inflow velocity provided better estimates of diastolic dysfunction in dogs with MMVD and CHF. Additional study is warranted to assess TDI-derived E/Em sept, an index of diastolic function that could contribute to the management of dogs with MMVD and CHF.

The Role of Hypothyroidism in the Etiology and Progression of Dilated Cardiomyopathy in Doberman Pinschers
P. Beier, S. Reese, P.J. Holler, J. Simak, G. Tater and G. Wess
Background Hypothyroidism and dilated cardiomyopathy (DCM) are both common diseases in Doberman Pinschers. A possible influence of hypothyroidism on the etiology and progression of DCM is controversial. Objectives Evaluation of the role of hypothyroidism in etiology and progression of DCM. Animals A total of 175 Doberman Pinschers. Methods In this longitudinal prospective study, echocardiography and 24-hour ambulatory ECG recordings were performed in all dogs as screening tests for DCM. Total thyroxine (TT4) and thyroid ultrasonography served as initial screening tests for hypothyroidism and low TT4 values were followed
Relationship of Body Size to Metabolic Markers and Left Ventricular Hypertrophy in Cats

L.M. Freeman, J.E. Rush, A. Feugier and I. van Hoek

Background Cats with hypertrophic cardiomyopathy (HCM) are larger and have higher insulin-like growth factor-1 (IGF-1) concentrations than cats without HCM. Hypothesis/Objectives The aim of this study was to assess echocardiographic findings in a colony of adult cats to determine the relationship between early growth and left ventricular hypertrophy (LVH). Animals Twenty-eight neutered adult cats (20 males, 8 females) from a colony ≥3 years of age for which growth curves were available. Methods Case-control study. Physical examination and echocardiography were performed, and body weight, body condition score (BCS), and head length and width were measured. Circulating glucose, insulin, N-terminal pro-B-type natriuretic peptide (NT-proBNP), and IGF-1 concentrations were measured and growth data were collected. Stepwise multivariate analyses were performed. Results Mean age was 5.2 ± 1.1 years. Current BCSs ranged from 4 to 9 (median, 6) and mean body weight was 4.88 ± 1.29 kg. Variation in body weight was apparent by 6 (mean = 3.26 ± 0.80 kg) and 12 months of age (mean = 4.02 ± 1.02 kg). Cardiac abnormalities included a cardiac murmur (n = 7; 24%), gallop (n = 3; 10%), and arrhythmia (n = 1; 4%). Fourteen of 28 cats (50%) had echocardiographic evidence of LVH. Head width (P = .017), body weight (P < .001), NT-proBNP (P = .023), and IGF-1 (P = .013–.022) were significantly associated with selected measures of LVH. Conclusions and Clinical Importance Potential associations between body size, IGF-1, LVH, and HCM warrant future prospective studies.

Complication Rates Associated with Transvenous Pacemaker Implantation in Dogs with High-Grade Atrioventricular Block Performed During versus After Normal Business Hours

J.L. Ward, T.C. DeFrancesco, S.P. Tou, C.E. Atkins, E.H. Griffith and B.W. Keene

Background Transvenous pacemaker implantation in dogs is associated with a relatively high complication rate. At our institution, pacemaker implantation in dogs with high-grade atrioventricular block (HG-AVB) frequently is performed as an after-hours emergency. Hypothesis Among dogs with HG-AVB, the rate of major complications is higher when pacemakers are implanted after hours (AH) compared to during business hours (BH). Animals Client-owned dogs with HG-AVB that underwent transvenous pacemaker implantation between January 2002 and December 2012 at the North Carolina State University Veterinary Teaching Hospital. Methods Retrospective medical record review. Two-year follow-up was required for complications analysis. Results Major complications occurred in 14/79 dogs (18%) and included lead dislodgement, lead or generator infection, lead or generator migration, and pacing failure. Incidence of major complications was significantly higher AH (10/36, 28%) compared to BH (4/43, 9%; P = .041), and all infectious complications occurred AH. Median survival time for all dogs was 27 months and did not differ between AH and BH groups for either all-cause (P = .70) or cardiac (P = .40) mortality. AH dogs were younger than BH dogs (P = .010), but there were no other clinically relevant differences between BH and AH groups in terms of demographic, clinical, or procedural variables. Conclusions and Clinical Importance At our institution, AH transvenous pacemaker placement is associated with a higher rate of major complications (especially infections) compared to BH placement. This difference may be because of a variety of human factor differences AH versus BH.

Serum Cardiac Troponin I Concentrations in Dogs with Systemic Inflammatory Response Syndrome

L. Hamacher, R. Dörfelt, M. Müller and G. Wess

Background Myocardial injury can be detected by cardiac troponin I (cTnI) concentration, which appears to be a predictor of short-term death in critically ill patients. It is unknown if the best prognostic indicator of short-term survival is cTnI measurement at admission or at later time points. Hypothesis/Objectives Measuring cTnI with a high-sensitivity (HS) test at different time points after admission may be a better short-term prognostic indicator than a single cTnI measurement at admission in dogs with systemic inflammatory response syndrome (SIRS).
Glycemic Status and Predictors of Relapse for Diabetic Cats in Remission

Background Clinical significance of glycemic control in dogs is under-appreciated. Method Prospective, randomized, cross-sectional, multi-center, blinded cohort study (n = 100). Hypothesis Objectives Relationship between glycemia at admission and outcome of cardiac procedures. Results Forty-two dogs (n = 42) had noncardiac (ICD) and 58 dogs (n = 58) had cardiac (ICD). Median plasma glucose concentrations were higher in noncardiac (165 mg/dL; IQR = 125–244) compared to cardiac (179 mg/dL; IQR = 125–266; P < .01). Conclusion Glycemia at admission is predictive of outcome of cardiac procedures. Clinical Importance Glycemia is an important predictor of mortality and morbidity in dogs with cardiac disease.

Background It is unknown if diabetic cats in remission have persistent abnormalities of glucose metabolism and should be considered prediabetic, or have normal glucose tolerance. Objective To characterize glycemic status of diabetic cats in remission and to determine predictors of relapse. Animals A total of 21 cats in diabetic remission and 28 healthy control cats. Methods At a median of 107 days after remission, screening blood glucose concentration was measured on entry to the clinic. After a 24-hour fast in hospital, fasting blood glucose, fructosamine and feline pancreatic lipase concentrations were measured, and 3 hours later, a simplified IV glucose tolerance test (1 g glucose/kg) performed. Twenty cats were monitored for relapse for at least 9 months. Results Of the 21 cats in remission, 19% (4/21) had impaired fasting glucose concentration and 76% (16/21) had impaired glucose tolerance. Of cats followed up for 9 months after testing, 30% (6/20) had relapsed and required insulin treatment. Fasting blood glucose concentration ≥7.5 mmol/L (≥135 mg/dL) (odds ratio [OR] = 12.8) and severely impaired glucose tolerance (≥5 hours to return to <6.5 mmol/L or <117 mg/dL; OR = 15.2) were significantly associated with relapse. Blood glucose concentration >14 mmol/L; 252 mg/dL at 3 hours was significantly associated with relapse (OR = 10.1). Conclusion and Clinical Importance Most cats in diabetic remission have impaired glucose tolerance and a minority have impaired fasting glucose concentration and should be considered prediabetic. More severe glucose intolerance and impaired fasting glucose concentration are predictors of relapse. Ongoing glucose monitoring of diabetic cats in remission is recommended.

Serum Cortisol Concentrations in Dogs with Pituitary-Dependent Hyperadrenocorticism and Atypical Hyperadrenocorticism


Background Atypical hyperadrenocorticism (AHAC) is considered when dogs have clinical signs of hypercortisolemia with normal hyperadrenocorticism screening tests. Hypothesis/Objectives To compare cortisol concentrations and adrenal gland size among dogs with pituitary-dependent hyperadrenocorticism (PDH), atypical hyperadrenocorticism (AHAC), and healthy controls. Animals Ten healthy dogs, 7 dogs with PDH, and 8 dogs with AHAC. Method Dogs were prospectively enrolled between November 2011 and January 2013. Dogs were diagnosed with PDH or AHAC based on clinical signs and positive screening test results (PDH) or abnormal extended adrenal hormone panel results (AHAC). Transverse adrenal gland measurements were obtained by abdominal ultrasound. Hourly mean cortisol (9 samplings), sum of hourly cortisol measurements and adrenal gland sizes were compared among the 3 groups. Results Hourly (control, 1.4 ± 0.6 µg/dL; AHAC, 2.9 ± 1.3; PDH, 4.3 ± 1.5) (mean, SD) and sum (control, 11.3 ± 3.3; AHAC, 23.2 ± 7.7; PDH, 34.7 ± 9.9) cortisol concentrations differed significantly between the controls and AHAC (P < .01) and PDH (P < .01) groups. Hourly (P < .01) but not sum (P = .27) cortisol concentrations differed between AHAC and PDH dogs. Average transverse adrenal gland diameter of control dogs (5.3 ± 1.2 mm) was significantly less than dogs with PDH (6.4 ± 1.4; P = .02) and AHAC (7.2 ± 1.5; P < .01); adrenal gland diameter did not differ (P = .18) between dogs with AHAC and PDH. Conclusions and Clinical Importance Serum cortisol concentrations in dogs with AHAC were increased compared to controls but less than dogs with PDH, while adrenal gland diameter was similar between dogs with AHAC and PDH. These findings suggest cortisol excess could contribute to the pathophysiology of AHAC.


