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Thanks to the Wildlife Conservation Society for their financial support of the American College of Zoological Medicine to register as a certified CE provider for the state of New York. Attendees licensed in New York will receive CE credits for the AAZV 46th Annual Conference in Orlando.
Dear Esteemed Colleagues,

Welcome to warm and sunny Orlando for the 46th annual gathering of the American Association of Zoo Veterinarians (AAZV) for fun, frivolity and some very, very serious learning. This year we will continue the long standing tradition of providing an outstanding educational program to expand your minds and enhance your skills in order to benefit the endangered species, and the more common ones, that we care for.

The AAZV has been holding annual educational conferences in this challenging field for forty-five years. These meetings afford us the opportunity to share experiences, learn from each other and to deepen and broaden our knowledge base. However the AAZV is busy throughout the year providing new knowledge through the Journal of Zoo and Wildlife Medicine as well as providing valuable services for you, our members. The organizations membership and financial status remain stable and improving a bit each year. The diverse committees of the AAZV including the executive committee, continue to work hard to keep the organization vigorous, healthy and responsive to the needs of the members. We continue to benefit from the outstanding organizational talent and hard work of Pam Brownlee, Adine Nicholson and Dr. Rob Hilsenroth working from our global headquarters at White Oak, an organization which we are deeply appreciative towards for their support.

Our thanks to the scientific program committee headed up by Dr. Deena Brenner and Dr. Meg Sutherland-Smith who have put together an outstanding program of great speakers and challenging topics. Our thanks also to the American College of Zoological Medicine for sponsoring the continuing education credits for this conference. And finally our thanks to our hosts, Disney’s Animal Kingdom for a fabulous venue in which to hold our conference! Learn much, build new relationships and enjoy the camaraderie here in this great location for the 2014 AAZV Conference.

Sincerely,

 Douglas L. Armstrong, DVM
President, American Association of Zoo Veterinarians
Dear Colleagues and Friends,

On behalf of the Scientific Program Committee (SPC), I have the great pleasure of welcoming you to the 46th Annual Conference of the American Association of Zoo Veterinarians (AAZV). The members of the SPC, Jessica Siegal-Wilott, Deena Brenner, Susie Bartlett, Allison Tuttle, Meg-Sutherland-Smith, and Kelly Helmick have dedicated tireless hours to make this year’s conference a success, along with our gracious local hosts at Disney’s Animal Kingdom led by Scott Terrell and Deidre Fontenot.

The conference program continues to evolve each year based on your feedback. Our 27 session chairs had the arduous task of selecting from the over 251 submitted abstracts to develop 13 scientific sessions. These sessions are filled with cutting-edge presentations and represent a blend of taxa and discipline based themes. An additional 39 posters will present fascinating research and clinical medicine. As a new offering this year, a conservation session has been focused on a single taxa this year to facilitate expert commentary and discussion. This year’s focus is on bears and will change annually. Several featured speakers will present focused lectures throughout the week on important topics ranging from elephant tusk repair to anesthetic monitoring. The Advanced Topics sessions continue this year with a variety of advanced clinically relevant topics. Finally, a panel discussion will foster dialogue on the recently hot topic of management based euthanasia, followed by a featured speaker discussing the current state of zoos and aquariums in a changing media landscape.

Twenty-five hours of continuing education credit is available this year, sponsored by the American College of Zoological Medicine. The 15 amazing workshops being offered this year allow for up to an additional 25 hours of credit. Drawing attention to one unique offering this year, AAZV has partnered with the Disney Institute to create a full-day leadership development workshop. This program will provide professional development focused on the non-clinical aspects of the veterinarian’s role in modern zoos and aquariums. Representing a blend of hands-on, clinical medicine and in-depth didactic presentations – we hope everyone finds a workshop that appeals to their educational needs.

The SPC always welcomes your feedback through the conference survey to help us continually enhance and grow the program each year! We would like to gratefully acknowledge the tireless efforts of Rob Hilsenroth, AAZV executive director, and Adine Nicholson, Julie Fazlollah, and Pam Brownlee for their support in making this year’s conference a success.

Finally, welcome to Orlando – we hope you have a wonderful time at the conference advancing your education and spending time among friends!! And don’t forget to take a moment to embrace your inner child and enjoy the magic of Disney!! We hope you return home excited about the future of our profession and the difference we can make for animal health and conservation.

Warm wishes,

Michael Adkesson, DVM, Dipl. ACZM
Chair, AAZV Scientific Program Committee
Vice President, Clinical Medicine, Chicago Zoological Society / Brookfield Zoo
American Association of Zoo Veterinarians
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EXHIBITS COORDINATOR  Julie Fazlollah
LOCAL HOST  Scott Terrell, DVM, DACZM
             Deidre Fontenot, DVM
             Carlos Rodriguez, DVM, DACVP
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IMPROVING VILLAGE CHICKEN HEALTH TO PROMOTE PUBLIC HEALTH AND DECREASE BUSHMEAT HUNTING IN THE MAKIRA NATURAL PARK, MADAGASCAR

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Abstract

In the Makira Natural Park (MNP) in Northeastern Madagascar, wildlife is an important nutritional resource. People hunt animals to meet their own basic needs for survival. In the MNP, bushmeat hunting is occurring at unsustainable rates for many endangered species, including indri (Indri indri), black and white ruffed lemurs (Varecia variegata), brown lemurs (Eulemur spp.), and bamboo lemurs (Hapelemur griseus).5,6 One of the few assets owned by households are chickens, which could play a significant role to improve household nutrition and income, and reduce wildlife hunting if recurrent diseases could be controlled and chicken management could be improved.1,2,6 In 2011, we visited three communities in the MNP to understand the constraints to chicken production. Through participatory exercises, and health and husbandry evaluations, we determined that the main problem with chickens is Newcastle disease (ND).1 An important chicken disease worldwide, ND is best controlled with vaccination, though husbandry and biosecurity practices can reduce the risk of introduction of ND virus or reduce its spread once it has arrived. We reviewed quarantine and biosecurity, chick rearing and brooding hen management, parasite control, and nutrition.1,3 The remote location of the communities and the warm regional climate make it difficult to maintain a vaccine cold chain, necessitating a thermotolerant vaccine such as NDV4-HR and I-2 ND.4 At present neither of these vaccines is available in Madagascar. A vaccine campaign and poultry health education program, integrated with ecological education and monitoring, and bushmeat consumption monitoring is being planned for 2015.

ACKNOWLEDGEMENTS

This study was supported by the San Francisco Zoo Conservation Committee, Saint Louis Zoo Field Research for Conservation Program, and Wildlife Health Network.

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ANTIBIOTIC RESISTANCE PATTERNS IN FREE-RANGING EASTERN BOX TURTLES (*Terrapene carolina carolina*): COMPARISONS AMONG AN URBAN AND AGRICULTURE SITE AND IMPLICATIONS FOR HEALTH

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Abstract

Turtles are sentinels of the health of our shared environment, including increasing antibiotic resistance patterns. Two free-ranging populations of Eastern box turtles (*Terrapene carolina carolina*) were assayed for enteric flora and subsequent antibiotic susceptibilities. Seventy one percent of gram-negative organisms were resistant to at least one antibiotic with 30% being resistant to two or more and nearly 100% of gram-positive organisms were resistant to two or more antibiotics. In the gram-negative organisms, resistance was seen to cefoxitin, amoxicillin/clavulanic acid, cefazolin, ampicillin, ticarcillin, cefovecin, and ceftiofur and significant differences were seen in resistance patterns based on organism, state, sex, and age. In the gram-positive organisms, resistance was seen to penicillin, cefoxitin, oxacillin, clindamycin, amikacin, enrofloxacin, cefovecin, ceftiofur, cefazolin, marbofloxacin, gentamicin, erythromycin, trimethoprim/sulfamethoxazole, and chloramphenicol and significant differences were seen in resistance patterns by state, site, sex, age, and habitat. Health parameters including packed cell volume (PCV), total white blood cell count (WBC), total solids (TS), and weight were not significantly different based on antibiotic resistance patterns in gram-negative organisms. Similarly, there was no significant difference in health variables for gram-positive antibiotic sensitivity profiles, however decreasing WBC and TS were observed as the number of resistant antibiotics detected in bacteria increased. Further research needs to be done to look at other factors influencing antibiotic resistance in the environment, and Eastern box turtles have shown to be a viable species for testing enteric flora presence and antibiotic resistance.
MULTIHOST PATHOGENS IN, AND JAGUAR PREDATION ON, DOMESTIC DOGS IN NICARAGUA’S BOSAWAS BIOSPHERE RESERVE

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Abstract

Indigenous communities in Bosawás Biosphere Reserve practice subsistence agriculture and hunting within this high biodiversity rainforest. Most hunters do not own firearms, and rely on their dogs as hunting partners.1 The most common game are agouti, paca, and armadillos; large game such as peccaries, deer, and tapir are a smaller but important component.1 Bosawás is remote and lacks infrastructure, including veterinary support. Leptospirosis is a serious and common zoonosis in Nicaragua.2 Dogs, livestock, and wildlife are all potential reservoirs of leptospires in this environment. During a 2013 pilot study to investigate leptospirosis in dogs, we learned that jaguar predation on hunting dogs was a serious problem. Our focus has thus expanded to include disease impacts from the canine to the jaguar population by quantifying jaguar predation on dogs and documenting potential jaguar pathogens in dogs. While disease has not previously been a major concern for jaguar populations,3 the recent outbreak of canine distemper virus (CDV) in Amur tigers highlights the fact that even solitary carnivores living at low densities may be at risk from disease spillover from domestic dogs.4 Seroprevalence of CDV in 77 dogs tested in 2013 was 99%, indicating that this virus may be endemic. At least one dog was actively shedding leptospires; 55.4% were seropositive to ≥1 leptospiral serovar, 88.3% were seropositive to canine parvovirus, 18.5% were seropositive to Trypanosoma cruzi, and 4% were seropositive to Anaplasma. All of these pathogens are capable of infecting jaguars and may cause disease under certain circumstances.

LITERATURE CITED
ANTIBODIES AGAINST CANINE DISTEMPER VIRUS IN SYMPATRIC POPULATIONS OF SECHURAN FOXES (Lycalopex sechurae) AND DOMESTIC DOGS (Canis lupus familiaris)

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Abstract

Canine Distemper Virus (CDV) outbreaks have caused high mortality rates in wild carnivore populations, in which domestic dogs (Canis lupus familiaris) have been involved as proven or suspected sources of infection. The study of infectious diseases affecting the Sechuran fox (Lycalopex sechurae) has been identified as a priority by the Action Plan for Canids Conservation supported by research highlighting the potential for pathogen transmission between domestic dogs and Sechuran foxes inhabiting rural areas of northern Peru. Serum samples from 82 non-vaccinated domestic dogs and 13 free-ranging Sechuran foxes were collected in rural communities of the Piura region, located on the northern coast of Peru. Samples were assessed for antibodies against CDV using indirect immunofluorescence. Demographic data and information about the husbandry of domestic dogs was collected by means of questionnaires, and anthropogenic impact on the environment of the communities was qualitatively assessed. Antibodies against CDV were detected in 34.1% (28/82) and 46.2% (6/13) domestic dogs and Sechuran foxes, respectively. A substantial percentage of CDV positive dogs were born in the same area where they were sampled (46.4%) and were allowed to roam freely in different areas (39.3%). Neither dog lifestyle nor dog translocation was significantly associated with CDV serologic status. Anthropogenic impact and presence of CDV antibodies in both dogs and Sechuran foxes were significantly associated. These results suggest that exposure of domestic dogs and Sechuran foxes to CDV have naturally occurred in rural areas on the northern coast of Peru and anthropogenic impact might increase CDV exposure risk.

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LITERATURE CITED
INVESTIGATIONS INTO ENVIRONMENTAL PRESSURES ON FLORIDA MANATEE HEALTH: THE NEED FOR A MULTIDISCIPLINARY APPROACH FOLLOWING THE ONE HEALTH CONCEPT

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Abstract

Marine mammals are considered sentinels for aquatic ecosystem and human health because of their long life span, long-term coastal residency, potential to serve as depots for toxins, and charismatic power. The Florida manatee (Trichechus manatus latirostris) is an endangered marine mammal that has been the subject of numerous conservation efforts over the years. Major population threats such as watercraft trauma and loss of warm water habitat have received significant attention; however, recurring unusual and mass mortality events and continuing habitat and environmental pressures increase the need for an interdisciplinary approach to research and conservation efforts. Historically, red tide blooms in southwest Florida have made a significant impact on manatee-, human-, and ecosystem health. More recently, Florida Fish and Wildlife Conservation Commission (FWC) researchers and partners have responded to elevated mortalities of manatees, brown pelicans, and bottlenose dolphins in the Indian River Lagoon (IRL). These mortalities followed a dramatic reduction of seagrass in the area due to long-term, non-toxic phytoplankton blooms. Manatee deaths in the IRL reached catastrophic numbers by late winter of 2013 when an Unusual Mortality Event (UME) was declared. To date, the investigation into the yet unknown cause of these multi-species mortality events and any possible relation with the environmental changes is ongoing. These UME’s and other emerging threats that have been identified by FWC’s manatee necropsy program and organized health assessments, some of which have possible zoonotic potential (e.g., bacterial species, Toxoplasma gondii), highlight the importance of multidisciplinary investigations following the One Health concept.
GASTROINTESTINAL PARASITES OF DOMESTIC CARNIVORES AND LEMURS IN MADAGASCAR

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Abstract

Gastrointestinal parasites of domestic carnivores are known to cause pathology in captive lemurs. The purpose of this study was to determine if free-living lemurs are at risk of exposure to parasites transmitted by domestic carnivores as humans, and their pets, encroach into lemur habitat. Fecal samples from domestic carnivores (n=55), captive lemurs (n=49) and free-living lemurs (n=24) were evaluated. Three areas were studied: Betampona Nature Reserve, a protected lowland rainforest; Parc Ivoloina, a zoological park; and villages surrounding Parc Ivoloina. Samples were obtained from multiple species of free-living lemurs in Betampona and captive and free-roaming lemurs from Parc Ivoloina. Feces were collected from domestic dogs and cats, and owners completed a survey regarding the pet’s purpose, medical history, and owner awareness of zoonotic potential. Survey results indicated that the majority of the animals are kept for hunting and pest control, and few are surgically sterilized, vaccinated, or given anti-helminthics. One-third of the households confirmed a family member diagnosed with gastrointestinal parasites. The majority of the dogs and cats had multiple parasites, the most prevalent being nematodes and cestodes. The free-roaming lemurs in Parc Ivoloina had a higher prevalence of parasitism (93%) than captive lemurs (63%); but nematodes, specifically oxyurids and trichostrongyles, were the most prevalent for both groups. At Betampona, 54% of the lemurs sampled were parasitized, mostly with nematodes and protozoans. Results show similar types of parasites in all groups sampled, indicating that free-living lemurs may already be exposed to parasites common to domestic carnivores.

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The authors thank the Madagascar Flora and Fauna Group, the Saint Louis Zoo WildCare Institute, and the Saint Louis Zoo Institute for Conservation Medicine for funding and assistance with this project.
FUNDING PROJECTS AND PROGRAMS IN WILDLIFE HEALTH

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Abstract

In 2011, The Foundation Center, a non-profit organization that maintains comprehensive databases on US and global grant makers, estimated that private giving in the United States was approximately $303.1 billion dollars. 72% of that giving came from private living individual donors, 4% from corporations, 8% from donor bequests and 16% from foundations. At that time there were estimated to be 81,777 foundations with assets of $662 billion dollars. These foundations provided approximately $49 billion dollars in giving.¹ The Environmental Grantmakers Association, a voluntary association of foundations and giving programs concerned with the protection of the natural environment, estimates that in 2011 environmental grant making was approximately $2.8 billion dollars with the top three most funded primary issue areas being: 1) energy (18%); 2) biodiversity and species preservation (14%); 3) terrestrial ecosystems and land use (12%). They also noted a dramatic increase in funding for population and sustainable agriculture and foods systems as well as fresh water/inland water ecosystems.² There is no tracking of wildlife health specific funding support however, it seems likely that this would comprise a fractional amount of the giving totals. Sources of funding for wildlife health include those provided by parent institutions (either through revenue generating activities such as zoo or aquarium admissions fees, restricted or unrestricted endowments), government grants, private individual donors (both living and bequests), corporate donors, corporate foundations and charitable foundations. In order for wildlife health professionals to be successful in finding support it is beneficial to understand how to develop robust projects or programs that might be of interest to one or a number of funding sources and then to create a strategy for fundraising directed at those opportunities with the greatest likelihood for success.