B.T. Hardy, J.F. de Brito Galvao, T.A. Green, S.R. Braudaway, S.P. DiBartola, L. Lord and D.J. Chew

Background Long-term treatment of cats with ionized hypercalcemia using alendronate has not been evaluated. Hypothesis/Objectives Alendronate is well tolerated in treatment of ionized hypercalcemia in cats. Animals A total of 21 cats with ionized hypercalcemia. Methods Prospective study of 12 cats with ionized hypercalcemia of idiopathic origin was identified by telephone and email communication with a convenience sample of consulting veterinarians. Cats were treated with alendronate at a dose of 5–20 mg per feline PO q7d. Serum ionized calcium concentration (iCa) was measured before beginning treatment with alendronate, and after 1, 3, and 6 months of treatment. Alendronate dosage was adjusted according to iCa. Evaluation included physical examination, CBC, biochemistry profile, and diagnostic imaging. The owners and referring veterinarians were questioned about any observed adverse effects. The Wilcoxon matched-pairs signed rank test was used to compare baseline iCa to iCa at different time periods. Results Alendronate treatment resulted in a decrease in iCa in all 12 cats. The median percentage change in iCa was −13.2%, −15.9%, and −18.1% (range, −29.6 to +7.6; −30.5 to −1.9; −45.8 to +1.5%) at the 1, 3, and 6 month time points, respectively. Baseline iCa was significantly different from 1 month (P = .0042), 3 months (P = .0005), and 6 months (P = .0015). No adverse
and histopathologic confirm no identified underlying etiology. Animals Six dogs had MRI of the spinal cord, decompressive spinal surgery, and surgical outcomes in histopathologically confirmed extraparenchymal spinal cord hematomas in dogs with medicine. Objectives To describe the signalment, clinical findings, magnetic resonance imaging (MRI) spontaneous extraparenchymal spinal cord hematoma have not been described previously in veterinary extraparenchymal spinal cord hematoma formation with neoplasia, intervertebral disk disease, and snake envenomation. There are rare reports of spontaneous extraparenchymal spinal cord hematoma formation in dogs with no known cause in human medicine. Multiple cases of spontaneous extraparenchymal spinal cord hematoma have not been described previously in veterinary medicine. Objectives To describe the signalment, clinical findings, magnetic resonance imaging (MRI) features, and surgical outcomes in histopathologically confirmed extraparenchymal spinal cord hematomas in dogs with no identified underlying etiology. Animals Six dogs had MRI of the spinal cord, decompressive spinal surgery, and histopathologic confirmation of extraparenchymal spinal cord hematoma not associated with an underlying cause. Methods Multi-institutional retrospective study. Results Six patients had spontaneous extraparenchymal
spinal cord hematoma formation. MRI showed normal signal within the spinal cord parenchyma in all patients. All hematomas had T2-weighted hyperintensity and the majority (5/6) had no contrast enhancement. All dogs underwent surgical decompression and most patients (5/6) returned to normal or near normal neurologic function postoperatively. Follow-up of the patients (ranging between 921 and 1,446 days) showed no progression of neurologic clinical signs or any conditions associated with increased bleeding tendency. Conclusions and Clinical Importance Before surgery and histopathology confirming extraparenchymal hematoma, the primary differential in most cases was neoplasia, based on the MRI findings. This retrospective study reminds clinicians of the importance of the combination of advanced imaging combined with histopathologic diagnosis. The prognosis for spontaneous spinal cord extraparenchymal hematoma with surgical decompression appears to be favorable in most cases.

Prevalence of Chiari-like Malformations in Clinically Unaffected Dogs
Background The importance of Chiari-like malformation (CM) in the generation of clinical signs or the formation of syringomyelia in dogs is incompletely understood, partly because the prevalence of various CM definitions in unaffected dogs is unknown. Hypothesis/Objectives The aims were: to estimate the prevalence of CM in dogs asymptomatic for CM or syringomyelia, according to 3 currently used definitions; and, to investigate the effect of brachycephaly and head position during magnetic resonance (MR) imaging on estimates of the prevalence of CM. Animals One ninety-nine client-owned dogs without apparent signs of CM or syringomyelia. Methods Blinded, retrospective analysis. Archived MR images were analyzed for evidence of cerebellar indentation and impaction into or herniation through the foramen magnum. Logistic regression analysis was used to investigate the relationship of CM diagnosis with head position and the cranial index (a measure of brachycephaly). Results In 185 non-Cavalier King Charles Spaniel (CKCS) dogs, indentation was identified in 44% (95% CI, 47–51%) and impaction in 22% (95% CI, 16–28%). No asymptomatic, non-CKCS dogs showed herniation. Regression analysis showed a significant increase in the odds of indentation and impaction in an extended head position and as the cranial index increased (became more brachycephalic). Conclusions and Clinical Importance The high prevalence of cerebellar indentation and impaction suggests that they may be normal anatomical variations and therefore unsuitable as definitions of CM. We suggest that future research into CM in dogs should define cases and controls more strictly so that overlap between normal and abnormal animals is minimized.

Low-Field MRI and Multislice CT for the Detection of Cerebellar (Foramen Magnum) Herniation in Cavalier King Charles Spaniels
K. Kromhout, H. van Bree, B.J.G. Broeckx, S. Bhatti, L. Van Ham, I. Polis and I. Gielen
Background Cavalier King Charles Spaniels (CKCS) have a high prevalence of Chiari-like malformation (CM). Herniation of the cerebellum into the foramen magnum is a key diagnostic feature for CM. Midsagittal MR images are the preferred technique for visualizing cerebellar herniation (CH). Objective To investigate whether CT can be used to diagnose CH. Animals Fifteen client-owned CKCS dogs referred for investigation of the brain and cranial cervical spine on MRI and CT. Methods Two reviewers retrospectively analyzed midsagittal T1WSE and T2WSE MR images and midsagittal pre- and postcontrast 2D multiplanar reformatted CT images from each dog for the presence of CH. And, if present, the length (mm, CHL) of the herniation was measured. The results were analyzed statistically. Results There was no significant difference between the different observers and techniques for the detection of CH and measurement of CHL. Overall, the CHL was longer on the CT images. Conclusion and Clinical Importance Both techniques are useful for detecting CH and measuring CHL. Because CHL does not have a known direct impact on the clinical presentation of CM, CT can be used as a diagnostic tool in a routine clinical practice for CM in CKCS when MRI is not available. We emphasize that MRI is the standard screening technique in CKCS for breeding purposes to detect the presence of CM and SM and, at the current time, CT cannot replace MRI.

Prevalence and Heritability of Symptomatic Syringomyelia in Cavalier King Charles Spaniels and Long-term Outcome in Symptomatic and Asymptomatic Littermates
Background Syringomyelia (SM) is common in the Cavalier King Charles Spaniel (CKCS). Dogs with syringes express clinical signs or might be clinically silent. Objectives To investigate the prevalence and heritability of symptomatic SM, the association between clinical signs and magnetic resonance imaging (MRI) findings, and
long-term outcome. Animals All CKCS registered in the Danish Kennel Club in 2001 (n = 240). Methods A cross-sectional questionnaire-based prevalence study validated by telephone interviews and clinically investigated clinical signs of SM. Dogs were 6 years at the time of investigation. A prospective observational litter study including clinical investigations, MRI and 5-year follow-up of symptomatic and asymptomatic siblings. Heritability was estimated based on the scale of liability in the study population and litter cohort. Results The cross-sectional study estimated a prevalence of symptomatic SM at 15.4% in the population. Thirteen symptomatic and 9 asymptomatic siblings participated in the litter study. Spinal cord syringes were confirmed in 21 of 22 littermates (95%). Syrinx diameter and mean syrinx:spinal cord ratio were significantly correlated with clinical signs (P < .01). Estimated heritability of symptomatic SM was 0.81. Symptomatic SM motivated euthanasia in 20%. Dogs with syringes, which expressed no clinical signs at the age of 6, remained asymptomatic in 14/15 cases (93%). Conclusions and Clinical Importance The prevalence of symptomatic SM is high and genetics have a high impact on clinical disease expression. Further investigations of factors influencing the outbreak threshold of clinical signs of SM are desirable.

Association between Estrus and Onset of Seizures in Dogs with Idiopathic Epilepsy
S.A.E. Van Meervenne, H.A. Volk and L.M.L. Van Ham
Background Catamenial epilepsy in humans is defined as changes in seizure frequency over the course of the menstrual cycle. Three hormonally based patterns of seizure exacerbation have been determined. Objectives The aim of this study was to evaluate whether there is an association between onset of seizures and the estrous cycle in intact bitches with presumptive idiopathic epilepsy and whether a pattern to the onset of seizures could be recognized. Animals Forty-five intact female dogs from a hospital population with a presumptive diagnosis of idiopathic epilepsy. Methods In a retrospective study, the database of a small animal hospital in Sweden was searched for medical records of intact female dogs diagnosed with epilepsy or seizures. The stage of the estrous cycle as reported either by the owner or the veterinarian at the time of the first seizure was noted. Results Of the 45 dogs with idiopathic epilepsy, 17 (38%) had their first seizure when in heat and six dogs (13%) had their first seizure 1–3 months after heat. Nine dogs (20%) had seizures reoccurring in relation to their estrous cycle. Conclusions and Clinical Importance These findings suggest an association between estrus and onset of seizures in intact bitches with presumptive idiopathic epilepsy. Two hormonally based patterns could be recognized: one during heat and one during a specific time point at the end of diestrus. This could be explained by the proconvulsive effects of estrogen or loss of protective effect against seizures of progesterone, respectively.

Clinical Phenotype of X-Linked Myotubular Myopathy in Labrador Retriever Puppies
Background Seven male Labrador Retriever puppies from 3 different litters, born to clinically normal dams and sires, were evaluated for progressive weakness and muscle atrophy. Muscle biopsies identified a congenital myopathy with pathologic features consistent with myotubular myopathy. Further investigations identified a pathogenic mutation in the myotubularin gene, confirming that these puppies had X-linked myotubular myopathy (XLMTM). Objective To review the clinical phenotype, electrodiagnostic and laboratory features of XLMTM in this cohort of Labrador Retrievers. Results Male puppies with XLMTM were small and thin compared with their normal littermates. Generalized weakness and muscle atrophy were present by 7 weeks of age in some puppies and evident to most owners by 14 weeks of age. Affected puppies stood with an arched spine and low head carriage, and walked with a short, choppy stride. Muscle atrophy was severe and progressive. Patellar reflexes were absent. Laryngeal and esophageal dysfunction, and weakness of the masticatory muscles occurred in puppies surviving beyond 4 months of age. Serum creatine kinase activity was normal or only mildly increased. EMG findings were nonspecific and included positive sharp waves and fibrillation potentials. Clinical signs progressed rapidly, with most affected puppies unable to walk within 3–4 weeks after clinical signs were first noticed. Conclusions and Clinical Importance Although initial clinical signs of XLMTM are similar to the phenotypically milder centronuclear myopathy in Labrador Retrievers, XLMTM is a rapidly progressive and fatal myopathy. Clinicians should be aware of these 2 distinct myopathies with similar clinical presentations in the Labrador retriever breed.

Randomized Phase III Trial of Piroxicam in Combination with Mitoxantrone or Carboplatin for First-Line Treatment of Urogenital Tract Transitional Cell Carcinoma in Dogs
Background Reported response rates of transitional cell carcinoma (TCC) in dogs to piroxicam in combination with either mitoxantrone or carboplatin are similar; however, it is unknown whether either drug might provide
superior duration of response. Hypothesis/Objectives To determine if the progression-free interval (PFI) of dogs with TCC treated with mitoxantrone and piroxicam was different than that of dogs receiving carboplatin and piroxicam. The hypothesis was that the efficacy of mitoxantrone is no different from carboplatin. Animals Fifty dogs with TCC without azotemia. Methods Prospective open-label phase III randomized study. Either mitoxantrone or carboplatin was administered every 3 weeks concurrently with piroxicam with restaging at 6-week intervals. Twenty-four dogs received carboplatin and 26 received mitoxantrone. Results Response was not different between groups (P = .56). None of the dogs showed complete response. In the mitoxantrone group, there were 2 (8%) partial responses (PR) and 18 (69%) dogs with stable disease (SD). In the carboplatin group, there were 3 PR (13%) and 13 (54%) dogs with SD. The PFI was not significantly different between groups (mitoxantrone = 106 days; carboplatin = 73.5 days; P = .62; hazard ratio 0.86; 95% confidence interval 0.47–1.56). Dogs with prostatic involvement experienced a shorter survival (median, 109 days) compared to dogs with urethral, trigonal, or apically located tumors; this difference was significant (median 300, 190, and 645 days, respectively; P = .005). Conclusions and Clinical Importance This study did not detect a different in outcome in dogs with TCC treated with either mitoxantrone or carboplatin in combination with piroxicam.

Expression of Nociceptive Ligands in Canine Osteosarcoma
Background Canine osteosarcoma (OS) is associated with localized pain as a result of tissue injury from tumor infiltration and peritumoral inflammation. Malignant bone pain is caused by stimulation of peripheral pain receptors, termed nociceptors, which reside in the localized tumor microenvironment, including the periosteal and intramedullary bone cavities. Several nociceptive ligands have been determined to participate directly or indirectly in generating bone pain associated with diverse skeletal abnormalities. Hypothesis Canaline OS cells actively produce nociceptive ligands with the capacity to directly or indirectly activate peripheral pain receptors residing in the bone tumor microenvironment. Animals Ten dogs with appendicular OS. Methods Expression of nerve growth factor, endothelin-1, and microsomal prostaglandin E synthase-1 was characterized in OS cell lines and naturally occurring OS samples. In 10 dogs with OS, circulating concentrations of nociceptive ligands were quantified and correlated with subjective pain scores and tumor volume in patients treated with standardized palliative therapies. Results Canine OS cells express and secrete nerve growth factor, endothelin-1, and prostaglandin E2. Naturally occurring OS samples uniformly express nociceptive ligands. In a subset of OS-bearing dogs, circulating nociceptive ligand concentrations were detectable but failed to correlate with pain status. Localized foci of nerve terminal proliferation were identified in a minority of primary bone tumor samples. Conclusions and Clinical Importance Canine OS cells express nociceptive ligands, potentially permitting active participation of OS cells in the generation of malignant bone pain. Specific inhibitors of nociceptive ligand signaling pathways might improve pain control in dogs with OS.

Effect of Synthetic Colloid Administration on Coagulation in Healthy Dogs and Dogs with Systemic Inflammation
V. Gauthier, M.K. Holowaychuk, C.L. Kerr, A.M.E. Bersenas and R. Darren Wood
Background Synthetic colloids are often used during fluid resuscitation and affect coagulation. Objective To compare the effects of an isotonic crystalloid and synthetic colloid on coagulation in healthy dogs and dogs with systemic inflammation. Animals Sixteen adult purpose-bred Beagles. Methods Randomized, placebo-controlled, blinded study. Dogs were randomized into one of two groups receiving fluid resuscitation with either 40 mL/kg IV 0.9% NaCl or tetrastarch after administration of lipopolysaccharide or an equal volume of placebo. After a 14-day washout period, the study was repeated such that dogs received the opposite treatment (LPS or placebo) but the same resuscitation fluid. Blood samples were collected at 0, 1, 2, 4, and 24 hours for measurement of coagulation variables. Results Administration of either fluid to healthy dogs and dogs with systemic inflammation resulted in similar increases in prothrombin time and activated clotting time. In comparison to saline administration, tetrastarch administration resulted in significantly decreased R (P = .017) in healthy dogs, as well as significantly increased activated partial thromboplastin time (P ≤ .016), CL30% (P ≤ .016), and K (P < .001) and significantly decreased platelet count (P = .019), a (P ≤ .001), MA (P < .001), and von Willebrand factor antigen (P < .001) and collagen binding activity (P ≤ .003) in both healthy dogs and dogs with systemic inflammation. Conclusions and Clinical Importance Tetrastarch bolus administration to dogs with systemic inflammation resulted in a transient hypocoagulability characterized by a prolonged activated partial thromboplastin time, decreased clot formation speed and clot strength, and acquired type 1 von Willebrand disease.
Apparent Resolution of Canine Primary Hypoparathyroidism with Immunosuppressive Treatment
J. Warland, B. Skelly, C. Knudsen and M. Herrtage

Tethered Cord Syndrome Associated with a Thickened Filum Terminale in a Dog
S. De Decker, T. Gregori, P.J. Kenny, C. Hoy, K. Erles and H.A. Volk

The Veterinary Journal

Renal fibrosis in feline chronic kidney disease: Known mediators and mechanisms of injury
Jack Lawson, Jonathan Elliott, Caroline Wheeler-Jones, Harriet Syme, Rosanne Jepson
Chronic kidney disease (CKD) is a common medical condition of ageing cats. In most cases the underlying aetiology is unknown, but the most frequently reported pathological diagnosis is renal tubulointerstitial fibrosis. Renal fibrosis, characterised by extensive accumulation of extra-cellular matrix within the interstitium, is thought to be the final common pathway for all kidney diseases and is the pathological lesion best correlated with function in both humans and cats. As a convergent pathway, renal fibrosis provides an ideal target for the treatment of CKD and knowledge of the underlying fibrotic process is essential for the future development of novel therapies. There are many mediators and mechanisms of renal fibrosis reported in the literature, of which only a few have been investigated in the cat. This article reviews the process of renal fibrosis and discusses the most commonly cited mediators and mechanisms of progressive renal injury, with particular focus on the potential significance to feline CKD.