LITERATURE CITED
URBANIZED WILDLIFE: YOU ARE WHERE YOU LIVE

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Abstract

Urbanization causes wildlife declines and biodiversity loss, but some species benefit from resources offered by human- altered habitats. Yet, if hosts change their behaviors, aggregate near food sources and interact with novel species, “resource provisioning” can increase contact rates and exposure to pathogens, or alter the host’s immune function. This also affects disease risks for humans, especially when feeding brings people into close proximity with wildlife. We examined the recent urbanization of White Ibis (Eudocimus albus) in Florida to ask: 1) how do urban resources affect patterns of movement and aggregation? 2) does resource provisioning affect host stress and immunity? We predicted that human-provided food/water would reduce movement of ibis, and alter susceptibility to infection. Through radio telemetry (n=30) we found that ibis movements are limited to foraging and roosting in urban settings. Ibis (n=261) are infected with Salmonella spp. (13% prevalence), which was negatively correlated with wetland cover. Sixty-two percent (n=16) of PFGE patterns for ibis Salmonella spp. isolates matched profiles in CDC PulseNet USA database. We also found evidence for a surprisingly high prevalence of paramyxovirus and avian influenza antibodies (74% and 89% respectively; n=98). We found higher levels of fecal and plasma corticosterone metabolites than previously reported for ibis maintained on natural diets. Analysis of bactericidal capacity against E. coli (BKA) showed a high ability to fight off E. coli, compared to other species, but with high individual variation. Results indicate that the behavior, pathogen prevalence and immune function of ibis has changed to adapt to urban environments.
PHARMACOKINETICS OF BUTORPHANOL DELIVERED VIA OSMOTIC PUMP OVER 7 DAYS TO COMMON PEAFOUL (Pavo cristatus)

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Abstract

Avian pain management is particularly challenging due to the limited selection of effective medications and the frequency required for sufficient dosing. Commercially available osmotic pumps are implants that deliver a constant rate of medication using the osmotic gradient of the patient’s interstitial fluid. Initially developed for laboratory research, recent studies have validated their use in zoo and exotic animal practice. This study evaluated the utility of these pumps to deliver butorphanol continuously to common peafowl (Pavo cristatus). Twelve adult males were anesthetized for surgical implantation of two osmotic pumps containing butorphanol b (2mL each pump, 40-45mg/ml, 247μg/kg/hr). Pumps were removed under anesthesia 168hr later. Blood was collected just prior to implantation, at 3, 6, 12, 24, 48, 72, 96, 120, 144, and 168hr post-implantation, and at 3, and 6hr post-removal. Plasma butorphanol levels were measured via high-performance liquid chromatography. Results showed a peak in plasma levels at 24hr (98.3 ± 19.6ng/mL) with a steady state of butorphanol (mean = 83.0 ± 16.7ng/mL) throughout the week. Plasma levels are similar to previously established analgesic levels in avian patients. Following pump removal, butorphanol was rapidly cleared (half life = 1.44 ± 0.43hr). Clearance (3.9L/kg/hr) was similar to chickens and raptors. This study establishes a safe, effective, and practical method for managing pain continuously in post-surgical or acute trauma avian cases without the need for frequent dosing or handling. Dosages using different models of the pumps can be extrapolated from this data set to improve postoperative care for other avian species.

aAlzet® 2ML1 pump (DURECT, Corp., Cupertino, California, 95015, USA; www.alzet.com), 2mL fill volume, pump rate 10uL/h, duration 7d
b ZooPharm, Windsor, Colorado, 80550, USA)

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LITERATURE CITED
EVALUATION OF THERMAL ANTINOCICEPTIVE EFFECTS OF BUPRENNORPHINE HYDROCHLORIDE IN COCKATIELS (Nymphicus hollandicus)

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Abstract

Buprenorphine hydrochloride, a semisynthetic partial mu opioid receptor agonist, has shown thermal antinociceptive properties in American kestrels (Falco sparverius) in a recent study. The antinociceptive properties of buprenorphine have not been fully determined in psittacines, and have only been evaluated in a study using electrical stimulus in African grey parrots (Psittacus erithacus erithacus and Psittacus erithacus timneh) which did not show significant effects. Cockatiels (Nymphicus hollandicus), the most common companion bird kept in USA households, were selected (n=16) for this blinded, within-subjects, complete crossover study with four periods, assigning them randomly to four treatment groups. The four treatments consisted of intramuscular administration of buprenorphine hydrochloride (0.6, 1.2 and 1.8 mg/kg; Buprenex®, 0.3mg/ml, Reckitt Benckiser Healthcare Ltd. Dansom Lane Hull, England HU8 7DS) and saline (0.9%NaCl, Hospira Inc., Lake Forest, IL 60045 USA). Foot withdrawal response to a thermal noxious stimulus was determined before treatment and 0.5, 1.5, 3, and 6 hours after treatment administration. Agitation-sedation scores were determined 1-3 minutes before each thermal stimulus. There was no significant difference in thermal withdrawal threshold between the three buprenorphine treatments and the saline treatment, and no dosages were found to produce a significant sedative effect. No significant effect of period, treatment order, or sex was found. Further studies investigating other types of stimulation, formulations, routes of administration, testing times, and pharmacokinetics are needed to fully determine the analgesic and adverse effects of buprenorphine in psittaciiformes and the use of buprenorphine in clinical settings.

ACKNOWLDEGMENTS

This study was supported by the Richard M. Schubot Parrot Wellness & Welfare Program and the Center for Companion Animal Health at the School of Veterinary Medicine, University of California, Davis.

LITERATURE CITED

VORICONAZOLE TOXICITY IN MULTIPLE PENGUIN SPECIES

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Abstract

Aspergillosis is a common respiratory fungal disease in penguins managed under human care.4 Triazole antifungal drugs, such as itraconazole, are most commonly used for treatment; however, itraconazole treatment failures from drug resistance are becoming more common, requiring newer treatment options.2,7 Voriconazole, a newer triazole, is being used more often. Until recently,8 no voriconazole pharmacokinetic studies have been performed in penguins, leading to empirical dosing based on other avian studies, which has led to increased anecdotal reporting of drug toxicity and even potential death. This report describes 13 cases of voriconazole toxicity in three penguin species: 10 African penguins (Spheniscus demersus), two Humboldt penguins (S. humboldti), and one macaroni penguin (Eudyptes chrysolophus) between four different institutions. Clinical signs of toxicity ranged and progressed in severity from anorexia, lethargy, weakness, ataxia, paraparesis, apparent vision changes, seizure-like activity to generalized seizures. Similar signs of toxicity have also been reported in humans,3,5,10 in whom voriconazole therapeutic range for Aspergillus spp. infections is 2-6 µg/ml.1 Plasma voriconazole levels were measured in six penguins, which were markedly elevated at 44.28 and 57.93 µg/ml in more severely affected birds with paraparesis and seizures, respectively; moderately elevated at 15.69 and 17.78 µg/ml in mildly ataxic birds; and mildly elevated at 8.12 and 10.63 µg/ml in anorexic, lethargic and weak birds. These concentrations were well above those known to result in CNS toxicity, including encephalopathy, in humans.9 This report highlights the importance of species-specific dosing of voriconazole and blood therapeutic monitoring, and warrants further investigation and pharmacokinetic studies.

ACKNOWLEDGMENTS

The authors wish to thank the husbandry and animal care staff from their respective institutions for their dedicated care of these penguins. We thank Dr. Waldoch from Omaha’s Henry Doorly Zoo and Aquarium for case submissions. Lastly, we thank Mr. Harshaw of Animal Interaction Design Group.

LITERATURE CITED
AVIAN MYCOBACTERIOSIS: WHOLE-GENOME SEQUENCE ANALYSIS FOR TRANSMISSION SOURCE IDENTIFICATION

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Abstract

Avian mycobacteriosis is a troubling disease facing bird collections and conservation programs around the world and has lead to euthanasia of exposed but clinically healthy suspects in the past. There is growing evidence on the importance of the environment in transmission.¹,² The hypothesis of this study is that whole-genome sequence variation between infected birds will help reveal the importance of an environmental route of infection rather than bird-to-bird transmission. From 2001 through 2013, mycobacteria from 33 birds of various species from San Diego Zoo diagnosed with mycobacteriosis at necropsy were successfully isolated. These birds were divided into 11 groups including at least two individuals sharing a spatial and temporal period based on their movement history between enclosures. Whole genome sequencing of each isolate and alignment against reference genomes in the NCBI databases enabled higher resolution isolate differentiation than previous DNA-fingerprinting methods. A phylogenetic tree was inferred based on the number of single nucleotide variants between the isolates. The phylogenetic tree showed that 20 of the Mycobacterium avium samples group into three closely related clusters. Seven other M. avium isolates are distant from these clusters. The remaining isolates are other species, including M. fortuitum and M. intracellulare. In conclusion, the avian mycobacterial isolates show strain diversity. Mutation rate experiments will enable assessment of the significance of the relatively few variants between some isolates within a cluster. Preliminary interpretation suggests the infections were acquired independently from the environment.

ACKNOWLEDGMENTS

Thank you to the Ellen Browning Scripps Foundation for funding, to Jennifer Burchell for technical support, and to the National Science Foundation for computer time at the San Diego Supercomputer Center.

LITERATURE CITED

EFFECTS OF EXERCISE ON LIPID METABOLISM IN HISPANIOLAN AMAZON PARROTS (Amazona ventralis) WITH HYPERCHOLESTEROLEMIA

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Abstract

Hypercholesterolemia and atherosclerosis are common in psittacines, particularly Amazon and African grey parrots.1 Associations have been demonstrated between naturally-occurring and experimentally-induced hypercholesterolemia and atherosclerosis in psittacines.2,3,7 Daily exercise improves lipid metabolism in humans, rhesus macaques, rats, and chickens under varying experimental conditions.4-6,8 Hispaniolan Amazon parrots with naturally-occurring hypercholesterolemia (343-576 mg/dL) were divided into two groups: housed as a flock and exercised daily with 30 minutes of aviary flight and 30 minutes walking on a rotating perch (n=8), or housed in individual cages with no exercise regime (n=4).

A lipid panel (total cholesterol, HDL, LDL, and triglyceride)a was preliminarily validated for this species. Body weight, chest and abdominal girth, hematology, plasma biochemistry, and the lipid panel were measured at baseline, 9, and 15 weeks. Weight and girth were significantly lower in exercised than control birds at 9 and 15 weeks. Plasma HDL concentration was significantly higher at 9 weeks, but returned to near baseline by 15 weeks. No significant changes in hematology, biochemistry, or other lipid values were noted. Results were similar to studies in humans, in which increased HDL is the most consistent effect of exercise on blood lipids.5 Results at 15 weeks may have been affected by decreasing voluntary participation in aviary flight exercise. Additional investigation will be required to determine the amount of exercise and the degree of change in lipid metabolism necessary to improve long-term wellness outcomes in psittacine species predisposed to dyslipidemia and atherosclerosis.

ACKNOWLEDGEMENTS

Support was provided by a Mazuri Grant from the AAZV Wild Animal Health Fund and by the Richard M. Schubot Parrot Wellness and Welfare Program. The authors thank Jessica Huai-Chen Chang for assistance administering the exercise program.

LITERATURE CITED


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2014 Proceedings Annual Conference AAZV
DIGESTIBILITY OF CRITICAL CARE DIETS AND NITROGEN BALANCE IN OILED COMMON MURRES (Uria aalge) AND WESTERN GREBES (Aechmophorus occidentalis) RECEIVED FOR REHABILITATION IN CALIFORNIA

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Abstract

Nutritional support is a primary therapy administered to animals during responses to oil spills, but data informing nutritional decision-making during events is limited. Common Murres and Western Grebes naturally oiled by oceanic seeps off Ventura and Santa Barbara Counties, CA, USA were assigned to diets with varying levels [5.8% (no added oil), 11.0%, and 20%] and types of oil (corn, salmon) added to a partially purified basal dieta. Birds ranged from extremely emaciated to thin (62-80% wild mean mass). We assessed nitrogen retention (NR), apparent nitrogen digestibility (ApND), nitrogen-corrected apparent metabolize energy (AMECn), energy digestibility (ED), fat digestibility (FD), and estimated fat excretion (FE) through use of acid insoluble ash as an indigestible marker. Fat excretion is important in these species because once birds have been cleaned they are at risk of re-contamination during care. Lower fat diets resulted in higher NR, higher ApND, higher AMECn, and lower FE. NR and FE were found to have a negative relationship, where decreases in nitrogen retention were significantly related to increases in fat excretion. ED significantly declined with declines in body mass regardless of diet, suggesting severity of emaciation reduced birds’ ability to extract energy from food. ED was highest in the 11% salmon oil diet; hence, this diet had the highest effective energy content despite lower gross kcal/kg diet. Diets fed during oil spills historically have had high fat concentrations in an effort to provide maximum caloric support, however results of this study suggest lower fat diets may be more efficacious.

aEmeraid Piscivore, Lafeber Company, 24981 N 1400 East Road, Cornell, IL 61319, 1-800-842-6445

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This project was supported by the California Department of Fish and Wildlife’s Oil Spill Response Trust Fund through the Oiled Wildlife Care Network at the Wildlife Health Center, School of Veterinary Medicine, University of California, Davis. Many thanks to the staff and volunteers of International Bird Rescue who cared for these animals and assisted with feeding and sample collection. Special thanks to Ted Lafeber for his generosity in donating specially mixed diets for this study.
PRELIMINARY INVESTIGATION OF HYDROXYETHYL STARCH FOR AVIAN RED BLOOD CELL CRYOPRESERVATION

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Abstract

Because of the short life span and high metabolic rate of avian red cells, storage of these cells is difficult.\textsuperscript{3} With the lack of readily available hemoglobin-based oxygen carriers, practitioners are hard-pressed to treat birds with life-threatening anemia if fresh whole blood from a homologous donor is not available. Cryopreservation would allow for long-term storage of avian red blood cells and serve as a source of blood if a homologous donor is unavailable. Hydroxythyl starch (HES) has been used to cryopreserve human and canine red blood cells.\textsuperscript{1-2,4-5} Our hypothesis was that HES would be equally effective for cryopreserving chicken red blood as assessed by saline stability, cell recovery, and apoptotic markers. Results suggest excellent post-thaw saline stability (95.5\%) but unacceptable cell recovery (76.8\%). This presentation overviews the preliminary investigation of HES for avian red blood cell cryopreservation.

LITERATURE CITED
EROSIVE ENTERITIS AND INTESTINAL OBSTRUCTION CAUSED BY DECOMPOSED GRANITE IN LESSER FLAMINGOS (Phoenicopterus minor): CLINICAL MANAGEMENT OF A LARGE FLOCK AND LONG-TERM IMPLICATIONS

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Abstract

Decomposed granite (DG), also known as crushed granite, is a construction and landscaping material commonly used in zoos as a base for flamingo exhibits. Since 2008 the Fort Worth Zoo has used synthetic grass (turf) over a compacted layer of DG in the flamingo exhibit. In 2013 the turf was removed, pressure washed and the DG replaced. The turf was then re-stretched in place. Few months later a number of flamingos presented with lethargy, poor body condition, anemia and hypoproteinemia. Radiographs revealed radiopaque material in the ventriculus and dilated intestinal loops. Necropsy showed granite-like material in ventriculus, severe congestion of intestinal mucosa and obstruction of intestinal lumen by caseous plugs surrounded by fecal material. Histopathology revealed marked chronic erosive colitis, mild erosive proventriculitis and hypercontraction of the muscular tunics of ventriculus. Radiographic screening of 82 flamingos revealed 64.5% with moderate amount of radiopaque material, 25.6% with large amount, 8.53% with small amount and 1.2% did not have any material. Flushing the ventriculus per os in the Trendelenburg position and by esophagostomy tube yielded poor results, as did the attempt to endoscopically remove the material. Medical treatments included antibiotics in water, cathartic drugs, contrast agents or a combination thereof. Screening radiographs were repeated in all birds to evaluate changes in material content. Before the birds were released back into the exhibit, the soil substrate beneath the artificial grass was completely removed and replaced with a concrete surface (sloped to a drain) and topped with a layer of Dri-dek® before the original turf was re-applied.

ACKNOWLEDGMENTS
The authors thank the veterinary technicians and the bird department at the Fort Worth Zoo for their invaluable assistance during the flock assessment and treatments.
EVALUATING THE PHARMACOKINETICS OF MELOXICAM AFTER INTRAVENOUS AND INTRAMUSCULAR ADMINISTRATION IN TILAPIA (Oreochromis niloticus)

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Abstract

Critically evaluating the pharmacokinetic behavior of a drug in the body provides crucial information about how to effectively treat a patient. Currently, pharmacokinetic studies that exist in fish have primarily focused on drugs used to treat infectious disease and minimal attention has been given to analgesic drugs. The objective of this study was to determine the pharmacokinetics of meloxicam (1 mg/kg) in tilapia (Oreochromis niloticus). A single dose of meloxicam was administered either intravenously (IV) or intramuscularly (IM). Blood samples were obtained at pre-determined times after drug injection. Plasma meloxicam concentrations were determined and noncompartmental pharmacokinetic analysis was performed. The mean terminal half-life of meloxicam after IV and IM administration was 1.36 hours and 1.8 hours, respectively. The area under the plasma concentration-versus-time curve extrapolated to infinity was 11.26 h•µg/mL after IV administration and 5.72 h•µg/mL after IM administration (1.97 ratio). The mean peak plasma concentration after IM injection was 1.95 µg/mL. Bioavailability of meloxicam after IM administration was approximately half that of IV administration. Elimination was relatively rapid in both routes of administration, suggesting that maintaining clinically relevant plasma concentrations may be difficult using this dose. Administration of meloxicam at a dose of 1 mg/kg in tilapia may be useful for short, minimally painful procedures, but further studies are needed. This study represents the first pharmacokinetic evaluation of a non-steroidal anti-inflammatory drug in a fish species.
EVALUATING THE EFFICACY OF ALFAXALONE AS AN ANESTHETIC AGENT IN OSCAR FISH (*Astronatus ocellatus*)

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Abstract

Alfaxalone is a neurosteroid anesthetic that has been utilized as an induction agent in a variety of species, including fish. While parenteral anesthetic agents are used in fish, immersion anesthetics are more commonly used. Of these, tricaine methanesulfonate is the most popular immersion anesthetic; however, it is not as readily available at this time because a major distributor is no longer offering it for sale. The objective of this study was to evaluate the efficacy of alfaxalone as an immersion anesthetic in Oscar fish (*Astronotus ocellatus*), a popular cichlid amongst aquarium enthusiasts, and its effect on physiologic and blood gas parameters in this species. The study design was a prospective experimental trial. Six Oscar fish, examined and found to be healthy, were individually immersed in water with 5 mg/L (5 ppm) alfaxalone. The water temperature was maintained between 23.9-26.7°C and water quality parameters were appropriate for this species. During the anesthetic trial, fish were monitored for anesthetic plane based on a defined ordinal scale, opercular rate, heart rate, response to noxious stimuli, and blood gas values at baseline (pre-immersion), surgical anesthetic depth, and at recovery. Alfaxalone at 5 mg/L was sufficient to induce anesthesia for diagnostic sampling in the Oscar fish. Median lactate was significantly increased (p<0.05) in all fish that were anesthetized. Median PCO2 was also found to be increased but was not statistically significant (p=0.07). No other significant differences were noted in the physiologic or blood gas parameters that were measured.
EVALUATION OF INTRAMUSCULAR ALFAXALONE FOR INDUCTION OF ANESTHESIA IN CLINICAL REPTILE CASES

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Abstract

Alfaxalone is a neurosteroid anaesthetic that binds to γ-aminobutyric acid cell surface receptors. Alfaxalone is highly insoluble in water and historically was formulated in combination with alfadolone and the solubilising agent Cremophor EL. A new formulation of alfaxalone, solubilised in cyclodextrin, has been used to induce anaesthesia in a variety of reptile species.¹⁻³

Alfaxalone was injected i.m. at a dose of 10 - 30 mg/kg in 6 snakes, 15 lizards and 16 chelonians. The animals weighed 20 - 4180g and general condition prior to anesthesia ranged from good to poor. Anesthesia was required for various surgical and diagnostic reasons. Mean induction time was 19 min (range 3 - 40 min). Six animals achieved deep sedation, 21 light anesthesia and 4 surgical anesthesia. Differences in immobilization levels were seen between species; higher doses of alfaxalone were required in Hermann’s tortoises in comparison to sliders to achieve similar levels of immobilization. Two cases showed apnea 5-10 minutes after administration of alfaxalone. Supplemental isoflurane to perform surgery was administered as required in 46% of the cases and of these 84% were manually ventilated. Mean time to regaining spontaneous ventilation after discontinuation of isoflurane was 17 minutes (5 - 60 min). Recovery from anesthesia was smooth. Two geckos, both presenting in poor general condition and requiring surgery due to dystocia, died in the post-operative phase.