Nausea: Current knowledge of mechanisms, measurement and clinical impact
Hannah Kenward, Ludovic Pelligand, Karine Savary-Bataille, Jonathan Elliott
Nausea is a subjective sensation, which often acts as a signal that emesis is imminent. It is a widespread problem that occurs as a clinical sign of disease or as an adverse effect of a drug therapy or surgical procedure. The mechanisms of nausea are complex and the neural pathways are currently poorly understood. This review summarises the current knowledge of nausea mechanisms, the available animal models for nausea research and the anti-nausea properties of commercially available anti-emetic drugs. The review also presents subjective assessment and scoring of nausea. A better understanding of the underlying mechanisms of nausea might reveal potential clinically useful biomarkers for objective measurement of nausea in species of veterinary interest.

Poisoning of dogs and cats by drugs intended for human use
Cristina Cortinovis, Fabiola Pizzo, Francesca Caloni
One of the main causes of poisoning of small animals is exposure to drugs intended for human use. Poisoning may result from misuse by pet owners, off-label use of medicines or, more frequently, accidental ingestion of drugs that are improperly stored. This review focuses on classes of drugs intended for human use that are most commonly involved in the poisoning of small animals and provides an overview of poisoning episodes reported in the literature. To perform this review a comprehensive search of public databases (PubMed, Web of Science, Scopus, Google Scholar) using key search terms was conducted. Additionally, relevant textbooks and reference lists of articles pertaining to the topic were reviewed to locate additional related articles. Most published information on small animal poisoning by drugs intended for human use was from animal and human poison control centres or from single case reports. The dog was the species most frequently poisoned. The major drugs involved included analgesics (nonsteroidal anti-inflammatory drugs), antihistamines (H1-antihistamines), cardiovascular drugs (calcium channel blockers), central nervous system drugs (selective serotonin reuptake inhibitors, baclofen, benzodiazepines and zolpidem), gastrointestinal drugs (loperamide), nutritional supplements (vitamin D and iron salts) and respiratory drugs (β2-adrenergic receptor agonists).

Inbreeding impact on litter size and survival in selected canine breeds
Grégoire Leroy, Florence Phocas, Benoit Hedan, Etienne Verrier, Xavier Rognon
Data obtained from the French Kennel Club and the Fichier National Canin were used to estimate the effect of inbreeding on average litter size and survival in seven French breeds of dog. Depending on the breed, litter sizes were 3.5–6.3 puppies and longevities were 7.7–12.2 years. Estimated heritabilities were 6.0–10.9% for litter size and 6.1–10.1% for survival at 2 years of age. Regression coefficients indicated a negative effect of inbreeding on both individual survival and litter size. Although the impact of baseline inbreeding within breeds appears to be limited, the improper mating of close relatives will reduce biological fitness through significant reduction of litter size and longevity.
Association between the findings on magnetic resonance imaging screening for syringomyelia in asymptomatic Cavalier King Charles spaniels and observation of clinical signs consistent with syringomyelia in later life
E.J. Ives, L. Doyle, M. Holmes, T.L. Williams, A.E. Vanhaesebrouck
A questionnaire-based study was used to investigate the association between the findings on magnetic resonance imaging (MRI) screening for syringomyelia (SM) in 79 asymptomatic Cavalier King Charles spaniels (CKCS) and the subsequent development of clinical signs consistent with SM in later life. Owners reported clinical signs consistent with SM in 13/79 (16%) dogs at the time of the questionnaire. A significantly greater proportion of CKCS with a syrinx visible on MRI screening showed clinical signs in later life (9/25, 36%) than dogs without a visible syrinx (4/54, 7%; odds ratio 6.9). Whether the findings of MRI screening can be used to indicate the likelihood of an asymptomatic CKCS developing clinical signs consistent with SM in later life warrants further prospective study in a larger cohort of dogs.

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Evaluation of serum biochemical marker concentrations and survival time in dogs with protein-losing enteropathy
Mirjam Equilino, Vincent Théodoloz, Daniela Gorgas, Marcus G. Doherr, Romy M. Heilmann, Jan S. Suchodolski, Jörg M. Steiner, Iwan A. Burgener DVM
Objective—To evaluate serum concentrations of biochemical markers and survival time in dogs with protein-losing enteropathy (PLE). Design—Prospective study. Animals—29 dogs with PLE and 18 dogs with food-responsive diarrhea (FRD). Procedures—Data regarding serum concentrations of various biochemical markers at the initial evaluation were available for 18 of the 29 dogs with PLE and compared with findings for dogs with FRD. Correlations between biochemical marker concentrations and survival time (interval between time of initial evaluation and death or euthanasia) for dogs with PLE were evaluated. Results—Serum C-reactive protein concentration was high in 13 of 18 dogs with PLE and in 2 of 18 dogs with FRD. Serum concentration of canine pancreatic lipase immunoreactivity was high in 3 dogs with PLE but within the reference interval in all dogs with FRD. Serum α1-proteinase inhibitor concentration was less than the lower reference limit in 9 dogs with PLE and 1 dog with FRD. Compared with findings in dogs with FRD, values of those 3 variables in dogs with PLE were significantly different. Serum calprotectin (measured by radioimmunoassay and ELISA) and S100A12 concentrations were high but did not differ significantly between groups. Seventeen of the 29 dogs with PLE were euthanized owing to this disease; median survival time was 67 days (range, 2 to 2,551 days). Conclusions and Clinical Relevance—Serum C-reactive protein, canine pancreatic lipase immunoreactivity, and α1-proteinase inhibitor concentrations differed significantly between dogs with PLE and FRD. Most initial biomarker concentrations were not predictive of survival time in dogs with PLE.

Survival analysis of critically ill dogs with hypotension with or without hyperlactatemia: 67 cases (2006–2011)
Laura B. Ateca, Stefan C. Dombrowski, Deborah C. Silverstein
Objective—To determine whether critically ill hypotensive dogs without hyperlactatemia have the same prognosis as critically ill hypotensive dogs with hyperlactatemia. Design—Retrospective case series. Animals—67 critically ill dogs with hypotension. Procedures—Medical records were searched from January 2006 through December 2011 for dogs that were hospitalized in the intensive care unit and that had hypotension and measurement of blood lactate concentration. Blood lactate concentration, systolic blood pressure, and survival rate were compared between hypotensive dogs with and without hyperlactatemia. Results—19 of 67 (28%) dogs survived and were discharged from the hospital. Hypotensive dogs without hyperlactatemia had a significantly higher systolic blood pressure and were 3.23 (95% confidence interval, 1.04 to 9.43) times as likely to survive, compared with hypotensive dogs with hyperlactatemia. Age, weight, severity of clinical illness, and duration of hospitalization did not differ significantly between hypotensive dogs with and without hyperlactatemia. Conclusions and Clinical Relevance—Results suggested that hypotensive dogs without hyperlactatemia had a better prognosis and chance of surviving to hospital discharge than did hypotensive dogs with hyperlactatemia. Because blood lactate concentration was negatively associated with systolic blood pressure and survival probability, it may be a useful metric for determining the prognosis of hypotensive dogs.
Exogenous thyrotoxicosis in dogs attributable to consumption of all-meat commercial dog food or treats containing excessive thyroid hormone: 14 cases (2008–2013)

Michael R. Broome, Mark E. Peterson, Robert J. Kemppainen, Valerie J. Parker, Keith P. Richter
Objective—To describe findings in dogs with exogenous thyrotoxicosis attributable to consumption of commercially available dog foods or treats containing high concentrations of thyroid hormone.
Design—Retrospective and prospective case series. Animals—14 dogs. Procedures—Medical records were retrospectively searched to identify dogs with exogenous thyrotoxicosis attributable to dietary intake. One case was found, and subsequent cases were identified prospectively. Serum thyroid hormone concentrations were evaluated before and after feeding meat-based products suspected to contain excessive thyroid hormone was discontinued. Scintigraphy was performed to evaluate thyroid tissue in 13 of 14 dogs before and 1 of 13 dogs after discontinuation of suspect foods or treats. Seven samples of 5 commercially available products fed to 6 affected dogs were analyzed for thyroxine concentration; results were subjectively compared with findings for 10 other commercial foods and 6 beef muscle or liver samples. Results—Total serum thyroxine concentrations were high (median, 8.8 µg/dL; range, 4.65 to 17.4 µg/dL) in all dogs at initial evaluation; scintigraphy revealed subjectively decreased thyroid gland radionuclide in 13 of 13 dogs examined. At ≥ 4 weeks after feeding of suspect food or treats was discontinued, total thyroxine concentrations were within the reference range for all dogs and signs associated with thyrotoxicosis, if present, had resolved. Analysis of tested food or treat samples revealed a median thyroxine concentration for suspect products of 1.52 µg of thyroxine/g, whereas that of unrelated commercial foods was 0.38 µg of thyroxine/g. Conclusions and Clinical Relevance—Results indicated that thyrotoxicosis can occur secondary to consumption of meat-based products presumably contaminated by thyroid tissue, and can be reversed by identification and elimination of suspect products from the diet.

Use of laterally placed vacuum drains for management of aural hematomas in five dogs
Michael M. Pavletic
Case Description—5 dogs (a Newfoundland, Golden Retriever, Shiba Inu, Staffordshire Terrier, and Vizsla) were referred for evaluation and treatment of unilateral aural hematomas within a week after their formation. Clinical Findings—Aural hematomas involved the left (3) or right (2) ears. Treatment and Outcome—With patients under anesthesia, the aural hematomas were approached surgically from the convex, or lateral, pinnal surface. Two small incisions were used to position a vacuum drain into the incised hematoma cavity. The drain exited at the base of the pinna and adjacent cervical skin. The free end of the drain was attached to a vacuum reservoir for 18 to 21 days. Drains and skin sutures were removed at this time along with the protective Elizabethan collar. All hematomas resolved and surgical sites healed during the minimum 6-month follow-up period. Cosmetic results were considered excellent in 4 of 5 patients. Slight wrinkling of the pinna in 1 patient resulted from asymmetric enlargement of the cartilaginous walls of the hematoma, where vacuum application resulted in a slight folding of the redundant lateral cartilage wall. Clinical Relevance—The described treatment was efficient, economical, and minimally invasive and required no bandaging or wound care. Placement of the drain tubing on the convex (lateral) aspect sheltered the system from displacement by patients with an Elizabethan collar in place. Overall cosmetic results were excellent; asymmetric enlargement of the cartilaginous walls of the hematoma with slight folding of the pinna was seen in 1 patient.

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Comparison of anamnestic responses to rabies vaccination in dogs and cats with current and out-of-date vaccination status
Michael C. Moore, Rolan D. Davis, Qing Kang, Christopher I. Vahl, Ryan M. Wallace, Cathleen A. Hanlon, Derek A. Mosier
Objective—To compare anamnestic antibody responses of dogs and cats with current versus out-of-date vaccination status. Design—Cross-sectional study. Animals—74 dogs and 33 cats. Procedures—Serum samples were obtained from dogs and cats that had been exposed to rabies and brought to a veterinarian for proactive serologic monitoring or that had been brought to a veterinarian for booster rabies vaccination. Blood samples were collected on the day of initial evaluation (day 0) and then again 5 to 15 days later. On day 0, a rabies vaccine was administered according to label recommendations. Paired serum samples were analyzed for antirabies antibodies by means of a rapid fluorescent focus inhibition test. Results—All animals had an antirabies antibody titer ≥ 0.5 IU/mL 5 to 15 days after booster vaccination. Dogs with an out-of-date vaccination status had a higher median increase in titer, higher median fold increase in titer, and higher median
titer following booster vaccination, compared with dogs with current vaccination status. Most (26/33) cats, regardless of rabies vaccination status, had a titer ≥ 12 IU/mL 5 to 15 days after booster vaccination.

Conclusions and Clinical Relevance—Results indicated that dogs with out-of-date vaccination status were not inferior in their antibody response following booster rabies vaccination, compared with dogs with current vaccination status. Findings supported immediate booster vaccination followed by observation for 45 days of dogs and cats with an out-of-date vaccination status that are exposed to rabies, as is the current practice for dogs and cats with current vaccination status.

Evaluation of the effects of hospital visit stress on physiologic variables in dogs
Ryan F. Bragg, Jennifer S. Bennett, Annelise Cummings, Jessica M. Quimby
Objective—To evaluate differences in pulse rate, rectal temperature, respiratory rate, and systolic arterial blood pressure in dogs between the home and veterinary hospital environments. Design—Prospective observational study. Animals—30 client-owned healthy dogs. Procedures—Study dogs had respiratory rate, pulse rate, rectal temperature, and systolic arterial blood pressure measured in their home environment. Dogs were then transported to the veterinary hospital, and measurements were repeated. Results—Significant differences in blood pressure, rectal temperature, and pulse rate were observed between measurements obtained in the home and hospital environments. Mean blood pressure increased by 16% (95% confidence interval [CI], 8.8% to 24%), rectal temperature increased by < 1% (95% CI, 0.1% to 0.6%), and pulse rate increased by 11% (95% CI, 5.3% to 17.6%). The number of dogs panting in the hospital environment (19/30 [63%]) was significantly higher than the number of dogs panting in the home environment (5/30 [17%]).

Conclusions and Clinical Relevance—Results of the present study suggested that practitioners should consider stress from transportation and environmental change when canine patients have abnormalities of vital signs on initial examination, and the variables in question should be rechecked before a definitive diagnosis of medical illness is reached or extensive further workup is pursued.

Jodi A. Kuntz, Allyson C. Berent, Chick W. Weisse, Demetrius H. Bagley
Objective—To describe the technical aspects and clinical outcome of endoscopic- and fluoroscopic-guided ureteropelvic lavage and ureteral stent placement for treatment of obstructive pyonephrosis in dogs.
Design—Retrospective case series. Animals—13 client-owned dogs (14 obstructed ureters). Procedures—All patients with obstructive pyonephrosis were treated with a ureteral stent. Medical records were reviewed for history, clinical signs, pre- and postprocedural clinical and imaging data, and short- and long-term outcomes.
Results—13 dogs (14 ureters) had unilateral or bilateral ureteral obstructions and pyonephrosis due to ureterolithiasis (n = 13) or a suspected ureteral stricture (1). Eleven dogs had positive results of bacteriologic culture of urine obtained from the bladder, renal pelvis, or both. Ten were thrombocytopenic, and 8 were azotemic. Stents were placed fluoroscopically with endoscopic (n = 11) or surgical (3) assistance. Median hospitalization time was 48 hours (range, 6 to 260 hours). Median follow-up time was 480 days (range, 2 to 1,460 days). Intraoperative complications occurred in 2 patients (stent occlusion from shearing of a guide wire, and wire penetration of the ureter at the location of a stone). Short-term complications included a bladder hematoma (n = 1) and transient dysuria (1). Long-term complications included stent encrustation (n = 1), stent migration (1), and tissue proliferation at the ureterovesicular junction (5), which had no clinical implications. Recurrent urinary tract infections were documented in 7 dogs. Conclusions and Clinical Relevance—Ureteral stenting was a successful renal-sparing treatment for obstructive pyonephrosis in dogs and could often be performed in a minimally invasive manner. There were few major complications. This technique may be considered as an effective treatment option for this condition in dogs.

Triceps brachii muscle reconstruction with a latissimus dorsi muscle flap in a dog
Michael M. Pavletic, Russell Kalis, Patricia Tribou, Pam J. Mouser
Case Description—A 6-year-old spayed female Border Collie was examined for a severe deformity of the right forelimb. Three months prior to examination, the patient awkwardly fell off the couch and became acutely lame in the right forelimb, progressing to non-weight bearing over the following 72 hours. Clinical Findings—On physical examination, the dog carried the limb caudally against the thoracic wall, with the shoulder flexed and elbow in extension. The right triceps brachii muscle was atrophied and contracted, resulting in a resistant tension band effect that precluded manipulation of the right elbow joint. The physical changes in the triceps muscle were considered the primary cause of the patient's loss of limb function. Treatment and Outcome—
Surgical treatment by means of elevation and transposition of the ipsilateral latissimus dorsi muscle was performed. The exposed triceps brachii muscles were transected 3 cm proximal to the tendons of insertion. Via a separate incision, the right latissimus dorsi muscle was elevated and tunneled subcutaneously beneath the interposing skin between the 2 surgical incisions. The muscle was then positioned and sutured to the proximal and distal borders of the divided triceps muscle group. Two weeks later, physical therapy was initiated. After 2 months, the patient regularly walked on the limb most of the time (9/10 steps). Clinical Relevance—The surgical procedure for elevation and transposition of the latissimus dorsi muscle was relatively simple to perform. Physical therapy was an essential component to achieving the successful functional outcome in this case. This technique may be considered for treatment of similar patients in which the triceps muscle group is severely compromised.

The Canadian Veterinary Journal

Retrospective evaluation of continuous rate infusion of regular insulin intravenously for the management of feline diabetic ketoacidosis

Pamela N. Bollinger, Lisa E. Moore

The use and efficacy of continuous rate infusion (CRI) of regular insulin intravenously for the treatment of feline diabetic ketoacidosis was retrospectively evaluated. The study focused on the rate of glucose decline, time to resolution of inappetence, time to long-term injectable insulin, and length of hospital stay. Review of medical records from 2009 to 2011 identified 10 cases that met the inclusion criteria. Six cats were existing diabetics, 3 of whom had recent insulin changes. Five cats had concurrent diseases. The mean time to long-term injectable insulin was 55 hours. The mean length of hospitalization was 3.8 days. Five cats survived to discharge. In 5 patients, an insulin CRI permitted a short hospital stay and transition to long-term injectable insulin. Many cats with diabetic ketoacidosis are prior diabetics with concurrent disease and/or a history of recent insulin changes.