In conclusion, alfaxalone in its new formulation is a reliable agent in lizards, turtles and snakes to induce sedation or anesthesia. The level and duration of immobilization is dose- and species dependent. Respiratory depression may occur and the anesthetist should be prepared to intubate the reptile’s trachea. Due to its dilute concentration, the injection volume of alfaxalone for i.m. dosages is fairly large in comparison to other anesthetics.

LITERATURE CITED
EVALUATION OF ALFAXALONE-MIDAZOLAM FOR SEDATION AND 
ANESTHETIC INDUCTION IN CALIFORNIA SEA LIONS (Zalophus californianus) IN 
A REHABILITATION CENTER 

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Shedd Aquarium, Chicago, IL 60605 USA 

Abstract 

Alfaxalone (Alfaxan®, Jurox, London, UK, 10 mg/ml) is a rapid-acting, neurosteroid anesthetic 
that can be administered by intravenous or intramuscular injection. Alfaxalone is widely used 
throughout Europe, Australia, and Canada in a variety of domestic and exotic species.2-8 
Reported use in marine mammals is limited, with the most complete study to date having been 
done in free-ranging South American fur seals (Arctocephalus australis).1 

Anesthetic induction of California sea lions (Zalophus californianus) (n=9) with alfaxalone 
(1.07-2.02 mg/kg) and midazolam (0.196-0.312 mg/kg) administered intramuscularly was 
performed opportunistically during assessments at a rehabilitation center. Mean and median 
times to initial effect were 3.22 min and 3.0 min respectively. Mean and median times to 
recumbency were 5.22 min and 4.0 min, respectively. A deep plane of sedation adequate for 
non-stimulating procedures, including radiographs, ultrasound, and blood sampling, was 
achieved. Supplemental isoflurane was required for more invasive procedures (n=6), such as 
oral surgery and wound debridement. Heart and respiratory rates remained within normal ranges. 
Mild to moderate hypoxia was noted in some cases (n=2), but was quickly corrected with 
tubation and supplemental oxygen. Mild to moderate muscle fasciculation was commonly 
noted and exacerbated by auditory stimuli, but not tactile or visual stimuli. No other side effects 
were observed. Smooth recoveries from anesthesia were noted in cases antagonized with 
flumazenil (n=5, 0.010-0.016 mg/kg IM). 

Alfaxalone with midazolam appears to be a safe and reliable combination for anesthetic 
induction in California sea lions, and warrants further investigation. Additionally, this may be a 
favorable induction protocol for ophthalmic exams and procedures, as ventromedial rotation of 
the globe was minimal compared to other drug combinations. 

LITERATURE CITED 

Analg. 38: 461-6. 
medetomidine-alfaxalone and medetomidine-ketamine in semi-free ranging Bennett's wallabies (Macropus 

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ALFAXALONE, IN COMBINATION WITH MEDETOMIDINE AND AZAPERONE, FOR IMMOBILIZATION OF CAPTIVE WHITE-TAILED DEER (Odocoileus virginianus)

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Abstract

Alfaxalone is a neurosteroid, which produces dose dependant GABAergic effects, ranging from sedation to general anesthesia. There are few reports describing the use of alfaxalone in wild mammals1. Our objective was to determine if alfaxalone would improve the induction and recovery characteristics of a medetomidine-azaperone combination, without compromising cardiovascular stability. Six captive White-tailed deer were immobilized with medetomidine (0.15 mg/kg) plus azaperone (0.2 mg/kg) (MA). An additional six deer were immobilized using these drugs with the addition of 0.5 mg/kg of alfaxalone (MAA). Drugs were delivered IM (DD). Heart rate (HR), respiratory rate (RR), and rectal temperature (RT) were monitored every 5 minutes and compared with a 2-way ANOVA for repeated measures. An arterial blood gas sample was obtained at 15 minutes post DD. Blood gas variables, induction and recovery times were compared with a paired t-test. One hour post DD, atipamezole was administered at 5 times the medetomidine dose. There were no statistically significant differences, between treatments, in any cardiopulmonary parameters. HR and RT decreased significantly over time with both treatments. Both treatments induced hypoxemia (PaO2 [MA, 54 +/- 7 {mean +/- SD} mmHg; MAA, 55 +/- 10 mmHg]) and hypoventilation (PaCO2 [MA, 53.4 +/- 4 mmHg; MAA, 53.4 +/- 4 mmHg]). The addition of alfaxalone resulted in a statistically significant (p=0.0037) reduction in induction time (time to head down [MA, 11.1 +/- 3.8 min; MAA, 5.5 +/- 0.6 min]). Time to standing was significantly (p=0.049) longer with alfaxalone (standing [MA, 9.1 +/- 2 min; MAA 12.2 +/- 2.6 min).

The addition of alfaxalone to medetomidine-azaparone significantly reduced induction time, while sparing cardiopulmonary function.

LITERATURE CITED
EFFECT OF AZAPERONE ON BLOOD PRESSURE AND OTHER CARDIORESPIRATORY PARAMETERS IN ETORPHINE-IMMOBILIZED FREE-RANGING AFRICAN ELEPHANTS – ROLE IN MANAGING ANESTHETIC COMPLICATIONS

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Abstract

Etorphine is commonly used to immobilize elephants. However potential adverse cardiovascular effects include hypertension.1 This has been associated with development of pulmonary edema and death. Addition of azaperone to the immobilizing combination may provide synergistic effects and counteract cardiovascular effects of etorphine. This study was undertaken to assess the cardiorespiratory effects of azaperone either added to the initial drug combination or administered i.v. after immobilization of free-ranging African elephants.

Fifty-five bull African elephants were immobilized with either etorphine alone or etorphine with azaperone in the dart, or etorphine with azaperone administered i.v. 10 minutes after recumbency. Cardiorespiratory parameters were monitored every 5 minutes, including invasive blood pressure values using an auricular artery. Although median heart rates were not different before and after i.v. azaperone (50 and 51 bpm, respectively), values for systolic (229 vs. 156 mmHg), diastolic (158 vs 117.5 mmHg), mean blood pressures (187 vs 132 mmHg) and pulse pressures (76 vs 45 mmHg) were significantly lower after administration of i.v. azaperone (p<0.0001). Similarly, when parameters for elephants administered etorphine alone with etorphine and azaperone in the dart were compared, elephants receiving azaperone had significantly lower blood pressure values. This study supports the use of azaperone to minimize cardiovascular complications associated with etorphine immobilization in elephants, although caution should be used when administering azaperone i.v.

ACKNOWLEDGEMENTS
The authors thank the South African National Parks for funding this project. The authors acknowledge the essential role of the veterinary teams, capture teams, and helicopter pilots of South African National Parks in safely immobilizing the elephants used for this study.
LITERATURE CITED
CURRENT REVIEW OF ANESTHESIA OF CAPTIVE NILE HIPPOPOTAMUS 
(Hippopotamus amphibious) AT DISNEY’S ANIMAL KINGDOM

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Abstract

The anatomical and physiological characteristics of the Nile hippopotamus (Hippopotamus amphibious) create many anesthetic challenges. Captive Nile hippopotamus anesthesia has historically been fraught with complications. Previous anesthetic protocols have explored the use of potent opioids alone and in combination with other anesthetic agents. Anesthetic events have commonly resulted in apnea, bradycardia, cyanosis, and even death.¹ Over the last 12 years, Disney’s Animal Kingdom has explored alternative anesthetic protocols to potent opioids in captive hippopotami including: butorphanol, medetomidine (BM); butorphanol, azaperone, medetomidine (BAM); and ketamine, butorphanol, azaperone, medetomidine (KBAM).

In this retrospective investigation, 12 anesthetic events in captive Nile hippopotami (ranging from 270kg to 1820kg) were reviewed. Time to initial effect, time to intubation, and recovery time varied among the different anesthetic protocols. Intubation was achieved in the majority of clinical cases, and all patients received supplemental oxygen. Several venipuncture techniques and sites were explored with varied success. The patients were monitored using electrocardiography, capnography, pulse oximetry, and, in some cases, blood gas analysis. Findings suggest that blood gas data may be the most reliable tool for anesthetic monitoring in Nile hippopotami. The findings of this review suggest that anesthetic protocols using butorphanol, azaperone, and medetomidine may produce reliable anesthetic effects with low rates of complications in captive Nile hippopotami. Further investigation is recommended.

LITERATURE CITED
COMPARISON OF INDIRECT BLOOD PRESSURE VALUES IN CHIMPANzeES (Pan troglodytes) ANESTHETIZED WITH TWO ANESTHETIC PROTOCOLS: Tiletame-ZOLAZEPAM AND Tiletame-ZOLAZEPAM-MEDETOMIDINE

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Abstract

Heart disease is considered one of the major causes of mortality in captive chimpanzees (Pan troglodytes).3,5 Hypertension is a significant risk factor in cardiovascular disease in humans, and may contribute to cardiac disease in chimpanzees.1,3 Arterial blood pressure is also a fast and informative method of assessing cardiovascular function during anesthesia. Because blood pressure (BP) is typically measured under anesthesia in chimpanzees, it is paramount to determine baseline values for different anesthetic protocols. Fifty-three chimpanzees ranging from 1 to 37 years old were chemically immobilized with one of two different anesthetic combinations: tiletamine-zolazepam (TZ, average dose 10mg/kg), n=23 or tiletamine-zolazepam-medetomidine (TZM, average dose TZ- 2mg/kg, M–0.030mg/kg) n=30. Blood pressures were obtained over 70 minutes using a sphygmomanometer and stethoscope over the brachial artery. Systolic, diastolic blood pressures and heart rate (HR) results for the TZ group were 104.79 +/- 11.51mmHg, 58.47 +/- 11.57mmHg and 86.08 +/- 7.49 beats per minute (BPM) respectively. For the TZM group systolic, diastolic and HR results were: 127.75 +/- 13.17mmHg, 87.89 +/- 12.22mmHg and 72.71 +/- 5.01 BPM respectively. Preliminary results indicate that adult chimpanzees immobilized with the TZ combination at Chimfunshi Wildlife Orphanage are within the normotensive category group.1 Higher systolic and diastolic BP were observed on the TZM group, with the systolic BP still falling within the normotensive reference range but diastolic BP in the pre-hypertensive category.1 The higher BP observed in the medetomidine combination is consistent with findings in other great species when this drug has been utilized.2,4

LITERATURE CITED

OUTCOMES OF THE AZA WORKSHOP ON DIAGNOSIS, TREATMENT AND PREVENTION OF INFERTILITY

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Abstract

Many zoo-based animal populations are unsustainable. The logistics of bringing recommended pairs together may be one reason, but another not yet fully explored possibility is infertility. An association between reproductive failure and uterine pathology has been shown for a growing number of species (reviewed in Penfold et al. 2014)¹, indicating that potential infertility and contributing factors are in critical need of attention. Improving reproductive success and consequently, population sustainability, will require more than assisted reproductive techniques or improved husbandry. For many populations, identifying, treating and preferably preventing infertility will be key. A workshop held at the 2014 AZA mid-year conference brought together specialists in animal infertility, animal managers and veterinarians to review currently available information, highlighting taxonomic differences in the causes of infertility and approaches to treatment and prevention. Working groups, organized by taxon, formulated action plans, focusing particularly on methods for diagnosis and potential treatment of infertility. Outcomes included a fertility diagnostic flow diagram, a call for routine endocrine monitoring of pairs with breeding recommendations, and lifetime reproductive planning for females to establish and maintain fertility. Ungulates and carnivores were selected as the first models, reflecting the expertise of workshop participants, but other taxa are also in need of attention. Plans are in progress for a similar workshop for birds in 2015 in collaboration with the Avian SAG.

This session will present the outcomes of the workshop and solicit input and discussion with participants about identifying other species of concern, diagnostic techniques, and possible treatment of infertility across taxa.

ACKNOWLEDGMENTS

The authors thank the other 40 participants of the AZA Workshop for their discussions and input on the topic of infertility in zoo animal populations.

LITERATURE CITED

MILBEMYCIN OXIME (INTERCEPTOR ®) TREATMENT OF AMPHIPOD PARASITES (Hyperiidae) FROM SEVERAL HOST JELLYFISH SPECIES

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Abstract

On 28 June 2012, 36 wild-caught Crystal jellyfish (Aequorea victoria) from the coast of Victoria, British Columbia arrived at the John G. Shedd Aquarium. It was later discovered that these jellyfish were infested with hyperiid amphipods (Hyperia medusarum). All hyperiid amphipods are believed to be obligate parasites of gelatinous zooplankton during their development. In this case, the amphipods were introduced into a system containing several jellyfish species. Commonly used chemotherapeutics, such as copper and formaldehyde used to eradicate ectoparasites from fishes are generally not tolerated by aquatic invertebrates, such as jellyfish. Therefore, the decision was made to use milbemycin oxime (Interceptor ® tablets for dogs 50-100 lbs, Norvaris Animal Health US, Inc., Greensboro, NC USA), a treatment prescribed for red bug (Tegastes acroporanus) infestation in corals.

The affected systems received two treatments using one 25 mg aliquot of Interceptor ® per 10 gallons of tank water, 6-7 days apart. A third treatment was scheduled; however, Interceptor ® became no longer available at this time. Despite this, overall treatment to eradicate the parasite from the affected systems was successful. Although the majority of species endured the treatment with no obvious adverse effects, further studies evaluating the tolerance of jellyfish to milbemycin oxime, particularly in small juvenile E. indicans and A. aurita, are warranted. Overall, there were potentially more negative effects associated with the treatment in the hydrozoans than the scyphozoans. Further studies using a different milbemycin oxime product would be beneficial.

LITERATURE CITED

REMOTE CHEMICAL IMMOBILIZATION OF LARGE FISH

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Abstract

The challenges associated with remote chemical immobilization of shark and teleost species in large aquaria continues to be an ongoing problem. Other than the typical terrestrial dart administration challenges, factors such as depth (pressure), salinity, turbidity, and temperature play a great role. At Disney’s Living Seas with Nemo and Friends two dart delivery tools have been modified to address these issues. First, a pole syringe was created using a lightweight aluminum shaft with modifications using Cap-Chur equipment (Palmer Cap-Chur Inc, Powder Springs, GA 30127 USA) that fit Dan-inject darts (Dan-Inject of North America, Knoxville, TN 37931 USA). Secondly, a speargun (Mares, http://www.mares.com) was modified by decreasing the pressurized chamber to allow a slower discharge of the spear shaft and adjustments of this shaft with Cap-Chur equipment facilitated use of Dan-Inject darts. Initial results proved the pole syringe to be very successful, above and underwater. With the underwater dart gun there was limited success. Initial tests at less than 10 feet underwater indicated high velocity thus prompting modifications to the pressurized chamber; however, at nearly an atmosphere of depth, the discharge pressure of the speargun was too low thus only good for dart placement when the target was within 6 feet of the darter. Continued modifications are being made to adjust for depth and adequate pressure of the gun to safely place divers from the target animal. The pole syringe modifications have streamlined current successful darting and with further underwater dart gun modifications, successful deep water darting will be likely.

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The authors wish to extend a special thanks to Brian Harvey (Fugu Fisheries Ltd., Victoria, B.C.) and to the aquarium staff at Disney’s The Living Seas With Nemo and Friends.
PROTEIN AND CHOLESTEROL ELECTROPHORESIS OF PLASMA SAMPLES FROM THE COWNOSE RAY (*Rhinoptera bonasus*)

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Abstract

Basic research studies have detailed the lack of albumin and a dominance of lipoproteins in the blood of elasmobranchs.1,3 Protein electrophoresis has become a common and valuable tool available in many veterinary reference laboratories.2 This semi-automated platform can also be used to define other analytes including cholesterol fractions. In the present study, these methods have been implemented to examine the plasma from the cownose rays (*Rhinoptera bonasus*) under human care. Plasma protein electrophoretograms revealed a lack of albumin, poorly defined fractions with alpha migration characteristics, and well defined fractions with beta and gamma globulin migration characteristics. Cholesterol electrophoretograms revealed a dominance of very low density lipoprotein (VLDL) and low density lipoprotein (LDL) with a poorly defined high density lipoprotein (HDL) fraction. Two groups of samples were examined. The first represented animals managed under long term care (n=33) and the second represented animals that were wild-caught with samples collected immediately post-transport (n=43). The total solids concentration was significantly higher in the first group but differences in percent beta and gamma globulins were not significant. The cholesterol level was significantly lower in the transport group. This was reflected in a lower VLDL level. These preliminary results support the premise that these methods can be used in elasmobranchs. Future studies should address species specific reference interval generation and possible sex, age, husbandry, and seasonal differences. Examination of samples from clinically abnormal animals will best gauge the application of these tools in research studies and animal management.

ACKNOWLEDGMENTS

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LITERATURE CITED

MICROBES AND THE AQUARIUM

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Abstract

Microbes are everywhere. In every milliliter of surface seawater, there are 0.5 to 1 million bacteria and 10 million viruses. They are also found on every surface and comprise very complex ecosystems called biofilms. For those who think in terms of bacteria associated with biofiltration bacteria as “good” and pathogens as “bad”, the relationships are much more complex. Unfortunately, our thinking about the aquatic environment has been biased by our previously limited tool of culturing bacteria which captures <1% of the bacteria in water which has greatly limited our understanding of microbes in the environment.