Changes in blood pressure following escalating doses of phenylpropanolamine and a suggested protocol for monitoring

Gilad Segev, Jodi L. Westropp, Chen Kulik, Eran Lavy

This prospective, cross-over, blinded study evaluated the effect of various doses of phenylpropanolamine (PPA) on blood pressure in dogs. Dogs were randomized to receive a placebo or 1 of 3 dosages of immediate release PPA, q12h for 7 days [1 mg/kg body weight (BW), 2 mg/kg BW, or 4 mg/kg BW] in a cross-over design. Blood pressure was recorded every 2 h, for 12 h, on days 1 and 7. There were significant increases in systolic, diastolic, and mean blood pressure following administration of PPA at 2 mg/kg BW and 4 mg/kg BW. A significant decrease in heart rate was also noted at all PPA dosages, but not in the placebo. Administration of PPA was associated with a dose response increase in blood pressure. Dosages of up to 2 mg/kg BW should be considered safe in healthy dogs.

Total cystectomy and subsequent urinary diversion to the prepuce or vagina in dogs with transitional cell carcinoma of the trigone area: A report of 10 cases (2005–2011)

Kohei Saeki, Atsushi Fujita, Naoki Fujita, Takayuki Nakagawa, Ryohei Nishimura

The cases of 10 dogs with transitional cell carcinoma of the urinary bladder that underwent total cystectomy were retrospectively reviewed to evaluate the feasibility and outcome of total cystectomy and ureteral transplantation to the prepuce or vagina. Dehiscence of ureterostomy (n = 2), pyelonephritis (n = 3), oliguria (n = 2), azotemia (n = 1), and ureteral obstruction (n = 1) were observed complications. The estimated median survival time was 385 days. This study demonstrates the feasibility of total cystectomy and subsequent urinary diversion to the prepuce or vagina in dogs. Compared to previous ureterocolonic anastomosis, this technique is associated with fewer gastrointestinal and neurologic complications.

Hypoadrenocorticism in a kindred of Pomeranian dogs

Erin T. Mooney, Tara N. Hammond, Orla M. Mahony

Three adult Pomeranian dogs, full siblings from 2 litters, were diagnosed with primary hypoadrenocorticism following onset of hypoadrenal crisis. Review of the family history revealed the dogs' maternal grandmother also had hypoadrenocorticism. All 4 dogs were pedigree-certified by the American Kennel Club. An inherited basis for hypoadrenocorticism is proposed in these Pomeranian dogs.
Prolonged survival of a cat diagnosed with feline infectious peritonitis by immunohistochemistry
Timothy B. Hugo, Kathryn L. Heading
A 4-year-old, neutered male, British shorthair cat was presented with inappetence, vomiting, hyperproteinemia, and hyperglobulinemia. An exploratory celiotomy identified enlarged mesenteric lymph nodes. Immunohistochemistry of lymph node biopsies confirmed feline infectious peritonitis. This patient had a prolonged survival of 787 d after initial presentation.

Polioencephalomyelopathy in a mixed breed dog resembling Leigh’s disease
Orit Chai, Joshua Milgram, Merav H. Shamir, Ori Brenner
A 14-month-old mixed-breed dog was presented with acute onset of exercise intolerance that quickly progressed to quadriparesis. Gross and microscopic autopsy findings indicated a type of degenerative polioencephalomyelopathy resembling subacute necrotizing encephalomyelopathy in dogs or Leigh's disease in humans. This syndrome has previously been reported only in purebred dogs.

The Australian Veterinary Journal
In vitro interaction of some drug combinations to inhibit rapidly growing mycobacteria isolates from cats and dogs and these isolates' susceptibility to cefovacine and clofazimine (pages 40–45)
CJM Bennie, JLK To, PA Martin and M Govendir
Objectives - To investigate whether selected drug combinations used to treat rapidly growing mycobacteria (RGM) have drug–drug interactions that affect efficacy and to investigate each isolate's susceptibility to cefovacine and clofazimine, individually. Design - In vitro susceptibility testing of bacterial isolates.
Methods - Initially, five feline isolates and one canine isolate from both Mycobacterium fortuitum and M. smegmatis clusters (n = 12) underwent microbroth susceptibility testing to individual drugs to establish minimum inhibitory concentrations (MIC) of cefovacine, ciprofloxacin, clarithromycin, clofazimine, doxycycline, enrofloxacin, trimethoprim and sulfanilamide (the latter two as a combination). Checkerboard assays were then performed for susceptible M. smegmatis isolates for the following combinations: clarithromycin (one isolate only) versus enrofloxacin, clarithromycin vs doxycycline, clarithromycin vs trimethoprim/sulfanilamide; enrofloxacin vs doxycycline (six isolates); enrofloxacin vs trimethoprim/sulfanilamide (six isolates). Susceptible M. fortuitum isolates were tested against enrofloxacin versus doxycycline (four isolates only). Results - All six M. fortuitum isolates were susceptible to enrofloxacin, but only four of six were susceptible to doxycycline. All six M. smegmatis isolates were susceptible to doxycycline, enrofloxacin and trimethoprim/sulfanilamide. A single isolate from the 12, a M. smegmatis isolate, was susceptible to clarithromycin. The fractional inhibitory concentration of each drug ranged from 0.64 to 1.84, indicating that neither synergism nor antagonism was evident. All 12 isolates were resistant to cefovacine. The clofazimine MIC_{50} to inhibit isolate growth was approximately 3.3 µg/mL for both strains. Conclusion - Drugs commonly used for treatment of RGM, when tested as combinations, do not appear to antagonise one another in vitro. Cefovacine is not efficacious for treatment of RGM infections.

Journal of Feline Medicine and Surgery
Occlusion and malocclusion in the cat: What’s normal, what’s not and when’s the best time to intervene?
Lisa Milella
Practical relevance: Malocclusion affecting cats, and treatment thereof, has not been widely described in the veterinary literature, yet is a condition seen in a growing number of breeds, often causing pain and discomfort to the patient. Recognising the problem, and certainly whether it is a hereditary problem (eg, a skeletal malocclusion), is important for the longer term health of pedigree breeds. Clinical challenges: If there is a malocclusion, the mouth may be painful and a thorough occlusal assessment of the conscious patient may be difficult. Occlusal assessment should always be accompanied by a thorough oral examination and, where necessary, further investigation under general anaesthesia, including dental radiography. Recognising what is normal, and what is not, can be challenging; so, too, can be determining the correct time to intervene. Audience: This article is intended to help fill the gap in dental education regarding the range of developmental and acquired malocclusions seen in cats. Treatment options are also briefly reviewed. Evidence base: The guidance contained in this article is based on a combination of the published literature, the author’s personal experience and that of colleagues.
**Perioperative anaesthetic care of the cat undergoing dental and oral procedures: Key considerations**

Marieke de Vries and Gerhard Putter

Clinical challenges: Anaesthesia for dental and oral procedures in cats can be challenging and many factors need to be taken into consideration. Often it is older patients requiring these procedures and, while old age itself is not a contraindication for general anaesthesia, older patients tend to have limited homeostatic reserves and are, therefore, more prone to anaesthesia-induced insults of vital organs. Most sedative and anaesthetic agents have cardiovascular side effects, which may result in detrimental consequences in older patients in which organ reserves are likely reduced. Aims: The need for good patient assessment and management during the entire perianesthetic period cannot be overemphasised. This article describes how both anaesthetic protocol and intravenous fluid therapy should be tailored to the individual cat’s needs. Application of a multimodal analgesic protocol (the combination of different analgesic agents) and a balanced anaesthetic technique incorporating local nerve blocks is highly recommended and a particular focus of the review. The use of local anaesthetic agents for the latter not only provides optimal pre-emptive analgesia, but also reduces the amount of anaesthetic agents needed to maintain an adequate level of anaesthesia and, therefore, limits their side effects. Other key aspects of perianesthetic care of the feline dental and oral patient include airway protection, monitoring and maintenance of body temperature, eye protection, and analgesia extending well into the post-anaesthetic period. Evidence base: The authors draw on their clinical experience and the referenced literature to provide a practical overview of this critical but often-overlooked aspect of feline dentistry.

**Tooth resorption in cats: Pathophysiology and treatment options**

Cecilia Gorrel

**Practical relevance:** Tooth resorption is common in the domestic cat and the incidence has been reported to increase with increasing age. Cats with clinically missing teeth have also been found to be more likely to have tooth resorption. All types of teeth in the feline dentition may be affected, but lesions seem to be more common in certain teeth. **Clinical challenges:** Tooth resorption can be difficult to detect, with cats often masking signs of oral discomfort or pain. Routine radiography is required for timely diagnosis, as clinical (visual and tactile) methods only detect late-stage lesions – that is, when they become evident in the crown. The aetiology of many tooth resorptions is not clear. A large number of lesions appear to be idiopathic and, to date, there is no known treatment that prevents the development and/or progression of this category of tooth resorption. Tooth extraction is the gold standard treatment but teeth with resorptive lesions are notoriously difficult to extract and coronal amputation is often indicated. Determining the best treatment option in an individual case again relies on radiography. **Audience:** This review is aimed at feline and general practitioners, as well as veterinarians with expertise in dentistry. **Evidence base:** The author draws on the published literature and her clinical experience and own research to review current thinking about the epidemiology, aetiology and pathogenesis of tooth resorptions, and to offer advice on diagnosis and treatment options.