Microbes should be considered in two realms planktonic and sessile. The planktonic state is fairly straight forward whereas the biofilm ecology is extremely complex. Biofilms include organisms beyond bacteria and comprise fungi, algae, protozoans, and metazoans. An intricate ecologic process occurs as various environmental parameters change. These organisms secrete an assortment of chemicals known as extracellular polymeric substances (EPSs), which add to the total organic carbon (TOC) within the water column and are critical to the health of the organisms and water environment.

Many factors influence the number and types of microbes in the environment. There have been several papers published on the effects of chemicals on the biofilter and this is the most important consideration when adding therapeutic agents to water. It is important to know that most, if not all, of these drug interactions are dose-dependent and affect the biofilter’s efficiency to varying degrees; they should not be considered as having an all or nothing relationship.

On the flipside, drugs can also be digested/converted by microbes as a food source. When controlling an environment like the aquarium industry’s current standards, millions of bacterial species are starved into inactivity. These bacteria, although they may not be obvious, could still exploit any limiting nutrient sources, whether it is ammonia, nitrite, or phosphorus. This also applies to other nutrients that might enter the water. Nutrients can be any molecule which includes the needed elements which includes complex molecules such as therapeutics.

When a therapeutic agent is ingested by a human or animal, it is placed in a sterile environment once it is absorbed into the body. This is not the case when the same chemical is placed into a body of water. It is important to recognize the impact of microbes on chemicals, especially those with carbon chains and associated elements that may be nutrient sources. With the diversity of microbes in a water column, it is possible that one species will have an enzyme to break the chemical chains of the therapeutic and use it as a food resource. Therefore, it is important to invest in procedures for monitoring chemical concentration when treating animals. It is also important to recognize that there are different microbial communities in various institutions and...
even between tanks which will result in a variety of experiences by husbandry staff and clinicians.

ACKNOWLEDGMENTS
The author would like to thank the following people for their additions to this evolving conversation: Kent Semmens and Nick Andrews for all their thoughts around the role of biofilms and planktonic bacteria in marine aquaria; and Stacy Knight, Larry Boles, Matt Dawson, and Amber Thomas for their hard work designing and executing experiments that are helping illuminate the role of bacteria and environmental therapeutics.

LITATURE CITED
SEA TURTLE NEUROLOGY

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Abstract

A high percentage of sea turtles present to the Georgia Sea Turtle Center (GSTC) with neurological signs. Causes of neurological disease in sea turtles include infectious disease, parasites, marine algal toxins, vascular insults, hypoxia, nutritional, metabolic, and space occupying masses. The most common problem causing neurological disease, however, is traumatic injuries. Neurodiagnostics used in sea turtles include a neurological examination, clinical pathology and infectious disease testing, radiographs, advanced imaging, electromyogram, electroencephalogram, and cerebral spinal fluid tap.

A standardized neurological examination has been established for the sea turtles, which plays an important role in localizing lesions, prognostication, and evaluating the effectiveness of therapy. Turtles with neurological disease may exhibit circling, asymmetric buoyancy, inability to hold their heads up, ataxia, weakness, and paresis or paralysis. Sea turtles have 12 cranial nerves which are assessed in the same way a mammalian species is evaluated. Central nervous system signs include seizures, tremors, head tilt, visual deficits, and cranial nerve deficits. Ataxia and circling, nystagmus, head tilt, rolling, and imbalance are all signs of vestibular disease. Localizing spinal cord lesions is very similar to mammals. Complications of traumatic injuries involving the brain or spinal cord may include gastrointestinal ileus, osteomyelitis, and urinary bladder atony.

Therapeutic management of neurologic disease may include fluid therapy to achieve euvolemia or mild hypervolemia to avoid hypotension, oxygen therapy to avoid hypoxia, osmotic diuretics given IV via intermittent bolus, pain management, wound management and antimicrobials. Complete healing and return to normal function may take 1-3 years in some cases.
INVESTIGATING CHELONID FIBROPAPILLOMA-ASSOCIATED HERPESVIRUS IN SYMPTOMATIC AND ASYMPTOMATIC REHABILITATING GREEN SEA TURTLES (Chelonia mydas)

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Abstract

Fibropapillomatosis (FP) is the most important infectious disease of sea turtles, particularly green sea turtles (Chelonia mydas). Fibropapillomatosis tumors, characterized by cutaneous, conjunctival, and visceral growths, often debilitate affected turtles by impeding feeding, movement and vision, and/or leading to organ failure. Chelonid fibropapilloma-associated herpesvirus (CFPHV) is consistently associated with FP tumors, and has also been identified in clinically normal turtles, likely representing early or subclinical infection. In this study we develop and apply molecular techniques to better understand the virus-host pathosystem of CFPHV, and to investigate the role of cell type in symptomatic and asymptomatic CFPHV infections. This is a comparative study of juvenile, wild-caught green sea turtles in rehabilitation facilities throughout eastern Florida and Georgia, USA. Presence/absence of CFPHV is evaluated using quantitative polymerase chain reaction (qPCR) and serological screening, and turtles are designated as symptomatically/asymptomatically infected, or uninfected. Assaying for CFPHV DNA using qPCR, we explore cell type(s) infected, extent of virus replication, and viral loads in various biological samples, including FP tumors, skin, mucosae, blood, feces, urine, nervous tissues, and organs. Further inquiry includes evaluating the environment’s role in CPFHV prevalence by assaying tank filter and water samples for CFPHV DNA, as well as seawater and sea grass sampled from local green sea turtles’ natural habitats. Understanding characteristics of subclinical infection will allow for better identification of biological factors leading to viral transmission, and help optimize detection and control strategies for FP in natural and captive settings.
CLINICAL PATHOLOGY, SERUM BREVETOXIN, AND CLINICAL SIGNS OF FLORIDA MANATEES (Trichechus manatus latirostris) DURING THE BREVETOXIN RELATED MORTALITY EVENT IN SOUTHWEST FLORIDA 2013

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Abstract

During a red tide associated mass mortality event in southwest Florida in the winter and spring of 2012 -2013, 16 manatees were rescued and presented to Tampa’s Lowry Park Zoo (TLPZ). All manatees were examined, had blood samples taken for routine complete blood cell counts (CBC), serum biochemistry panels, and coagulation profiles (prothrombin time, partial thromboplastin time, fibrinogen concentration, platelet counts, and d-dimer concentration). Serum or plasma was banked for brevetoxin analysis and whole blood was collected in heparinized blood tubes for lymphocyte transformation (LTT) assays when possible. Brevetoxin analysis and LTT were repeated as possible during the convalescent period as well as at pre-release health assessments. Fifteen manatees were given atropine; 0.02mg/kg with ¼ the dose given IV and the remaining ¾ SQ. All manatees were given a course of injectable tulathromycin at 2.5mg/kg SQ q7d for 3 treatments and were fitted with flotation devices. Time to the removal of the flotation gear was recorded. Fifteen manatees survived and were released. Statistical clinical pathology differences between brevetoxin exposed manatees and the control population included inflammatory and stress responses, bleeding tendencies, and lower electrolyte levels in the brevetoxin exposed group. Recovery time for conscious manatees was half of that of unconscious manatees. Serum brevetoxin levels (PbTx3, ng/ml) were not different between conscious and unconscious manatees but all manatees measured tended to have serum brevetoxin levels decrease during the first several weeks of rehabilitation. Lymphocyte transformation shows suppression, but the clinical significance of this is still not understood.

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The authors wish to thank Dr. Nico Maldonado; the Veterinary Clinic Staff of Heather Henry, CVT and Michelle Devlin CVT, and the Manatee Rehabilitation Team led by Virginia Edmonds from Tampa’s Lowry Park Zoo. In addition we would like to gratefully acknowledge USFWC and FWC, in particular Martine de Wit, Andy Garrett, Denise Boyd and everyone at the Marine Mammal Pathobiology Lab for their assistance.
REPRODUCTIVE NEOPLASMS IN WILD AND LONG-TERM CAPTIVE FEMALE FLORIDA MANATEES (Trichechus manatus latirostris)

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Abstract

The endangered Florida manatee (Trichechus manatus latirostris) has been the focus of numerous studies and conservation efforts due to population threats from anthropogenic and environmental pressures such as watercraft trauma, harmful algal blooms and extreme cold water temperatures. Understanding manatee reproduction is important for population management. Currently little is known about reproductive pathology in this species, including neoplasia, as no reports of uterovarian neoplasia exist in the veterinary literature. This case series presents reproductive neoplasms and pathologies in eight wild and long-term captive female Florida manatees obtained through a carcass recovery program managed by Florida Fish and Wildlife Commission’s Marine Mammal Research and animal rehabilitation programs between April 2009 and May 2014. Neoplastic categories included granulosa cell tumor, leiomyoma, uterine carcinoma and ovarian adnexal tumor. One manatee had more than one neoplasm, and another also had pyometra. Underlying causes and predisposing factors to tumor development, and their effects on reproductive success are currently unknown. Asymmetric reproductive aging, as seen in elephants and white rhinos1-3, and a correlation between obesity and reproductive disorders in long-term non-reproductive female manatees are of interest and warrant further investigation.

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LITERATURE CITED
POST-OPERATIVE IN-HOSPITAL MANAGEMENT OF A WESTERN LOWLAND GORILLA (Gorilla gorilla gorilla) WITH A MULTIMODAL APPROACH TOWARD PATIENT CARE AND COMPLIANCE

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Abstract

An 85-kg, 23-year old, multiparous female Western lowland gorilla (Gorilla gorilla gorilla) was immobilized for exploratory laparotomy to investigate a suspected abdominal abscess. Infiltrative intra-abdominal and subcutaneous abscesses were confirmed surgically, with focal peritonitis associated with cecal and colonic perforation. Typhlectomy and ileocolic anastomosis were performed, and severely infiltrated body wall was resected. For the ensuing 28 days, the animal was maintained in a hospital setting to permit surgical recovery and ongoing treatment. The animal was attended by veterinary staff (doctors and technicians) and by Bronx Zoo Mammal Department keeper and curatorial staff for direct around-the-clock observation and care.

During the initial surgical immobilization, a 5 fr x 55 cm double-lumen percutaneous intravenous catheter (PowerPICC, Bard Access Systems, Salt Lake City, UT) was placed with ultrasound guidance in the left basilic vein. This catheter was maintained for the entire four-week post-operative period through a varied and evolving set of protective measures. The left arm was immobilized with fiberglass casting material (Vetcast Plus, 3M Health Care, Neuss, Germany), while the entire length of IV line to which the animal had contact was secured and encased within either rubber or lightweight flexible metal tubing. Continuous intravenous access permitted the use of sedative and analgesic drugs to maintain the animal in a state of tranquilization, yet sufficiently functional to eat and void normally, and move within the confines of her 1.7 m x 1.3 m x 1.8 m hospital enclosure. Fentanyl (100-150 ug/hr) and midazolam (1-1.5 mg/hr) were administered as constant-rate infusions and adjusted to effect for 19 days postoperatively. Ketorolac (30 mg IV BID) and acetaminophen (1000 mg IV TID) were administered for analgesia. Antimicrobials were administered intravenously based upon culture and sensitivity results. Lorazepam (2-4 mg PO BID) was introduced on Day 19 post-operatively as a replacement for IV midazolam, while fentanyl was gradually decreased from 100 ug/hr to 75 ug/hr CRI. However, midazolam was resumed and continued at 1-1.5 mg/hr CRI on Day 21 post-operatively, while fentanyl was further tapered from 75 ug/hr to 25 ug/hr CRI. Fentanyl and midazolam CRI were both discontinued on Day 28 post-operatively, when her IV catheter was removed and the animal was returned to her regular off-exhibit enclosure. She was maintained on oral lorazepam at 2-4 mg PO BID for 34 days, as she was gradually reintroduced to her troop. There were no complications associated with long term maintenance of the indwelling intravenous catheter, nor of immobilization of the left arm by casting. This case demonstrates a successful means of maintaining an indwelling percutaneous intravenous catheter.
in the Western lowland gorilla, and of promoting post-operative care and convalescence through constant chemical sedation.

ACKNOWLEDGMENTS
The authors would like to thank the Dr. Colleen McCann and the rest of the curatorial and keeper staff of the Bronx Zoo Mammal Department for many hours spent providing overnight care and observation. We also express our gratitude to Drs. Steve Gorfine and Dan Popowich, who were invaluable in leading the surgical intervention, and to Dr. Sharif Ellozy for his placement of the indwelling intravenous catheter.
FUNCTIONAL ASSESSMENT AND MULTI-MODAL APPROACH TO PAIN MANAGEMENT IN ZOO PATIENTS

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Abstract

Veterinarians today have more tools available than ever before to manage chronic or painful conditions in their patients. Zoo veterinarians are no exception to this, and with a little homework and flexibility, we can create a system of objective assessment of pain and dysfunction in our animals, and can implement many treatment options to manage discomfort and improve quality of life. This presentation will describe the Houston Zoo’s experience with implementing a standard method of pain or functional assessment, and the variety of treatment modalities we have used at our zoo in the past three years. Oral medications are an important aspect of therapy, but for brevity, will not be discussed in this paper.

With the goal of having a more useful method of assessing patient response to therapy, the Houston Zoo used the Cincinnati Orthopedic Disability Index for Canines (CODI) as a model, and implemented a numerical grading system of patient functional activities. Zoo keepers were asked to prioritize five functional activities that they observed the most restriction in in the animals they cared for, and these scores were re-assessed over time to determine an increase or decrease in function. Videos of animals moving or demonstrating restricted functions were captured and stored whenever possible.

The Houston Zoo used a class four, multiwave locked system (MLS) laser4 to treat seventeen zoo patients over a four month period in 2012. The two primary indications for treatment were lameness/joint pain, and wounds. Though the application of multiple therapies at once makes assessment challenging, a positive result of laser therapy was observed in eight of seventeen patients, with the majority of the positive responses seen in wound patients, rather than lameness/joint pain patients.

The Houston Zoo has treated four patients with autologous stem and regenerative cells (SRC) to improve joint health (a leopard [Panthera pardus], a Malayan tiger [Panthera tigris jacksoni], and a North Sulawesi babirusa [Babyrousa celebensis]) and to reduce immune mediated inflammation (one lion, Panthera leo). The SRC were prepared using a commercial point-of-care systemb that enables processing of adipose tissue, and re-administration of cells within ninety minutes and one anesthetic event. Again, while the application of multiple therapies at once makes assessment challenging, the joint patients demonstrated improved mobility within one
A week of treatment and appeared to have improved mobility for the projected duration of effect for SRC administration (approximately nine to twelve months). Two of these patients have had repeated administration of SRC over time and no patients have demonstrated adverse effects.

The Houston Zoo has treated two patients with extracorporeal shockwave therapy (ESWT) to improve joint health and mobility. During ESWT, energy is delivered to a focal point into tissues (up to 10 cm in depth), causing mechanical microstress in cells, resulting in modulation of inflammatory, angiogenic, and osteogenic proteins that assist the natural healing process. Both patients (Malayan tiger, leopard) underwent three anesthetic episodes two to four weeks apart for ESWT treatment. Improvement in gait and function was observed within a week following the third treatments in both animals, though both underwent a combination of therapies, which makes individual assessment of this treatment technique challenging.

Chiropractic adjustments are precise movements at a specific angle with a controlled force aimed at restoring the normal biomechanics and function of the vertebrae or joint. Acupuncture is one type of traditional Chinese medicine that has been in practice for over 4,000 years. Acupoints are stimulated with dry needle acupuncture, laser acupuncture, acupressure, aquapuncture, electroacupuncture, and/or moxibustion. They are very specific points throughout the body that have been correlated with treating certain conditions to help the body restore balance and heal itself. At the Houston Zoo, thirteen current patients, Nigerian dwarf goats (Capra hircus hircus, n=5), a llama (Llama glama), a guinea hog (Sus scrofa scrofa), a North Sulawesi babirusa, a Malayan tiger, a leopard, a black and white ruffed lemur (Varecia variegata variegata), a chimpanzee (Pan troglodytes), and a komodo dragon (Varanus komodensis), have had chiropractic adjustment and ten patients are undergoing routine acupuncture therapy, either via acupuncture laser\(^a\) (tiger, leopard, lemur, and babirusa) or traditional acupuncture needles (goats, llama). Treatment is performed by a consulting veterinarian certified in veterinary acupuncture and veterinary chiropractic techniques. Minor subluxations and rotations that were not palpable by standard veterinary assessments have been detected and corrected in several animals (goats, llama, guinea hog, and anesthetized tiger) and have resulted in significant clinical improvement. Over time, the frequency of chiropractic adjustments and acupuncture treatments decreases in most animals as they return to more normal conformation and function. Thus far, zoo patients not under anesthesia have been accepting of the acupuncture treatments and often relax or become sleepy during treatment.

In addition to oral joint supplements, nonsteroidal anti-inflammatory medications, and other oral analgesics, the advanced treatment modalities described above should be considered in zoo patients with chronic musculoskeletal pain. Careful assessment of the patient and overall health status is critical, as is open communication between the veterinary staff and the animal care staff on expectations and follow-up care. As zoo veterinarians, it is our responsibility to provide the highest standard of care for our animals, including the understanding and utilization of both new and centuries-old technologies.

\(^a\) Cutting Edge Veterinary Lasers, 350 Turk Hill Park, Fairport, NY 14450. [www.celasers.com](http://www.celasers.com)

\(^b\) ARCTM system, InGeneron, Inc., Houston, TX

\(^c\) MODEL Pointer Pulse hand held pulsed Laser and pulsed T.E.N.S., Lhasa OMS, Inc., Weymouth, MA USA
CIRCULATING IMMUNOGLOBULIN G IN A HEALTHY POPULATION OF NEONATAL BOTTLENOSE DOLPHINS (*Tursiops truncatus*)

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Abstract

The passive transfer of immunoglobulins is considered a crucial component of cetacean neonatal health.7 Like the bovid, equid, and suid families, the cetacean family has epitheliochorial placentation, which prevents transfer of immunoglobulins from the dam to the fetus in utero.3,9-11 The predominant immunoglobulin in colostrum from animals with this type of placentation is immunoglobulin G (IgG).1,2,6,8 Failure of passive transfer (FPT) of IgG can therefore predispose cetacean neonates to life-threatening infections. Dolphin calves with FPT require immediate and intensive veterinary care to help increase chance of survival. Early identification of passive transfer status is critical in reducing morbidity and mortality in neonates. No assay for the fast identification of successful passive transfer in bottlenose dolphins currently exists.