**Periodontal disease in cats: Back to basics – with an eye on the future**

Rachel Perry and Cedrie Tutt

**Practical relevance:** Periodontal disease is commonly encountered in feline practice. Gingivitis, followed by inflammation of the rest of the periodontal tissues, can lead to chronic oral infection, bacteraemia, pain and ultimately tooth loss. Given adequate plaque control and thorough, consistent dental home care, gingivitis is a reversible and controllable condition. Periodontitis, however, is an essentially irreversible and progressive condition. Treatment aims to control tissue inflammation, returning the gingiva to clinical health and preventing destruction of the periodontium in other parts of the mouth. **Clinical challenges:** Diagnosis must be established using a combination of oral examination under anaesthesia and dental radiography. Periodontitis leads to tooth attachment loss, and given the short length of most cat teeth, probing depths of 1 mm or more should alert the clinician to the presence of periodontitis. The decision of whether to extract or preserve affected teeth needs careful consideration. In practice, as periodontitis is often associated with type 1 tooth resorption, extraction is often required, but the slender and delicate nature of feline tooth roots, compounded by the destructive nature of tooth resorption, can frustrate extraction attempts. As highlighted in this article, iatrogenic damage to teeth is also a real risk if periodontal therapy procedures (including scaling and polishing) are not performed carefully. The challenges of providing home care in the cat are additionally discussed. **Evidence base:** The authors have drawn upon, wherever possible, an evidence base relating strictly to the feline patient. Where there is a lack of published research, evidence from canine and human studies is assessed.

**Globe penetration in a cat following maxillary nerve block for dental surgery**

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Rachel Perry, Denise Moore, and Emma Scurrell

Clinical summary: Dental treatment was carried out in an 8.5-year-old castrated male domestic shorthair cat found to have tooth resorption. Right mandibular, and right and left maxillary nerve blocks were administered using a 1 ml syringe attached to a 25 G x 5/8 inch needle and an intraoral technique. The following day the cat displayed blepharospasm of the right eye. The ocular signs progressed and 5 days later an ophthalmologist confirmed a blind, glaucomatous right eye. It was suspected that the eye had suffered a penetrating injury during dental surgery. Enucleation of the right eye was performed and gross and histopathological examination revealed a penetrating wound consistent with a needle tract injury. Practical relevance: Complications arising from veterinary dental regional anaesthesia appear to be rare; however, it may be that they are under-reported. This case report highlights the risks involved and reviews the safest and most efficacious regional anaesthesia technique for the feline maxilla.

Journal of Small Animal Practice

Pancreatitis in dogs and cats: definitions and pathophysiology.
P. Watson
Pancreatitis, or inflammation of the pancreas, is commonly seen in dogs and cats and presents a spectrum of disease severities from acute to chronic and mild to severe. It is usually sterile, but the causes and pathophysiology remain poorly understood. The acute end of the disease spectrum is associated with a high mortality but the potential for complete recovery of organ structure and function if the animal survives. At the other end of the spectrum, chronic pancreatitis in either species can cause refractory pain and reduce quality of life. It may also result in progressive exocrine and endocrine functional impairment. There is confusion in the veterinary literature about definitions of acute and chronic pancreatitis and there are very few studies on the pathophysiology of naturally occurring pancreatitis in dogs and cats. This article reviews histological and clinical definitions and current understanding of the pathophysiology and causes in small animals by comparison with the much more extensive literature in humans, and suggests many areas that need further study in dogs and cats

Diagnosis of pancreatitis in dogs and cats.
P. G. Xenoulis
Pancreatitis is the most common disorder of the exocrine pancreas in both dogs and cats. Ante-mortem diagnosis of canine and feline pancreatitis can be challenging. The clinical picture of dogs and cats with pancreatitis varies greatly (from very mild to severe or even fatal) and is characterised by non-specific findings. Complete blood count, serum biochemistry profile and urinalysis should always be performed in dogs and cats suspected of having pancreatitis, although findings are not specific for pancreatitis. Serum amylase and lipase activities and trypsin-like immunoreactivity (TLI) concentrations have no or only limited clinical value for the diagnosis of pancreatitis in either dogs or cats. Conversely, serum pancreatic lipase immunoreactivity (PLI) concentration is currently considered to be the clinicopathological test of choice for the diagnosis of canine and feline pancreatitis. Abdominal radiography is a useful diagnostic tool for the exclusion of other diseases that may cause similar clinical signs to those of pancreatitis. Abdominal ultrasonography can be very useful for the diagnosis of pancreatitis, but this depends largely on the clinician's experience. Histopathological examination of the pancreas is considered the gold standard for the diagnosis and classification of pancreatitis, but it is not without limitations. In clinical practice, a combination of careful evaluation of the animal's history, serum PLI concentration and abdominal ultrasonography, together with pancreatic cytology or histopathology when indicated or possible, is considered to be the most practical and reliable means for an accurate diagnosis or exclusion of pancreatitis compared with other diagnostic modalities.

Management of acute pancreatitis in dogs: a critical appraisal with focus on feeding and analgesia.
C. Mansfield and T. Beths
Knowledge about acute pancreatitis has increased recently in both the medical and veterinary fields. Despite this expansion of knowledge, there are very few studies on treatment interventions in naturally occurring disease in dogs. As a result, treatment recommendations are largely extrapolated from experimental rodent models or general critical care principles. General treatment principles involve replacing fluid losses, maintaining hydrostatic pressure, controlling nausea and providing pain relief. Specific interventions recently advocated in human medicine include the use of neurokinin-1 antagonists for analgesia and early interventional feeding. The premise for early feeding is to improve the health of the intestinal tract, as unhealthy enterocytes are thought to
perpetuate systemic inflammation. The evidence for early interventional feeding is not supported by robust clinical trials to date, but in humans there is evidence that it reduces hospitalisation time and in dogs it is well tolerated. This article summarises the major areas of management of acute pancreatitis in dogs and examines the level of evidence for each recommendation.

**Pancreatitis and triaditis in cats: causes and treatment.**
K. W. Simpson,

Pancreatitis in cats is frequently accompanied by concurrent disease in other organ systems. Co-morbidities include hepatic lipodosis, inflammatory liver disease, bile duct obstruction, diabetes mellitus, inflammatory bowel disease, vitamin deficiency (B12/cobalamin, folate or K), intestinal lymphoma, nephritis, pulmonary thromboembolism and pleural and peritoneal effusions. “Triaditis” is the term used to describe concurrent inflammation of the pancreas, liver and small intestines. Triaditis has been reported in 50 to 56% of cats diagnosed with pancreatitis and 32 to 50% of those with cholangitis/inflammatory liver disease. A definitive diagnosis of triaditis is based on the histopathological evaluation of each organ. However, the specific conditions of each organ that constitute a diagnosis of triaditis remains to be defined. While the aetiopathogenesis of pancreatitis and its relationship to inflammation in other organ systems is unclear, preliminary studies point to a heterogeneous group of conditions with differential involvement of host inflammatory and immune responses and enteric bacteria. Comprehensive, prospective studies that simultaneously evaluate the presence of predefined clinical, clinicopathological and histopathological abnormalities, coupled with high-resolution evaluation of pancreaticobiliary morphology, immunological profiling and screening for bacterial colonisation are required to advance diagnosis and therapy.

**Diabetes mellitus and pancreatitis – cause or effect?**
L. J. Davison

Diabetes mellitus and pancreatitis are two distinct diseases encountered commonly in small animal practice. Whilst the clinical signs of diabetes mellitus are usually unmistakeable, a firm diagnosis of pancreatitis can prove more elusive, as clinical signs are often variable. Over the past 10 to 15 years, despite the fact that the clinical signs of diabetes mellitus are remarkably consistent, it has become more apparent that the underlying pathology of diabetes mellitus in dogs and cats is heterogeneous, with exocrine pancreatic inflammation accompanying diabetes mellitus in a number of cases. However, the question remains as to whether the diabetes mellitus causes the pancreatitis or whether, conversely, the pancreatitis leads to diabetes mellitus – as there is evidence to support both scenarios. The concurrence of diabetes mellitus and pancreatitis has clinical implications for case management as such cases may follow a more difficult clinical course, with their glycaemic control being “brittle” as a result of variation in the degree of pancreatic inflammation. Problems may also arise if abdominal pain or vomiting lead to anorexia. In addition, diabetic cases with pancreatitis are at risk of developing exocrine pancreatic insufficiency in the following months to years, which can complicate their management further.

**Pancreatic surgical biopsy in 24 dogs and 19 cats: postoperative complications and clinical relevance of histological findings.**
K. M. Pratschke, J. Ryan, A. McAlinden and G. McLauchlan

Objective - To assess the immediate postoperative complications associated with pancreatic biopsy in dogs and cats and review the clinical relevance of biopsy findings. Methods - Retrospective review of clinical records from two referral institutions for cases undergoing pancreatic biopsy between 2000 and 2013. Results - Twenty-four dogs and 19 cats that had surgical pancreatic biopsy had sufficient detail in their clinical records and fulfilled the inclusion criteria. Postoperative complications were seen in 10 cases of which 5 were suggestive of post-surgical pancreatitis. Two patients were euthanased within 10 days of surgery because of the underlying disease; neither suffered postoperative complications. Pancreatic pathology was found in 19 cases, 7 cases showed no change other than benign pancreatic nodular hyperplasia, and no abnormalities were seen in 18 cases. Clinical significance - Complications may be encountered following surgical pancreatic biopsy, although the risk should be minimal with good surgical technique. Pancreatic biopsy may provide a useful contribution to case management but it is not clear whether a negative pancreatic biopsy should be used to rule out pancreatic disease. Dogs were more likely to have no significant pathology found on pancreatic biopsy than cats, where chronic pancreatitis was the most common finding.

**Serum paraoxonase 1 (pon1) activity in acute pancreatitis of dogs.**
A. Tvarijonaviciute, J. D. Garcia-Martinez, M. Caldin, S. Martínez-Subiela, F. Tecles, J. Pastor and J. J. Ceron. Objectives - Serum paraoxonase 1 is considered a marker of inflammation and oxidative damage. The aims of this study were to evaluate changes in serum paraoxonase 1 activity in dogs with acute pancreatitis, to correlate serum paraoxonase 1 activity and other analytes known to be altered in dogs with pancreatitis and to assess the relationship between serum paraoxonase 1 activity and disease severity in dogs with acute pancreatitis. Materials and methods - Retrospective analysis of dogs with acute pancreatitis and healthy dogs in which serum paraoxonase 1 activity was measured were compared. Results - Median serum paraoxonase 1 activity was significantly lower in dogs with pancreatitis (n = 19) compared to healthy ones (n = 19). Serum paraoxonase 1 activity was negatively correlated with serum lipase and amylase activities, and c-reactive protein and haptoglobin concentrations and was positively correlated with total cholesterol and glucose concentration. Disease severity was negatively correlated with serum paraoxonase 1 activity and positively correlated with triglyceride and c-reactive protein concentration. Clinical significance - Serum paraoxonase 1 activity is lower in dogs with acute pancreatitis and together with triglyceride and c-reactive protein concentrations is a potential marker of disease severity.

American Journal of Veterinary Research

Quantitative computed tomographic assessment of bone mineral density changes associated with administration of prednisolone or prednisolone and alendronate sodium in dogs. Seungjo Park, Juyeon Oh, Kyu-Yeol Son, Kyoung-Oh Cho, Jihye Choi. OBJECTIVE To evaluate whether a low-dosage regimen of prednisolone induces bone loss and whether administration of alendronate sodium prevents glucocorticoid-induced osteopenia in dogs by measuring trabecular bone mineral density (BMD) with quantitative CT. ANIMALS 8 healthy Beagles. PROCEDURES In 4 dogs, prednisolone was administered PO at a dosage of 2 mg/kg once daily for 4 weeks, 1 mg/kg once daily for 4 weeks, and 0.5 mg/kg once daily for 3 weeks. In the other 4 dogs, alendronate sodium (2 mg/kg, PO, q 24 h) was whether administered PO for 9 weeks in addition to the same dosage of prednisolone used in the prednisolone-treated dogs. Before (day 0 [baseline]) and 21, 42, 63, and 150 days after the start of treatment, BMD of the lumbar vertebrae was measured by quantitative CT. RESULTS BMD in the prednisolone treatment group decreased to 84.7% of the baseline value on day 42, increased to 87.9% on day 63, and recovered to 91.6% on day 150. In the prednisolone-alendronate treatment group, BMD decreased to 91% of the baseline value on day 21, increased to 93.8% on day 63, and then recovered to 96.7% on day 150. Bone mineral density in the prednisolone treatment group was generally lower, albeit not significantly, than that of the prednisolone-alendronate treatment group on each examination day. CONCLUSIONS AND CLINICAL RELEVANCE BMD temporarily decreased after low-dosage prednisolone administration; however, it gradually improved during tapering of the prednisolone dosage. These results have suggested that a low dosage of prednisolone can be used with little concern for development of osteopenia in dogs.

Procoagulant phospholipid concentration in canine erythrocyte concentrates stored with or without prestorage leukoreduction. Stephanie A. Smith, Thandeka R. Ngwenyama, Mauria O’Brien, Jennifer M. Herring, Rafaela Corsi, Alyssa Galligan; Alison N. Beloshapka, Ping Deng, Kelly S. Swanson, Maureen McMichael. OBJECTIVE To evaluate canine erythrocyte concentrates (ecs) for the presence of procoagulant phospholipid (PPL), determine whether PPL concentration changes during the course of storage of ecs, and ascertain whether prestorage leukoreduction (removal of leukocytes via gravity filtration) reduces the development of PPL. SAMPLE 10 whole blood units (420 g each) collected from 10 random-source, clinically normal dogs (1 U/dog). PROCEDURES The dogs were randomized to 1 of 2 groups. Of the 10 whole blood units collected, 5 were processed through a standard method, and 5 underwent leukoreduction. Whole blood units were processed to generate ecs, from which aliquots were aseptically collected from each unit weekly for 5 weeks. Supernatants from the concentrates were evaluated for procoagulant activity, which was converted to PPL concentration, by use of an automated assay and by measurement of real-time thrombin generation. RESULTS Supernatants from stored canine ecs contained procoagulant activity as measured by both assays. In general, the PPL concentration gradually increased during the storage period, but leukoreduction reduced the development of increased procoagulant activity over time. CONCLUSIONS AND CLINICAL RELEVANCE The presence of PPL in canine ecs may be associated with procoagulant and proinflammatory effects in vivo, which could have adverse consequences for dogs treated with ecs.
Medical infrared thermal imaging of cats with hyperthyroidism

OBJECTIVE To determine the usefulness of medical infrared thermal imaging (MITI) as a screening tool for hyperthyroidism in cats, evaluate the need for hair clipping over the ventral aspect of the neck to achieve optimal images, and determine whether there is a change in thermal patterns at 1 and 3 months after radioactive sodium iodide I 131 treatment. ANIMALS 17 cats with and 12 control cats without hyperthyroidism. PROCEDURES All cats underwent MITI first with the hair present and then after the hair was clipped. Each cat with hyperthyroidism was subsequently appropriately treated SC with radioiodide; reevaluations, including MITI before and after hair clipping and measurement of serum thyroxine concentration, were performed 1 and 3 months after treatment. RESULTS The MITI had 80.5% and 87.5% accuracy in differentiating hyperthyroid cats from clinically normal cats before and after the hair over the ventral aspect of the neck was clipped. Among cats with an initial serum thyroxine concentration > 4.0 µg/dl, the success rate for MITI-detected response to radioiodide treatment at the 1-month reevaluation was 92.86% in unshaved cats and 85.71% in shaved cats. The success rate for MITI-detected response to radioiodide treatment at the 3-month reevaluation was 100% in unshaved and shaved cats. CONCLUSIONS AND CLINICAL RELEVANCE Results indicated that MITI was successful in differentiating between hyperthyroid cats and clinically normal cats and identifying patients with thyroxine concentration within reference interval after radioactive sodium iodide I 131 treatment.

Determination of tonicity effects of ketoacids and lactate by use of two canine red blood cell assays.

OBJECTIVE To determine the tonicity effects of β-hydroxybutyrate, acetoacetate, and lactate in canine rbcs. SAMPLE rbcs from approximately 40 dogs. PROCEDURES 2 in vitro methods were used to conduct 4 experiments. The modified osmotic fragility assay was used to measure the ability of ketoacid salts added to serial sucrose dilutions to protect rbcs from osmotic hemolysis. In a second assay, a handheld cell counting device was used to measure changes in RBC diameter to assess the tonicity effect of solutions of ketoacid and lactate salts. RESULTS For the modified osmotic fragility assay, all ketoacid salts had an osmoprotective effect, but the effect was determined to be completely attributable to the tonicity effect of added cations (sodium and lithium) and not the ketoacid moieties. However, both the sodium and lithium lactate salts provided osmoprotection attributable to both the cation and lactate anion. For the second assay, RBC diameter was significantly increased with the addition of urea (an ineffective osmole) but did not change with the addition of glucose (an effective osmole), which established the behaviors of ineffective and effective osmoles in this assay. The RBC diameter was significantly increased over that of control samples by the addition of sodium β-hydroxybutyrate, lithium acetoacetate, and lithium lactate but was decreased by the addition of sodium lactate. CONCLUSIONS AND CLINICAL RELEVANCE For both assays, β-hydroxybutyrate and acetoacetate acted as ineffective osmoles, whereas lactate acted as an effective osmole in 3 of 4 experiments.