In this study, 79 serum samples, collected between 2002 and 2009, from six Navy bottlenose dolphin calves were used to establish normal IgG reference intervals for calves 0-48hrs and >7d to 1 year old using a custom quantitative bio-layer interferometry assay.5 There was a significant, positive linear association between calf age and IgG levels (P < 0.0001, R²=0.73). Predicted IgG levels for healthy calves in this population may be calculated using the following equation: IgG = 906 + (39.764 x age in days). IgG reference intervals for calves 0-48h (n=8) and > 7d to 1y (n=69) old were 62-406 and 1,303-5,550 ug/ml, respectively. These newly established reference intervals can aid in standardizing and validating rapid, pool-side tests to identify FPT in neonatal bottlenose dolphins.

ACKNOWLEDGEMENTS

The authors would like to thank the trainers, veterinary technicians, and veterinarians at the Navy Marine Mammal Program, including the U.S. Army Animal Care Specialists, for their assistance with the treatment and care of the animals. A special thanks to Cynthia Smith, Linda Archer, Jim Wellehan, Jennifer McGee, Chris Dold, and Meg Sutherland-Smith for their professional advice and assistance. Funding for this project was provided by the US Navy Marine Mammal Program through the National Academy of Sciences, National Research Council.

LITERATURE CITED


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Abstract

Neonatal mortality is a recognized concern in cetaceans, both under professional care and in the wild.1-3 Traditionally, medical intervention for intensive neonatal care has been hampered by the aquatic environment, anatomic challenges, and physiologic adaptations. Advancements in cetacean medicine now allow for an enhanced standard of care and although underreported in the literature, some successful neonatal interventions exist. Here we describe care of a male,13 kg, bottlenose dolphin calf (Tursiops truncatus) born to a primiparous dam after an uncomplicated labor. The calf was vibrant upon delivery, but was immediately rejected and traumatized by the dam. Immediate intervention and restraint allowed for physical examination, blowhole suctioning, oxygen supplementation, blood analysis, wound treatments, antibiotic and fluid administration, weight and measurements, and ultrasonography. Colostrum and milk were collected from the dam under manual and voluntary restraint for 6 days. The calf was fed a combination of the dam’s milk and supplemental formula via a gastric tube (18 Fr, 16” red rubber) at hourly intervals for 3 months, at which time the frequency was gradually decreased. The calf’s caloric needs were assessed daily based on weight and utilized to calculate feedings. Intensive care was continued daily to monitor systemic health (blood sampling, topical wound care, daily weights, etc.). The calf was originally housed alone in a 3,800 gallon pool and later transitioned to a medical pool with visual and auditory access to 2.5 other dolphins. Presently at 6 months of age, the calf continues to thrive, with routine examination, ultrasound, radiography, gastroscopy, and blood sampling to monitor health.

LITERATURE CITED

USE OF IMPLANTABLE LOOP RECORDERS TO MONITOR FOR CARDIAC DISEASE IN CAPTIVE GORILLAS (GORILLA GORILLA GORILLA)

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Abstract

Cardiac disease is the leading cause of death in captive male Western Lowland gorillas (Gorilla gorilla), accounting for nearly 45.7% of deaths in this population.1 Implantable Loop Recorders (ILRs) are valuable for monitoring cardiac disease in humans, and have been used in chimpanzees.1 They provide a continuous electrocardiogram (ECG) trace, detect cardiac arrhythmias, and measure daytime and nighttime heart rate (DHR, NHR) and heart rate variability (HRV). In this study, Reveal XT ILRs were placed in three male gorillas, 13-15 years of age; implants were interrogated biweekly, and data was analyzed for a two yr period. One gorilla had an average DHR of 65 bpm, an average NHR of 49 bpm, and HRV of 207. This individual was being treated with Lisinopril and Carvedilol during the study period, and had 4 episodes of early-morning bradycardia (HR<30 bpm). The remaining two gorillas had average DHR of 74 +/- 1.0 bpm and average NHR of 65 +/- 1.0 bpm, with HRV of 99 and 108. One of these received the same medications during the study period, and the other had regular episodes of supraventricular tachycardia, with rates around 188 bpm. There are three male gorillas from other institutions that have had ILRs for variable periods. Two of these, ages 10 and 13 yrs, had lower average DHR (40, 54 bpm) and NHR (47, 51 bpm) and higher heart rate variability (223, 139). A 27 yo male had an average DHR of 39 bpm and NHR of 33 with HRV of 284.

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The authors thank the Great Ape Heart Project for their support of the comprehensive study of heart disease in great apes. In addition the authors also thank the Primate Staff at the Detroit Zoo, for their commitment to training great apes for these and other veterinary procedures. Thanks also go to the Veterinary team at the Detroit Zoo.

LITERATURE CITED

EVALUATION OF WHOLE BLOOD TRANSFUSIONS IN RED-EARED SLIDERS
(Trachemys scripta elegans)

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Abstract

The efficacy of homologous and heterologous whole blood transfusions for treating acute blood loss in reptiles was evaluated in red-eared sliders (Trachemys scripta elegans). Sliders were divided into three groups: in group 1, turtles were bled 1.5% of their bodyweight, and left untreated; in group 2, turtles were bled as described above, then transfused with cross-matching-compatible homologous blood 48 hours later at 1.5% of their bodyweight; in group 3, turtles were bled as described above, then transfused with cross-matching-compatible heterologous blood from Chinese striped-neck turtles (Ocadia sinensis) 48 hours later at 1.5% of their bodyweight.

Body temperature (BT) and heart rate (HR) were closely monitored during transfusions. Packed cell volume (PCV), hemoglobin (Hb), red blood cell (RBC) count, white blood cell (WBC) count, and ratio of immature RBC were monitored in all sliders once a week for 15 weeks. There were no significant differences found in the value of PCV, RBC, and Hb between the homologous and heterologous transfusion groups at each time point. Nevertheless, in contrast to the heterologous group, PCV, RBC, and Hb in the homologous group recovered faster to the values before being bled.

In conclusion, whole blood transfusion from a heterologous donor of the same family provides similar clinical therapeutic effect with that from a homologous donor. However, heterologous blood transfusion may still arouse immune response, which seemed delayed due to lower metabolic rate in reptiles. The authors feel cross-matching is mandatory before either homologous or heterologous transfusion.
COAGULATION PROFILES IN NOVEL SPECIES: A RESEARCH AND DIAGNOSTIC TOOL FOR ZOO AND AQUATIC ANIMAL MEDICINE

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Abstract

Veterinarians specializing in nondomestic species are faced with unique challenges regarding research and diagnostic capabilities given the wild and sometimes dangerous nature of their patients. Standard diagnostic techniques used in small or large animal practice are not always possible due to anatomical constraints, size, tractability, or the inherent risk of anesthesia in highly valued, rare species. Diagnostic modalities that utilize simple, relatively non-invasive techniques show promise in evaluating nondomestic species and elucidating the pathophysiology behind poorly characterized disease processes in both wild and captive populations. Coagulation profiles which may include prothrombin time, partial thromboplastin time, d-dimer concentration, platelet counts, fibrinogen concentration, and thromboelastography (TEG) are frequently used in domestic species for evaluation of various disease processes including neoplasia, sepsis, trauma, inflammation, toxin exposure, and envenomation.1-3,6 Coagulation tests are also used to monitor response to drug therapy and may provide prognostic information. Few studies on coagulation profiles have been published on nondomestic species despite several reports of coagulopathies in both wild and captive species.4,5,7-16 Recent investigation utilizing tests for coagulation have discovered a correlation between hypercoagulation and manatee cold stress syndrome. Further, coagulopathies are suspected to occur in other specific disease syndromes observed in rhinoceros and several primate species based on ante- and postmortem published reports.4,10,12 Although the general process of coagulation is largely conserved between mammals, subtle differences occur which have a significant impact on test interpretation and our subsequent understanding of normal and abnormal physiology. Clinicians should consider coagulation testing as part of the diagnostic work-up in nondomestic species.

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LITERATURE CITED


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THERAPEUTIC PLASMA CONCENTRATION OF EPSILON AMINOCAPROIC ACID IN THE NORTHERN ELEPHANT SEAL (Mirounga angustirostris)

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Abstract

Drugs that inhibit fibrinolysis, such as epsilon aminocaproic acid (EACA), are a potential novel therapy for hemostatic disorders of zoological species. Although, to our knowledge, anti-fibrinolytic drugs are not commonly applied in zoo medicine, they are of increasing interest in human and companion animal medicine to prevent bleeding due to surgery, trauma, and other causes.1,5,6 One potential application of EACA is treatment of Northern elephant seals (NES) with Otostrongylus arteritis, a hemorrhagic diathesis associated with aberrant larval migration of Otostrongylus circumlitus.3,4 Therapeutic plasma concentration of EACA varies across species, from 5.82 μg/ml in horses up to 130 μg/ml in humans, necessitating investigation before the drug can be usefully and safely applied to a novel species.2,7 Citrated plasma from 25 healthy NES pups was collected and pooled for use in this study. An in vitro model of hyperfibrinolysis using thromboelastography (TEG) was adapted for NES plasma from previously published protocols.2,7 Increasing doses of tissue Plasminogen Activator were added to pooled NES plasma to achieve complete, rapid fibrinolysis as documented by TEG. Fibrinolysis was then inhibited by adding increasing doses of EACA. We used the TEG parameter of Estimated Percent Lysis (EPL) to indicate degree of fibrinolysis, and performed regression analysis of the arcsin square transform of EPL against EACA concentration, to estimate the minimum concentration of EACA required to completely inhibit fibrinolysis for 30 minutes after maximum clot strength was reached (EPL=0%). This analysis yielded an estimated therapeutic EACA plasma concentration of 85 μg/ml (95% confidence interval = 73.8 – 96.8 μg/ml).

LITERATURE CITED

AZA: COMMITTED TO SUSTAINING HEALTHY POPULATIONS

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Abstract

Caring for wildlife and wild places is a priority of the Association of Zoos and Aquariums. To meet this mission, AZA is committed to implementing best practices in animal health, welfare and animal management to sustain wildlife populations both in managed care and in the wild. Recognizing the need for an organized effort to address the many issues threatening our wildlife populations, AZA has launched several new initiatives and programs. There is a need for active involvement from all AZA members to achieve our mission. These programs include AZA’s Saving Animals from Extinction (SAFE) Initiative (which includes a focus on population sustainability), and an AZA Zoo and Aquarium All-Hazards Preparedness, Response, and Recovery (ZAAHP) Fusion Center. There are important roles for animal health professionals in all of these programs.
INSTITUTIONAL RISK ANALYSIS: A SMARTER BASIS FOR PRESHIPMENT TESTING AND QUARANTINE ELIMINATION?

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Abstract

Improvements in preventive medicine, disease eradication, pathology programs, and our understanding of diseases in zoos should make us question the current AZA / AAZV standards for quarantine and the extent of preshipment testing. Institutional risk analysis (based on a comprehensive pathology program with 30 years of data) was used at San Diego Zoo (SDZ) and SDZ Safari Park to eliminate quarantine (1994) and transmissible disease testing (2006) of animals transferred between the two institutions. In order to determine whether risk analysis could also be used for outside institutions, we reviewed quarantine mortality and morbidity data (risk of transmissible disease importation) and compared outgoing preshipment testing results with collection necropsy data (risk of transmissible disease exportation) at San Diego Zoo (2009-2013). No mammal failed quarantine due to a transmissible disease risk to the collection over the five-year period. The few birds and herps that failed from a transmissible disease risk were those accepted from sources without comprehensive pathology programs and no preshipment testing (e.g. non-AZA institutions, private breeders, confiscations). Both outgoing preshipment testing and necropsy data at SDZ showed no risk of transmissible disease exportation during the same period. Where risk analysis indicates, preshipment examinations could eliminate testing for transmissible diseases that the sending institution’s pathology program shows are unnecessary, and quarantine could be eliminated at the receiving institution. Resources currently spent on unnecessary quarantine and preshipment testing could then be more appropriately directed (e.g. pathology program, new arrival acclimation).
SUSTAINABILITY: IT’S MORE THAN INCREASING POPULATION NUMBERS!

Yvonne Nadler DVM MPH1*, Yvette Johnson-Walker DVM MS PhD1, Johanna Briscoe VMD Dipl ABVP (Avian)2, and Steve Olson3

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Abstract

The Association of Zoos and Aquariums spends a great deal of time tackling the issue of population sustainability. AZA professionals are dedicated to maintaining and increasing the numbers of animals in our collections through careful planning. However, there are other key components to sustainability. What if there was an outbreak of a Foreign Animal Disease that threatened our collections? What if a disease was detected in wildlife or agricultural species close to your zoo? How would that impact the day-to-day operations of your facility? Is it possible that disease management would involve quarantine, preventing movement of animals for breeding? And finally, the most frightening aspect: is it possible that depopulation of genetically valuable zoological specimens would be required to manage a disease outbreak? This talk will focus on unique sustainability concerns in the face of disease threats. Templates from other animal industries will be introduced which could serve as models for a unified approach to zoological sustainability in the face of Foreign Animal Disease outbreaks.
FAILURE TO REPRODUCE, WHO’S INVITED?

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Abstract

Reproduction is a multifactorial event, and reproductive success depends on many aspects of that animal’s history, environment, and health. Therefore, investigating infertility needs a multilayered, multidiscipline approach. It is rare that a condition with a simple solution is responsible for reproductive failure. As veterinarians, we are inclined to look for disease and evaluate the animal’s husbandry if there is a health issue. Environment can also have a profound impact on reproduction, even if the animals are otherwise healthy, and should be evaluated at the same time as the animal. Hormone monitoring is a diagnostic tool that provides longitudinal data that can help understand the problem of infertility, but is only one tool and should be used in conjunction with extensive communication to fully elucidate where the breakdown in reproduction might be occurring. Animal managers, reproductive specialists and veterinarians all have a crucial part to play in developing a plan for challenging cases. A diagnostic plan may contain evaluation of the male, via physical exam, blood parameters, semen and sperm assessments, and evaluation of the female including physical exam, blood parameters, hormone monitoring and possibly imaging (ultrasound, radiography, etc.), as well as an evaluation of the social situation and the behavior of the male and female towards each other. Other factors such as nutrition, appropriate management, and potential treatments to mitigate infertility should also be included in the plan. Maximizing reproductive potential of an individual needs input about the direct environment, general health, reproductive parameters, nutrition, etc. Therefore, input should always come from within the institution (keepers, animal managers, veterinarians) but may also need a consultant (reproductive specialist, nutritionist, behaviorist, imaging specialist, taxon specialist, and/or SSP advisor). Including all the stakeholders at the institution is a way of increasing the information input to solve the problem.

Acknowledgements
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GERIATRIC ANIMAL CARE AND END OF LIFE DECISION-MAKING IN ZOOLOGICAL INSTITUTIONS

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Abstract

Geriatric animal care management and end of life decision-making has become increasingly important with animals aging beyond median life expectancy1 in zoological institutions. Managing health of older animals involves considerations for “welfare” and “quality of life.” Veterinary hospice, with its focus on relieving pain and anxiety, while also preparing “family” for end of life, has potential application in zoo settings.2,3 In fall 2013, Disney’s Animals Science and Environment (ASE) held a seminar to address challenges encountered with geriatric animal care and end of life decision-making. Seminar goals were to provide the best possible care for animals, and provide resources and communication tools for staff. The seminar included pre-meeting homework, a half day workshop for managers and veterinarians, and a full day workshop for keepers. Both workshops covered common terminology, quality of life assessments, end of life decision-making process, and grief management. Keepers also attended lectures on geriatric animal medical conditions, drug and alternative therapies, nutrition, and husbandry techniques. After the seminar, action items were identified to improve geriatric animal care as well as communication around end of life decision-making. The benefit of such efforts have proven to be much more than revived enthusiasm in and attention to geriatric animal care at Disney. There has been more focus on improved communication and clarification of expectations between all levels of animal care staff and management. This multi-disciplinary, cooperative project offers an example of one way to improve animal care and help staff relations at any zoological facility housing geriatric animals.

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LITERATURE CITED

THE ROLE OF MANAGEMENT EUTHANASIA IN POPULATION SUSTAINABILITY AND ANIMAL WELFARE

David M. Powell, PhD*

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Abstract

The recent, highly publicized cull of a giraffe at a European zoo has brought the practice of management euthanasia, or culling, to the forefront. But this practice was already being discussed more in recent years as zoological associations around the world are realizing that many of their animal populations are not sustainable for the future. There are also emerging data that suggest that AZA populations could be healthier with more regular breeding, but this presents challenges when space is limited. Addressing the challenges of long-term sustainability and fertility management will require as diverse a toolbox as possible. Management euthanasia could play a role in managing populations to ensure fertility, behavioral skills, genetic diversity, and demographic stability, but it is undoubtedly one of the most difficult tools to implement for a number of reasons and involves inherent, difficult trade-offs. However, if zoos and aquaria are to deliver on their missions of managing animal populations over the long term for conservation, education, recreation and research, culling may have to be implemented more widely. In this talk, I’ll cover what we know about culling practices in zoos, the philosophical approach the AZA takes to culling, rationale and scenarios for its use, keeper attitudes about the practice and how AZA institutions could prepare themselves for this practice. Veterinarians will clearly have a role to play in the implementation of this tool and interactive discussion is therefore encouraged.
SOCIAL CHANGES, COMMUNICATION CHANNELS, AND MEDIA CREATE NEW CHALLENGES FOR INSTITUTIONS WITH ANIMALS IN PROFESSIONAL CARE

Jill Allread

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Abstract

Animal care experts in zoological institutions around the globe are increasingly subject to public scrutiny and even criticism as activist groups that oppose the public display of animals intensify their campaigns to influence public opinion. Critics of zoos and aquariums are using social media campaigns and content such as the documentary “Blackfish” to reach key audiences like educators, students and elected officials and encouraging the public to oppose keeping animals in zoos and aquariums and marine parks.

This rapid culture change influences the need for veterinarians to take an active role in communicating about their work. Heightened public interest in animals and their welfare is leading to veterinarians in zoos and aquariums being increasingly called upon to talk publicly about animal welfare issues, animal care practices, veterinary treatment and euthanasia.

Today institutions are asking their veterinarians to be key spokespersons with print, broadcast and social media -- such as in web blog or in videos on You Tube -- on topics that include animal deaths, which until the mid-1990s were generally not of interest to media. Also veterinarians are being interviewed by reporters, many who are more closely scrutinizing the care and welfare of zoo and aquarium animals. 1Veterinarians can best prepare to navigate these changes by understanding the issues and knowing how to communicate about their critical work that ensures animal well being and quality care.

LITERATURE CITED

POLAR BEARS IN A CHANGING CLIMATE

Gregory Thiemann, PhD*

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Abstract

Anthropogenic global warming is occurring more rapidly in the Arctic than elsewhere, and has already caused significant negative effects on sea ice-dependent species such as the polar bear. In this special presentation, Dr. Gregory Thiemann, Faculty of Environmental Studies at York University in Toronto, will discuss recent and ongoing research on the effects of climate change on polar bears, their habitat, and their prey. Although climate change is ultimately expected to negatively affect polar bears throughout their circumpolar range, the timing, magnitude and precise nature of climate-driven effects are difficult to predict. Nevertheless, quantitative estimates of the rate and magnitude of population declines are often required before meaningful conservation action can occur. Polar bears are likely to become more imperiled in the coming decades and specific ecological factors make polar bears especially sensitive to climatic changes. Among the most profound changes in Arctic ecosystems are expected reductions in the availability of marine mammals, the primary prey of polar bears. Reduced foraging opportunities will ultimately reduce the ability of individual polar bears to survive and reproduce. However, gaps in our understanding of polar bear-habitat relationships create opportunities for ex situ research that will be critically important for understanding, and conserving, polar bears in the wild.
UNDERSTANDING NATURAL URSID PHYSIOLOGY WITH TRAINED ANIMALS

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Abstract

Hibernation is a remarkable feat of extreme metabolism that results in a radical departure from the normal homeostasis that is seen in most mammals. Adapting research methods to understand this complex process in the bear can be quite challenging. Anesthesia is often used to obtain measures when studying wild animal biology. This is particularly troubling for cardiovascular physiology interpretation as anesthesia profoundly affects cardiac responses. The cardiac phenotype of the hibernating grizzly bear (*Ursus arctos horribilis*) was recently described using captive, trained animals to avoid the confounding effects of drugs. This study revealed unique differences that had not been previously assessed using anesthetized animals. For example, heart rate was mildly elevated by the anesthetic protocol during the active period but dramatically increased during hibernation over that of bears that were not anesthetized. Parameters of left ventricular systolic performance were impaired to a greater extent by anesthesia in the summer but less so in the winter. In contrast, anesthesia appeared to have greater depressive effects on diastolic filling cardiac parameters during hibernation. Thus the effect of a drug protocol on cardiac function is discordant from one season to another. The striking effect of hibernation on atrial chamber ejection was only identified when unanesthetized bears were studied. These bears have since been trained for various research projects. Endocrine rhythms including cortisol and melatonin rhythms are also profoundly affected by common anesthesia protocols. When possible, using trained animals can avoid erroneous interpretation of results and shed immense light on native physiology understanding.
DEVELOPING FIELD RESEARCH AND ZOO COLLABORATIONS TO PROMOTE POLAR BEAR (*Ursus maritimus*) CONSERVATION

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Abstract

Studies of wildlife populations in the absence of parallel controlled, captive research greatly constrains our ability to understand animals in the wild. Improved communication and collaboration between zoos and field researchers will build significant capacity towards understanding and helping to conserve wild populations. Although there has been increasing interest in conducting research in zoos, most studies to date have been conducted by zoo staff on behavior and with relevance largely to the captive setting. Thus, we are often missing opportunities to develop studies of captive animals with relevance to their conservation in the wild. This paper will highlight a recent collaboration with field research biologists and staff of the Alaska and Oregon Zoos to conduct a series of polar bear studies needed to improve our understanding of how wild populations are responding to sea ice loss. Beyond the original expected outcomes of the collaboration, this joint project proved to provide a wide range of benefits to the zoo, the research organization, and importantly to our understanding of polar bears and their long-term conservation. This paper will outline the keys to successful collaboration as a template to encourage similar future joint work. It will also outline and discuss the reasons why this collaboration was extremely valuable and beneficial to the species of interest in captivity and in the wild, as well as to the organizations involved.

LITERATURE CITED

THE USE OF MEDICAL TRAINING TO FACILITATE FIELD RESEARCH COLLABORATION IN POLAR BEARS (*Ursus maritimus*)

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Abstract

Operant conditioning has been utilized by many zoos to achieve voluntary behaviors in many species to allow physical exams, biomaterial collection, and other medically-indicated procedures without anesthesia or sedation. Polar bears (*Ursus maritimus*) present a relatively unique challenge, given their size and potential danger they pose to staff. Oregon Zoo has been utilizing large training cages that are fitted with adaptable apertures and a head cage to safely allow voluntary oral and body part exams, tooth-brushing, fluorescein-staining, ophthalmic medication administration, foot radiographs, fur clipping, dermatologic diagnostics, hyposensitization (allergy) injections, blood collection, and intravenous anesthetic induction. We have noted positive improvements in some blood parameters in voluntary sampling. Intravenous inductions have resulted in improved quality of anesthesia and recovery periods. This level of training has allowed for the evaluation of techniques being employed or considered in polar bear field research in a setting where diet and activity can be controlled. As a result, our polar bears have been involved in two recent studies. Our female bear has been trained to accept an accelerometer collar, providing the opportunity to quantify energetic costs of known behaviors in a captive setting and assess the accuracy and dependability of the accelerometers for wild bears. Second, dependable blood sampling and other biomaterial collection (hair samples) allowed researchers to measure the incorporation of dietary carbon and nitrogen isotopes into hair and blood of our polar bears while consuming controlled diets, allowing for the estimation of blubber and protein content in wild polar bear diets.
POLAR BEARS: HOW EX-SITU RESEARCH CAN ANSWER IN-SITU QUESTIONS

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Abstract

Zoos have often used the phrase “Ambassador for the species” to refer to particular animals or species they hold in their resident populations. While this terminology has continued to evolve, it is meant in part to point out the important role these animals can play in bringing awareness to the plight of their counterparts and their counterparts’ habitats in the wild. A prime example of this is the polar bear (Ursus maritimus). They are an amazingly popular visitor attraction in the Zoo setting. On a larger scale, and in the context of their role as “Ambassador”, their popularity, if properly utilized, has immense potential to bring about public awareness of the eminent dangers that climate change is having on their Arctic climate, melting sea ice, and their ultimate survival in the wild. By peaking public interest, captive polar bears can not only stimulate better public understanding of climate change, but ideally motivate actions to become more “green” in daily practices, reducing our carbon footprint, and potentially impacting the survival or their wild counterparts at some level.

Another emerging role captive polar bears are playing that has great potential for impacting their wild counterparts is through inclusion in collaborative research studies. A number of noninvasive studies that have included data from captive polar bears have been designed and conducted to help field scientists predict how polar bears will react to a changing Arctic climate, and to develop technologies to better study them in the wild. Collaborative working relationships between national and international field scientists, zoological institutions, and groups such as USFWS (U.S. Fish and Wildlife Service), USGS (U.S. Geological Service), and PBI (Polar Bears International) are increasing and are certainly proving to be fruitful endeavors. Auditory studies have helped further knowledge of maternal denning disturbance issues.² Olfactory studies are looking into the possible effects of a how fractured ice surface affects the ability of bears to find each other during breeding season in a vast and harsh environment.³ Other ongoing studies are looking at gene regulation in response to environmental factors,¹ and the potential for West Nile virus infection in wild polar bears in a warming Arctic climate (Ongoing study- Polar Bear SSP, Shellabarger). Additionally, techniques developed for assisted reproduction in other species are being developed for polar bears to enhance captive reproductive efforts and a sustainable captive assurance population should one be needed in the future (On-going study- Polar Bear SSP, Roth).

Polar bears are large, formidable animals, not generally thought of as good candidates for non-invasive or minimally invasive sampling or manipulations. Many of the projects mentioned above have shown that with the ingenuity and creativity of Zoo and animal staff, captive polar bears can safely be accessed and will willingly participate, providing valuable information. The collaborations between zoos, zoo veterinarians, field researchers and their affiliates, while not without obstacles, has proven very promising for polar bear research and should be fostered in an effort to gain more knowledge and a better understanding of the species as a whole.

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LITERATURE CITED
INFECTIONOUS PATHOGENS AND RESISTANCE TO DISEASES RELATED TO URSIDS: ARE MICROPARASITES A FACTOR IN THE URSID THREATENED SPECIES MANAGEMENT PLANS?

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Abstract

The Carnivora comprise 15 families and they are identified as one of the mammal groups most threatened by infectious agents. However, in the case of Ursids different authors have suggested that members of this family have a high resistance to infectious diseases and therefore infectious disease wouldn’t be relevant for their management. In order to verify the relationship between microparasites (virus, protozoa and bacteria), susceptibility to infection and clinical disease in Ursids, a literature review was conducted.

Reports were found documenting susceptibility to infection by 43 different pathogens and disease by at least 65 clinical reports and 20 pathogens, with viruses being the most common pathogen type associated with clinical cases. Although these reports mostly document individuals being affected rather than wild populations, it is very important to take infectious diseases into account for ex-situ and translocation management programs. Thus, biosecurity and preventive plans may be established for selected microparasites as an important issue for captive bear populations and translocation programs. In conclusion, further studies about the relationship of infectious pathogens and Ursid family may be conducted.

LITERATURE CITED
EVOLUTION IN GIANT PANDA (*Ailuropoda melanoleuca*) CONSERVATION: THE GROWING INTEREST IN HEALTH AND DISEASE SUSCEPTIBILITY

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Abstract

The giant panda, a flagship species for animal conservation, has been studied extensively over the past 15 yrs with *in situ* emphasis on evaluation and improvement of habitat and *ex situ* focus on reproduction and enhanced management. Wild giant pandas are fragmented into 35 subpopulations with a significant proportion now protected with 65 reserves. Panda densities within the larger populations appear to be increasing, but fragmentation is greater due to increased road and hydropower construction. Science based captive management has resulted in a population explosion from 120 pandas in 1998 to more than 370 individuals distributed globally today, a self-sustaining population managed from within China. With reproductive success and cub survival vastly improved, Chinese conservation efforts now are focused on successfully introducing pandas into existing or restored habitat. This priority has elevated concerns about diseases. Chinese colleagues are keenly interested in health issues that date back to findings from a major biomedical survey of giant pandas in the late 1990s. However, now the new linkages between *ex situ* and *in situ* activities re-emphasize that there is still much to be learned about giant panda health and disease susceptibility and transmission, including among feral and native species within shared wild habitat. Projects will address these priorities to help further ensure sustainability of the captive population while protecting wild giant pandas (and other species) during reintroductions/translocations. Especially important are international collaborations building veterinary capacity while beginning to fully understand disease sensitivity of this endangered species and reduce risks associated with moving animals.
“TWIN SWAPPING” A TECHNIQUE DEVELOPED FOR THE SUCCESSFUL REARING OF GIANT PANDA TWINS

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Abstract

The captive population of giant pandas has soared over the last 10 years. In 2002 there were 152 animals in 19 institutions and as of November 2013 there were 375 animals in 72 institutions. The genetic diversity of the captive population is 97.4%. This dramatic change has been due in part to improved husbandry practices and increased cub survival rate. Giant panda cubs are altricial and rely heavily on proper maternal care for survival. Even though the birth of twin cubs is not uncommon, the dam can normally only care for one cub, resulting in the death of the second one unless there is human intervention. In July 2013 giant panda twins were born at Zoo Atlanta. The zoo’s staff, in cooperation with Chinese colleagues from the Chengdu Research Base of Giant Panda Breeding, Chengdu, China, implemented a “twin swapping” technique to assist the dam in successfully rearing both cubs. This technique allowed for the rotation of cubs between the dam and nursery. The cubs’ birth weights were 99.1 and 145.3 grams and they were born within 2 minutes of each other. The giant panda nursery had been set-up prior to the expected birth window. Within a few minutes of birth, the second cub born was removed from the birth den and taken into the nursery for examination. Within 2 hours, the first cub was then also removed from the dam to be examined and the second born was returned to the dam. Initially, this pattern of swapping the cubs was done every 1-1.5 hr. During the first week the incubator temperature and humidity were 95°F (35°C) and 55-65% respectively. As the cubs grew and their ability to thermoregulate improved, these settings were adjusted and were aimed at maintaining a body surface temperature between 96.8-99.5°F (36-37.5°C). Over the following weeks the interval between cub swaps was increased and was dictated by the cubs feeding habits and weight gains. Every time a cub was in the nursery, it was stimulated to urinate and defecate and weights were recorded at the time they were removed from the dam and immediately before being returned to the dam. Formula supplementation was started on day 83, at which time the cubs’ body weights were 3,285 and 3,475 grams. The daily formula supplementation average was 1-2% of their body weight and the decision on when to start formula supplementation was made based on a decreased rate of growth as compared to previous cubs. The formula used consisted of Esbilac®a (12.5 grams), Enfamil® (Gentlease)b (12.5 grams) and water (75 mls). Between days 85 and 230 the cubs’ weights were below their siblings at a similar age, but by day 231 the weights were similar to their siblings, all of which had been exclusively mother reared. Even though “twin swapping” is an intense and time consuming endeavor, it has the great advantage of raising both cubs on maternal milk during the first few months. It also allows for proper social interaction between dam and cub.
The target population for giant pandas in captivity is 500 animals in order to maintain 90% genetic diversity for 200 years. Given the great improvements in the management of this species in captivity the future of the captive population appears bright.

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**ACKNOWLEDGEMENTS**
The authors would like to thank the entire Zoo Atlanta staff for their support and understanding during the rearing of the giant panda cubs. We are also grateful to the staff at the Chengdu Giant Panda Research Base.

**LITERATURE CITED**
ANIMAL WELFARE AND BEHAVIOR: OPPORTUNITIES TO THRIVE

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Abstract

The Association of Zoos and Aquariums (AZA) Accreditation Standards require each institution to develop a “clear process for identifying, communicating, and addressing animal welfare concerns within the institution in a timely manner, and without retribution.” This requirement leaves it up to each institution how to comply. The strategy that San Diego Zoo Global (SDZG) is using to comply with this requirement is described here. It is based on our desire to ensure that each animal under our care has the best life possible. The guiding principle for implementing the strategy is that it uses a comprehensive, evidence-based approach to go beyond personal opinions and perceptions in order to achieve an objective assessment. The process is grounded in our strategic plan which specifically calls out that animal health and welfare is our top priority.

The Animal Welfare Panel is a small, cross-functional team of animal care experts (a total of seven scientists, veterinarians, and curators), which unifies all animal welfare activities across our facilities. It is advisory to the Chief Life Sciences Officer and curators and has no regulatory authority of its own. This team provides management tools and high-level organizational support for curators and produces consistency for animal welfare programs throughout our organization.

The Panel promotes the collection of evidence-based metrics to inform the Curatorial/Collection staffs’ development of best practices and animal care standards. The metrics include input variables, i.e. natural history and animal management standards and output variables, such as reproductive success, behavioral diversity, and other positive and negative indicators of animal welfare. Behavioral research is one tool that we can use to measure those outputs. Behavioral research often includes the following: behavioral indicators of welfare; behavioral monitoring; and specific research projects used to examine applied aspects of animal care. Findings from behavioral research can be used to develop a data base for making evidence-based decisions about animal care.

The Panel responds to real issues and concerns using science-based evaluations. The system is designed to encourage responsible reporting, ideally through their supervisor as the first option. The concerns are submitted through a process that allows anonymity and encourages the submitter to use evidence to justify the concern. The format also encourages the submitter to offer solutions that are evidence-based. Submissions are prioritized based on urgency, and recommendations are made in a timely, transparent, and deliberative manner using a system designed to be trusted by both the administration and the animal care staff. The Panel looks for effective and realistic solutions, and works to develop an organizational culture that ensures animal welfare is always considered in decision-making processes.
The Animal Welfare Panel program for ensuring animal welfare is operationalized by the San Diego Zoo Global’s “Opportunities to Thrive” (derived from and expanding upon the current ‘five freedoms’ developed in the United Kingdom) and used as a tool to evaluate specific questions as they relate to each individual’s welfare.

1. Opportunity for a well balanced diet - Fresh water and a suitable, species specific diet will be provided in a way that ensures full health and vigor, both behaviorally and physically.
2. Opportunity to self-maintain - An appropriate environment including shelter and species specific substrates that encourage opportunities to self-maintain.
3. Opportunity for optimal health - Providing supportive environments that increase the likelihood of healthy individuals as well as rapid diagnosis and treatment of injury or disease.
4. Opportunity to express species-specific behavior - Quality spaces and appropriate social groupings will be provided that encourage species specific behaviors at natural frequencies and of appropriate diversity while meeting social and developmental needs of each species in the collection.
5. Opportunities for choice and control – Providing conditions in which animals can exercise control and make choices to avoid suffering and distress, and make behavior meaningful.

By establishing this evidence-based framework, we hope to join with other institutions in developing an innovative approach to measuring welfare. This should enable us all to identify areas of excellence and best practice, as well as areas in need of attention. Sharing the dynamics and wonders of the natural world through our thriving animal collection - with our organizational and professional peers, our animal care staff, and our guests - will be one of the most significant results of these efforts. This will become a foundational cornerstone of our continuing pursuit of organizational excellence and best practices in animal welfare.

LITERATURE CITED
MANAGEMENT OF BEHAVIORAL DISORDERS IN ZOO PRIMATES: TWO CASES AT MELBOURNE ZOO

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Abstract

We review veterinary management of two cases of behavioral disorders affecting primates at Melbourne Zoo. Each case required that we develop a system for monitoring progression of disease and/or response to therapy, in order to guide management and outcomes.

Case 1: delirium post-infarct in a gorilla (Gorilla gorilla gorilla)

A 49 year-old female gorilla presented with acute onset of mental confusion, nystagmus and bilateral upward gaze palsy. A neurocognitive deficit appeared likely, and differential diagnoses included development of a dementing illness and complications following transient ischemic incident (TIA). Over the next 12 weeks, clinical signs were monitored using simple tests that assessed social behaviors, short-term memory, thinking and planning ability, and awareness of environment. The tests suggested gradual improvement over a 3-month period, and a diagnosis of post-TIA delirium was made. At subsequent euthanasia, changes consistent with previous cerebral hemorrhages confirmed the diagnosis.\(^1\)

Case 2: anxiety disorder in a mandrill (Mandrillus sphinx)

A young male mandrill began demonstrating abnormal behaviors when two years of age. These increased in frequency and intensity, and included spinning, apparently involuntary limb movements, constant hand movements, and self-mutilation.

The clinical diagnosis was anxiety disorder with compulsive behaviors. The management plan included a training program focused entirely on rewarding calm behavior, enclosure modifications that allowed escape from any anxiety-inducing situations, and use of anti-anxiety medications (20 mg fluoxetine PO SID or 15 mg mirtazapine PO SID).

A simple monitoring system was used to assess response to therapy. The traffic signal system was based on a scale that may be used by children for emotional self-monitoring during cognitive behavior therapy.\(^2\) A “mood diary” provided basic assessment of overall anxiety level each day, and allocation of red (high intensity) days, amber (medium intensity) days and green (low intensity) days enabled keepers to monitor clinical progress over a nine-month period. The diary indicated that some clinical improvement had occurred during mirtazapine therapy. However, severe compulsive behaviors persisted at a high frequency. The mandrill was euthanized, having been assessed as having a poor quality of life.

LITERATURE CITED

RESULTS OF THE 2012-2013 MEGAVERTEBRATE ANALGESIA SURVEY: ELEPHANTS AND RHINOCEROS

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Abstract

Megavertebrate analgesic choices are based largely on anecdotal information. To examine current practices, an online survey utilizing the AAZV listserv was conducted from September 2012 through March 2013. Compiled data included; signalment, drugs administered, dosing regimens, efficacy (subjectively scored), ease of administration, and adverse events.

Thirty-eight facilities exhibited Asian (Elephas maximus) or African (Loxodonta africana) elephants and 33 exhibited White (Ceratotherium simum spp.), Black (Diceros bicornis spp.), or Indian (Rhinoceros unicornis) rhinos. Non-steroidal anti-inflammatories were administered to elephants and rhinos at all facilities. Phenylbutazone (0.25 - 10 mg/kg) and flunixin meglumine (0.2 - 4 mg/kg) were administered most commonly, followed by ibuprofen (0.8 - 8.5 mg/kg, to elephants only). Good to excellent efficacy was reported for ibuprofen. In elephants, six adverse events (gastrointestinal bloat or colic) were reported (30% associated with carprofen). In rhinos, adverse events were mild gastric ulceration and taste aversion.

Opioid drugs were administered to elephants at nine facilities and to rhinos at six facilities. Tramadol (0.5 - 2 mg/kg) was used most commonly, followed by butorphanol (0.05-0.2 mg/kg). Tramadol efficacy scores were highly variable in both elephants and rhinos. Butorphanol had good efficacy. Adverse events included drowsiness and decreased fecal production.

Other modes of analgesia included: glucosamine/chondroitin sulfate, gabapentin, corticosteroids, local anesthetics, low level laser therapy, alpha-2-adrenergic agonists, and omega 3/6 fatty acids.

This survey showed drug choices were similar among institutions, but significant variability in dosing regimens and efficacy exist. Further research to improve analgesia for these species is warranted.
EXERCISE AND HEALTH IN ASIAN ELEPHANTS (*Elephas maximus*)

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Abstract

Inactivity has been recognized as a major factor in behavioral stereotypies and health problems in captive Asian elephants (*Elephas maximus*).1 Besides weaving and digestive problems, lack of exercise can lead to overweight body condition, reduced muscle mass, and chronic degenerative joint disease in many species, including the Asian elephant.2,3

The current study measured the biomechanics of nine trained and less trained female Asian elephants during exercise. The age range was 14 – 54 years. Training status was categorized objectively by training hours and subjectively by the opinion of the elephant manager. Portable force plates and a specialized capturing and analyzing software were used to measure forces acting on the distal extremities. Results showed that large forces act on the musculoskeletal system of the Asian elephants during the normal gait, especially on the joints of the distal extremities. Differences in forces acting on distal extremities in relation to body weight were seen between trained and less trained elephants. Well-trained elephants had better control over their weight distribution, which reduced the stress on their joints during exercise.

Thus, captive management of Asian elephants should promote regular training programs, stimulating elephants to move and exercise every day. It is important to respect the ability and preferences of an individual animal. Individual training programs should train all musculoskeletal regions for various topographic environments and situations. An appropriate body weight, intact foot conformation, good foot health, and physical fitness are required to cushion forces and reduce the biomechanical stress on the extremities’ articulations.

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We like to thank P. Habegger, Habegger Maschinenfabrik AG, Thun, Switzerland for their expertise and providing the specialized measuring equipment.

LITERATURE CITED

PSYCHOTROPIC DRUG USE IN CAPTIVE WILD ANIMALS

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Abstract

While a limited amount of data has been published regarding the use of the psychotropic drugs in animals commonly kept in zoo environments, that does not mean that the enormous amount of data that does exist regarding these drugs cannot be cautiously extrapolated to help improve the lives of zoo animals. The mammalian brain in particular is remarkably similar from taxon to taxon, so with a knowledge of the neurotransmitters that most affect behaviors and the drugs that most affect those neurotransmitters, appropriate drug choices can be made to assist in improving the welfare of some individuals. While drugs should never be expected to make up for a poor or inappropriate environment, they can be very helpful for animals that are exhibiting maladaptive or malfunctional behaviors regardless of the inciting cause.

Introduction

A minimal amount of peer reviewed research data has been published on the use of psychotropic drugs in wild animals and what has been published is mostly in the form of occasional case reports. However, many of these drugs have been in development for decades and much research exists on their use in a variety of different species, including non-human primates. Veterinary behaviorists have used many of these drugs successfully in pets over the past 20 years by extrapolating what information we do have about their use in humans and laboratory animals. While much remains to be learned about the exact mechanism of these medications, the fact is, they do help improve the quality of life for many animals when used in a rational manner.

So what is the most rational manner in which to use these medications? The first and probably most important thing we can do is to change our “mind set” about psychotropic drugs. We need to stop thinking of psychotropic drugs as something that we will use to “change behavior” but rather as a tool that can be used to help put an animal in a state of mind where it can learn. Most animals with problem behaviors are, for a variety of different reasons, experiencing some degree of anxiety or fear. The ability to learn can be seriously impaired when an animal is in a constant state of anxiety. Decreasing anxiety with medication, gives us the opportunity to use behavior modification to teach animals alternative behavioral responses or use desensitization and/or classical conditioning to change their response to particular fear, anxiety, or stress inducing stimuli.

To ensure the greatest safety for an animal being prescribed a psychotropic drug, a complete blood count and serum chemistry profile should always be performed first. While evidence of the drugs causing organ dysfunction is rare, if an animal had a pre-existing condition that was not yet diagnosed, administration of the drugs could potentially exacerbate it.
Neurotransmitters

Psychotropic drugs are believed to produce their behavioral effects due to their actions on different neurotransmitters in the central nervous system. The neurotransmitters that are particularly pertinent to behavior and behavioral problems are gamma-amino-butyric acid (GABA), glutamate, acetylcholine, norepinephrine (noradrenaline), dopamine, and serotonin.

GABA is an amino acid neurotransmitter that is synthesized from glutamate. GABA neurons are the major inhibitory neurotransmitter in the brain and are widely distributed throughout the central nervous system where they serve important regulatory functions associated with vigilance, anxiety, muscle tension, memory and epileptogenic activity. Benzodiazepines and barbiturates are examples of drugs that act on GABA neurons.

Acetylcholine is the most widely distributed neurotransmitter. Cholinergic neurons are excitatory neurons with pathways distributed throughout the central and peripheral nervous system. Muscarinic cholinergic synapses are found in smooth muscle, cardiac muscle, peripheral autonomic ganglia, and parasympathetic post-ganglionic synapses. Nicotinic cholinergic synapses are found at the neuromuscular junction. Blockade of muscarinic cholinergic receptors is responsible for atropine-like side effects of the antipsychotics and tricyclic antidepressants: dry mouth and eyes, urine retention, constipation, mydriasis, cardiogenic effects (tachycardia), and increased intraocular pressure.

The monoamine neurotransmitters, catecholamines and indoleamines, are related by their chemical structure. These neurotransmitters are concentrated within the hypothalamus, midbrain and limbic system and are stored within vesicles in the axons and nerve terminals. They are primarily inactivated by reuptake at the synaptic cleft, so drugs that block or inhibit their reuptake increase their availability and activity.

The catecholamine neurotransmitters include norepinephrine, epinephrine and dopamine. These neurotransmitters generally produce CNS stimulation. A large portion of the brain’s dopamine is located in the corpus striatum where it modulates the part of the extrapyramidal pathways concerned with coordinated motor activities. Dopamine levels are also high in some regions of the limbic system. Dopamine depletion or inactivation occurs as a result of administration of tranquilizers, neuroleptics or antipsychotics and leads to behavioral quieting, depression and extrapyramidal signs. Excess dopamine release is caused by administration of amphetamines, apomorphine or methylphenidate and has been associated with the development of stereotypies.

Norepinephrine is formed by the hydroxylation of dopamine. Centrally, norepinephrine is stimulating and is postulated to affect mood, the functional reward system and arousal. Peripherally, norepinephrine is the post-ganglionic neurotransmitter of the sympathetic nervous system. Excess noradrenergic activity has been associated with mania, while norepinephrine depletion is associated with depression.

The indoleamine neurotransmitters include serotonin, and melatonin. These neurotransmitters are synthesized from dietary tryptophan. Serotonin, also known as 5-hydroxytryptamine (5-HT) receptors are found predominantly in the brain and act primarily in an inhibitory manner both
pre- and post-synaptically. Different receptor subclasses are responsible for modulation of sleep-wake cycles, mood, and impulse control. 5-HT receptors are widely distributed throughout the brain and much is still being learned about the far reaching effects of this important neurotransmitter. There is growing supporting evidence for the role of serotonin in aggression. Impaired synthesis or metabolism of serotonin has repeatedly been found to be associated with increased aggression.\textsuperscript{1,11,15} Dogs diagnosed with aggression have lower levels of 5-HIAA (a serotonin metabolite) in their cerebrospinal fluid than control dogs.\textsuperscript{14} An inverse correlation between levels of 5–HIAA in the CSF and a history of aggression has been found repeatedly in human, primate and laboratory studies.\textsuperscript{7,10,19}

Monoamine oxidase is an enzyme that metabolizes norepinephrine, dopamine, and serotonin. Monoamine oxidase inhibitors such as selegiline cause elevation in monoamine neurotransmitters by inhibiting this enzyme.

Once you have a general understanding of the neurotransmitters and their basic effects, it is simplest to speak of the psychotropic drugs by class as most classes are defined by the neurotransmitters they effect. Knowledge of the general effects of the different neurotransmitters, then helps you to understand the drug effects and why we use them as we do, as well as why the drugs have the side effects they do.

**Benzodiazepines**

Benzodiazepines are one of the most widely prescribed drugs in the world. They work by facilitating the transmission of GABA in the central nervous system. The primary functions for which we use benzodiazepines in veterinary medicine are: Reducing muscle movement and anxiety and controlling seizure activity.

Generally speaking, benzodiazepines have a rapid onset of action with effects that can last a variable period of time, generally under a day. Clinicians should use caution when giving benzodiazepines to animals that may be aggressive as they have the potential to lead to disinhibition of aggression.\textsuperscript{3} To confound matters however, in laboratory studies, they have been shown to increase affiliative behaviors in some species such as rhesus macaques and they have been found to have a taming effect in some species.\textsuperscript{5,6,16} At low doses, benzodiazepines have a calming, anti-anxiety affect and at higher doses they may be sedating. Paradoxical excitation seems to be a relatively common problem noted when prescribing benzodiazepines in dogs, but we haven’t documented the use of these drugs enough in other species to know how common that may or may not be in other species. If it occurs, generally, we recommend increasing the dose by 25-50% and giving another test dose after the excitation of the first dose wears off. If excitation occurs again, then switching to a different benzodiazepine can be tried before abandoning use of the class completely in that individual. Due to the possibility for paradoxical excitation, it is ideal for a “test dose” of a benzodiazepine to be given at a time when a caretaker can observe the patient for a few hours and when the animal can be separated from its social group for a while, if it is safe to do so. Obviously, depending on the individual you are treating, the problem and the particular environment, it may be safer to switch drugs immediately if you have a paradoxical reaction. This is a decision that must be made by the clinician on a case by case basis.
There are many different kinds of benzodiazepines ranging in duration of action from 3 hours (alprazolam) to 10 hours (clorazepate). When treating pets, benzodiazepines are often just given 30-60 minutes prior to the occurrence of a fear-inducing event. When the events that are disturbing to a particular patient cannot be predicted, a regular dosing regimen should be established.

Benzodiazepines do have the potential to produce addiction, so after long term use in an animal, the dose should be decreased slowly (25-30% per week) in order to prevent problems when stopping the drug. Tolerance to the drug is also common, so clinicians should be prepared to increase the dose when the animal must be on it for an extended period of time.

Benzodiazepines are highly protein bound and hypoproteinemia will lead to an increased volume of distribution. They are metabolized in the liver and excreted by the kidneys, so their use should be avoided if liver or kidney disease exists. Idiopathic hepatic necrosis has been documented in cats receiving diazepam, so you may wish to avoid its use completely in felids. However, there is limited evidence to suggest other benzodiazepines are particularly dangerous to cats and many of them are used safely in practice on a regular basis. In laboratory studies, clonazepam specifically has been found to be substantially less toxic to cats than chlordiazepoxide, diazepam or flurazepam. Other side-effects of the benzodiazepines include, ataxia, muscle relaxation, increased appetite, anxiety, hallucinations, muscle spasticity and insomnia. Contraindications for the use of most benzodiazepines also include glaucoma, pregnancy and lactation.

Benzodiazepines can be very useful when employing multimodal drug therapies, as they can be safely used with other maintenance medications such as SSRIs and SNRIs.

<table>
<thead>
<tr>
<th>Medication</th>
<th>Dog dose</th>
<th>Cat dose</th>
<th>Useful information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alprazolam (Xanax)</td>
<td>0.02-0.1 mg/kg q 4h</td>
<td>0.0125-0.25 mg/kg q 8h</td>
<td>Minimal active metabolites Rapid onset of action</td>
</tr>
<tr>
<td>Clonazepam (Klonopin)</td>
<td>0.1-0.5 mg/kg q 8-12h</td>
<td>0.015-0.2 mg/kg q 8h</td>
<td>Extensive liver metabolism but less toxic to cats</td>
</tr>
<tr>
<td>Diazepam (Valium)</td>
<td>0.5-2.0 mg/kg q 4h</td>
<td>0.1-1.0 mg/kg q 4h</td>
<td>Multiple active metabolites Short half life; May potentiate organophosphates</td>
</tr>
<tr>
<td>Oxazepam (Serax)</td>
<td>0.04-0.5 mg/kg q 6h</td>
<td>0.2-1.0 mg/kg q 12-24h</td>
<td>No active metabolites Slower onset but longer duration of action</td>
</tr>
</tbody>
</table>

**GABA Analogues**

These drugs work on voltage-gated calcium channels to prevent calcium influx which inhibits the release of excitatory neurotransmitters such as glutamate. This action helps to block pain, increase the seizure threshold and decrease anxiety. Gabapentin is the drug most often used in veterinary medicine. Pregabalin is also available but is still on patent and therefore much more costly. Side-effects are infrequent. Withdrawal associated seizures are reported in humans so taper use of this medication as a precautionary measure. Avoid the use of the commercial liquid human formulation as it contains xylitol.
Selective Serotonin Reuptake Inhibitors (SSRIs)

Selective serotonin reuptake inhibitors (SSRIs), work by blocking the serotonin transport transport system (SERT) and as the name implies, this lead to increased levels of serotonin in the synaptic cleft while having minimal effects on other neurotransmitters. With prolonged administration, down regulation of post-synaptic auto-receptors also occurs. The SSRIs are classified as antidepressants, however, they have anxiolytic, anticompulsive and some antiaggressive effects as well. They contribute to mood elevation and calming, with minimal sedation and no impairment of learning.

When pet owners report side effects of the SSRIs, anorexia and sedation are the most common. In most cases, the side effects decrease with time and they almost always disappear completely if the medication is discontinued. Other side effects that have been noted in a variety of species are: constipation, diarrhea, urinary retention, anxiety, irritability, agitation, tremors, insomnia, and decreased libido. Again, these virtually always disappear with discontinuation of the drug.

Serotonin syndrome is a condition that has been reported in humans taking excessive quantities of medications that increase serotonin levels or other medications that are incompatible with the SSRIs, at the same time as SSRIs. Signs may include: tachycardia, tremors, ataxia, restlessness, seizures, vomiting, nausea, hypotension or hypertension and sudden death. At this time, no case of serotonin syndrome in a pet being treated with psychotropic drugs has been documented so it is very difficult to say how problematic it may be in any non-domestic species. To avoid serotonin syndrome, medical records need to carefully document ALL medications AND nutraceuticals or supplements being given to an animal. For example, supplements such as St. John’s Wort and L-tryptophan work by increasing levels of serotonin, so these types of products could potentially lead to serotonin syndrome if their use goes unnoticed.

The SSRIs should not be used on an as needed basis. They should be given for at least 6-8 weeks to take effect before considering stopping the drug. At that point, if there are no negative side effects, adding an adjunctive drug may be more practical than stopping the SSRI and restarting another drug that may take 6-8 weeks to take effect. The SSRIs should not be given to animals receiving selegiline, amitraz dips (or Certifect) or thioridazine. While the use of these products may be uncommon in the zoological setting, an awareness of these contraindications could be important. Treatment with fluoxetine should not be started until 2 weeks after discontinuation of selegiline or amitraz treatment. Due to the long half-life of fluoxetine, treatment with selegiline should not be started until 5 weeks after the discontinuation of fluoxetine. The use of SSRIs should also be avoided in geriatric patients or those with kidney or liver disease, diabetes, glaucoma and in pregnant or lactating females. Caution should be used in prescribing them to breeding animals because of the potential for decreased libido. The SSRIs are strongly bound to plasma proteins so their use when prescribing other drugs that bind to plasma proteins should be avoided. Care should be used if administering SSRIs with tricyclic antidepressants (TCAs), carbamazepine, haloperidol and benzodiazepines as lower doses of these medications will be required.
The SSRIs are not addictive but gradual withdrawal is recommended. In case of overdose with an SSRI, treatment is supportive.

Table 2 Typical oral doses of two of the more commonly used SSRIs.

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dog dose</th>
<th>Cat dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluoxetine (Prozac)</td>
<td>1.0-2.0 mg/kg once daily</td>
<td>0.5-1.5 mg/kg once daily</td>
</tr>
<tr>
<td>Paroxetine (Paxil)</td>
<td>1.0-1.5 mg/kg once daily</td>
<td>0.5-1.5 mg/kg once daily</td>
</tr>
</tbody>
</table>

**Serotonin and noradrenaline reuptake inhibitors (SNRIs)**

These drugs increase the amounts of both serotonin and noradrenaline available at the synaptic cleft by inhibiting reuptake. As with SSRIs, down regulations of autoreceptors will occur with prolonged administration, thereby increasing efficacy. These drugs also have anticholinergic and antihistaminic effects and act as α-1 adrenergic agonists. TCAs are the most commonly used SNRIs in veterinary medicine and include amitriptyline, clomipramine, desipramaine, doxepin and imipramine. Clomipramine is available in a veterinary formulation Clomicalm® approved for the treatment of separation anxiety in dogs, so has receive much use in the veterinary field in the last 10 years.

SNRIs are used for the same behavior problems as SSRIs, should be administered long-term as a maintenance medication and are given orally once or twice daily. Because of their anticholinergic, antihistaminic and α-1 adrenergic agonistic effects, there can be pronounced side effects which include cardiac arrhythmias, decreased blood pressure, constipation, urine retention, gastrointestinal signs and sedation. As with SSRIs, SNRIs should be used with caution in animals already receiving other medications that affect serotonin levels. TCAs and SSRIs have been shown to artificially lower laboratory thyroid values so these should be interpreted with caution if evaluated in an animal that has been receiving these medications for more than a few weeks.

Although not addictive, gradual withdrawal is recommended when using these medications.

**Serotonin antagonist-reuptake inhibitors (SARIs)**

Trazodone is classified as a SARI. At lower doses, it antagonizes serotonin, histamine and α-1 adrenergic postsynaptic receptors. At higher doses it blocks SERT (serotonin transporter) and antagonizes additional postsynaptic serotonin receptors. Recent research indicates that it may also modulate GABA revealing a mechanism of action separate from that of SSRIs and SNRIs. Trazodone is rapidly absorbed, reaching peak plasma levels 1 hour after administration and is therefore appropriate for both PRN and maintenance use. There is some evidence that trazodone works synergistically with SSRIs and SNRIs and ongoing research in dogs for treatment of anxiety indicates that it is well tolerated. As with SSRIs and SNRIs, SARIs should be used with caution in animals already receiving other medications that affect serotonin levels. Trazodone is used to treat insomnia in people and has been suggested for use in addressing the sleep cycle changes seen in cognitive decline.

In dogs, a common starting dose for trazodone is about 2-3 mg/kg as needed. The dose can be slowly increased up to a total of 7 mg/kg every 12 hours, depending on the problem and what
other medications the animal is taking. Trazodone has been used in cats at doses ranging from 12.5–50 mg per cat as needed.

Azapirones

Buspirone is the main drug from this category used in veterinary medicine. It is often used as an augmentation drug in conjunction with a primary maintenance medication such as an SSRI. It is a serotonin 1A partial agonist and an antagonist of dopamine receptors. It has an anxiolytic effect. It takes 6 weeks or more before reaching maximum effect and is short acting, requiring twice or three times daily dosing. One interesting side effect noted is increased social behavior in cats and this effect deserves more study in other species.3 Buspirone side effects are very uncommon but in some cases may include dizziness, insomnia, nervousness, nausea, headache fatigue and mania. Buspirone may take several weeks to take effect but is safe for use in geriatric and pregnant patients. It should not be given with MAOIs and caution should be used if giving with erythromycin or itraconazole. The dose for treating cats with buspirone is 2.5-7.5 mg/cat every 12 hours or 0.5-1.0 mg/kg every 12 hours. Treat dogs with buspirone at 0.5-2.0 mg/kg every 8-24 hours.

Monoamine oxidase inhibitors (MAOIs)

MAOIs interfere with the action of monoamine oxidase A & B which are the primary enzymes responsible for the breakdown of multiple catecholamines including serotonin, dopamine, adrenaline and noradrenaline. Increasing these substances should lead to an elevation of mood. Selegiline is the MAOI most often used in the United States. The effects of MAOIs are more extensive than just neurotransmitters. They affect many systems in the body and as such should be used with caution in combination with other drugs. Selegiline is licensed for use in cognitive decline in dogs in the United States and for other behavior disorders in Europe.2,8 It has some effect on anxiety, but because of its delayed action and restricted use in combination with other medications, it is used less in the US for behavioral problems not associated with cognitive decline.

α-2 adrenergic agonists

Clonidine is an α-2 agonist used in humans for the treatment of hypertension, attention deficit hyperactivity disorder (ADHD), post traumatic stress disorder (PTSD) and impulsivity. It works by blocking norepinepherine release from α-2 receptors on presynaptic neurons. A single study showed that clonidine is efficacious in the treatment of canine anxiety.12 Clonidine takes 1-2 hours to take effect and lasts for approximately 6 hours. Side effects are rare but the drug should be used with caution in animals with cardiac conditions, as it can cause hypotension.

Antipsychotics

Antipsychotic agents include the phenothiazine tranquilizers, acepromazine and chlorpromazine and the butyrophenones, haloperidol and azaperone. These agents block the action of dopamine. Dopamine depletion results in behavioral quieting, depression and extrapyramidal signs (EPS). EPS are Parkinsonian like-symptoms such as difficulty initiating movements, muscle spasms,
motor restlessness, and increased muscle tone resulting in tremors and stiffness. In addition, the blockade of dopamine receptors effects brain regions responsible for controlling thermoregulation, basal metabolic rate, emesis, vasomotor tone and hormonal balance. Antipsychotics also produce a state of decreased emotional arousal and a relative indifference to stressful situations. With chronic use, tardive dyskinesia may develop as a result of up regulation of dopamine receptors. This is an inability to control movements and hyperkinesis. Chronic side effects can occur after as little as three months of treatment and are potentially irreversible even after discontinuation of the medication.

Although their effects can be quite rapid, the use of these drugs can produce very inconsistent results, especially when used to treat aggression. They have actually been known to increase aggressiveness in animals with no known history of aggression. Due to their wide-ranging dangerous side-effects and the availability of several safer and likely more efficacious choices, these drugs should not be the first choice of behavioral drugs in any animal species.

Conclusion

While much remains to be learned about the role of the different neurotransmitters on behavior and the effects of the psychotropic drugs, for more than 20 years these drugs have been used successfully to decrease suffering in many animals. With careful extrapolation, the newer, safer drugs such as the SSRIs, the SNRIs and the SARI s should be used more frequently and older classes of drugs such as the antipsychotics only used as a last resort when treating problem behavior in captive wild animals.

LITERATURE CITED
BALAMUTHIA MANDRILLARIS IN A WESTERN LOWLAND GORILLA (Gorilla gorilla gorilla)

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Abstract

Amoebic encephalitis caused by Balamuthia mandrillaris is an emerging disease of importance for both humans and other mammals, including many non-human primates. The opportunistic free-living pathogenic amoebic organism is thought to be acquired through the respiratory tract, nasal passages, or breaks in skin; however, much about this disease’s pathogenesis remains unknown. Infections are usually fatal and present a diagnostic challenge for both human doctors and veterinarians because of the lack of specific clinical signs and non-invasive antemortem diagnostics.

A 22-year old male Western lowland gorilla presented for vague clinical signs in August 2013, which progressed to severe neurologic disease over the course of 10 days despite treatment and supportive care. Gross necropsy revealed hemorrhagic foci within the brain, multifocal tan nodules within the kidneys, and regionally extensive tan areas within the pancreas. Histopathology revealed necrotizing meningoencephalitis and vasculitis with intraleional amoebic organisms. Similar organisms were also identified in granulomatous lesions of the kidney, pancreas, and eye. Immunohistochemistry and PCR analysis of tissue samples confirmed the identity of the organism as Balamuthia mandrillaris.

There have been over 150 reported human cases of this disease worldwide since 1986, although the actual incidence may be higher. Although there is no agreed upon course of treatment, the investigational drug, miltefosine, has shown promise and is available through the CDC. Increased awareness of this disease in both veterinary and human medicine has highlighted the importance of collaboration between multiple fields in order to learn more about the biology and pathology of the Balamuthia mandrillaris organism.

ACKNOWLEDGEMENTS

We give sincere appreciation to Drs. Atis Muehlenbachs, Alexandre Dasilva, Yvonne Qvarnstrom, and Lindy Liu with the Infectious Disease Pathology Branch and the Parasitic Diseases Branch at the Centers for Disease Control and Prevention for their assistance and cooperation with this case.

LITERATURE CITED

BEST PRACTICES FOR THE CARDIAC NECROPSY: TIPS FOR CLINICIANS (AND PATHOLOGISTS) PERFORMING APE NECROPSIES

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Abstract

Cardiovascular disease is a significant cause of mortality in all of the captive ape species and has even been diagnosed in some wild gorillas and chimpanzees. Historically, post-mortem cardiac evaluation has been performed by numerous independent prosectors using varying protocols. While this allows diagnosis of an individual case, the lack of standardization hinders analysis of data across populations as lesions and measurements can vary depending on sampling site. Standardized necropsy protocols are critical for collecting data which can be compared within and among species to accomplish the goals of the Great Ape Heart Project based at Zoo Atlanta, including a clinicopathological database to improve diagnosis, treatment and our understanding of cardiovascular disease in apes. In human medicine, there are agreed upon criteria and sections to examine in post-mortem evaluation of hearts. Much of this methodology is directly applicable to the study of cardiac disease in apes but is different from the techniques commonly taught in pathology labs during veterinary school. Therefore, the goal of this presentation is to introduce both clinicians and pathologists to best practices for evaluating ape hearts at necropsy. Both basic and more advanced protocols (see below rationale) will also be available in free downloads in both iBook and Android formats.

In preparation for the cardiac necropsy, the prospector needs to have available a digital camera, 1cm or greater ruler or size marker appropriate for use with photographs, a scale appropriate for weighing the heart, and a piece of string/twine in addition to tools and any diagrams needed for prosection. With the body in dorsal recumbency, open the chest cavity and before any tissues are sampled or manipulated, take a photograph of the heart in situ. After the pluck is removed, separate the heart from the lungs by cutting the major vessels 5cm from the base of the heart. Particular attention should be given to including both superior and inferior vena cava (these are often inadvertently lost). Flush out clots (ideally with saline but water can be used) and weigh the heart. Next, a series of photographs will be taken with a ruler in the image so that measurements can be determined. Place the heart with the anterior side and both auricles facing up and the apex at the bottom, such that the right auricle is on the left and the left auricle is on the right and take a photograph. Rotate the heart 90° to the left (left auricle is now facing the
camera) and photograph, rotate the heart another 90° to the left (posterior view) and photograph, and rotate the heart a final 90° to the left (right auricle is facing the camera) and photograph. Pick up the heart and take a photograph of the heart base (with the vessels facing the camera). Examine the heart for gross lesions and describe. To measure the circumference, wrap a string around the heart at the level of the coronary groove and then lay the length of string that outlines the circumference on a ruler.

At this point, the heart can be fixed and further sectioning deferred. If you wish to stop at this point, make a single transverse cut, perpendicular to the long axis, through the heart at 3cm (chimpanzees, orangutans and bonobos) or 4cm (gorillas) from the apex, rinse out any remaining clots, weigh the heart, and suspend the heart in formalin to fix. Suspension can be achieved by tying a string around the great vessels, or “building” a cradle of paper towel or a surgical bonnet. Both sections of the heart can then be submitted to the pathologist for further evaluation. At this point, the prosector must also choose whether the basic or advanced protocol will be followed. The basic protocol will sample key features of myocardium and valves, but does not circumferentially evaluate myocardium, or key aspects of the conduction system (sinoatrial node, atrioventricular node, bundle) or coronary arteries. The advanced protocol will provide this comprehensive evaluation (see below). If the basic protocol is chosen, the prosector may choose to continue with the cardiac examination. To continue with the prossection, lay the heart with the anterior side facing up and make repeated 1cm parallel transverse slices, perpendicular to the long axis (the posterior and anterior myocardium thickness will be equal) through the myocardium (continue to 3cm for chimpanzees, orangutans and bonobos and 4cm for gorillas) starting at the apex. On this final (mid ventricular) slice, mark the posterior wall (loop of suture, surgical staple, surgical ink or small notch). Photograph the 3 or 4 slices together and then fix the 3rd/4th slice in formalin.

The remainder of the heart should be opened along the lines of flow. Open the atrium from posterior vena cava to the auricle. Cut from the back (posterior side) of the right atrium into the right ventricle and out the pulmonary artery. Use string to measure the right atrioventricular (tricuspid) valve circumference. Photograph the inside of the right side of the heart with a ruler alongside the heart (not on the heart please!). Section the right atrium and ventricle with valve and fix in formalin. Using string, measure the circumference of the pulmonic valve. Next, open the left atrium from pulmonary vein to auricle and then make a single longitudinal cut perpendicular to this through the middle of the left ventricular free wall. Examine the left atrioventricular (mitral) valve and endocardium for lesions. Measure the left atrioventricular valve circumference using the string method. Photograph the inside of the left side of the heart with a ruler alongside the heart. Take a longitudinal section through the left atrium, atrioventricular valve and ventricle and fix in formalin. Cut through the mitral valve along the septum and into the aorta to open the aorta. Measure the aortic valve circumference using the string method. Take a longitudinal section of the septum from the aorta into the left ventricle and fix in formalin. Take a cross section (“donut”) of aorta 1.5cm from the aortic valve and fix. In addition to the cardiac portion of the necropsy, don’t forget to open the entire length of the thoracic and abdominal aorta and examine for lesions such as dissections and atherosclerosis. For the advanced protocol, taking sections of thoracic and abdominal aorta (regardless of whether lesions are present) is valuable for the GAHP.
The advanced protocol includes several more assessments that will provide valuable data for future GAHP analyses, and which may potentially provide critical diagnostic information in unexpected cardiac deaths. These assessments include: determination of vascular dominance (determining whether the right coronary or left circumflex branch of the left coronary artery feeds the apex), more detailed evaluation of the coronary arteries at multiple levels, and evaluation of the conduction system. Protocols for these procedures are detailed in the iBook and Android apps. Additionally, directions for post-fixation sampling and identification of standard blocks are also included so that pathologists are aware of which sections of submitted fixed tissues should be examined histologically. By standardizing our approaches in this way, we can establish reference ranges for each ape species, compare lesions within and among ape species, develop detailed consensus among pathologists on histological criteria for classifying lesions, and provide high quality data that can be used in future studies into the pathogenesis of ape cardiovascular disease.

ACKNOWLEDGMENTS
Funding and in-kind support was provided by many organizations and individuals, including: the Institute of Museum and Library Services National Leadership Grant (to the Great Ape Heart Project based at Zoo Atlanta Grant # LG-26-12-0526-12); Drs Hayley Murphy and Marietta Dindo-Danforth (GAHP), Cardiovascular Pathology Laboratory, CVM, TAMU; Brad Gilleland and the Educational Resources Center, College of Veterinary Medicine UGA; and Dr. William Foster and Birmingham Zoo Incorporated.

LITERATURE CITED
NO KIDDING: BRUCELLOSIS IN WAXY TREE FROGS, (Phyllomedusa sauvagii)

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Abstract

Several \textit{Brucella} species are recognized as pathogens in mammals, primarily affecting reproductive or locomotor systems.\textsuperscript{1} A newly recognized \textit{Brucella} sp. closely resembling \textit{Brucella inopinata}, has recently been isolated from abscesses in a big eyed tree frog \textit{Leptopelis vermiculatus}, and from the carcasses of African bullfrogs \textit{Pyxicephalus edulis}.\textsuperscript{1,2} This report describes the clinicopathologic and molecular features of brucellosis due to a \textit{Brucella inopinata}-like bacterium in 3 waxy tree frogs in a zoological collection. All cases had histologic features of abscess formation and/or sepsis. Clinical, gross and histologic features were similar to other primary bacterial infections of amphibians, including mycobacteriosis and chlamydiosis, emphasizing the importance of culture and pathologic investigation. \textit{Brucella inopinata} phenotypically resembles \textit{Ochrobactrum anthropi}, necessitating molecular sequencing for differentiation. \textit{Brucella inopinata} or a very closely related \textit{Brucella sp} appears to be a primary pathogen in frogs. \textit{Brucella inopinata} has been cultured from humans with typical symptoms of brucellosis.\textsuperscript{1} Transmission of \textit{Brucella spp}. from frogs or other animals to humans has thus far not been documented.

LITERATURE CITED

SUBSPECTACULAR NEMATODIASIS CAUSED BY A NOVEL Rhabdias SPECIES IN BALL PYTHONs (Python regius)

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Abstract

Diseases of the spectacle in snakes are common and include pseudobuphthalmos and subspectacular infections, due to bacterial, fungal or protozoal organisms or trauma.1 However, subspectacular nematode infections are very rare. Only one report exists of subspectacular nematodiasis caused by Rhabdias martinoi in wild grass snakes (Natrix natrix) from Russia.2 Subspectacular nematodiasis was diagnosed in captive-bred juvenile ball pythons (Python regius) from two unrelated facilities in Wisconsin and Virginia within a six-month period. The snakes presented with similar lesions, including swelling of facial, periocular and oral tissues. Bilaterally the subspectacular spaces were distended and filled with an opaque fluid, which contained adult nematodes and eggs. Euthanasia was performed and histopathology showed nematodes throughout the periocular tissue, subspectacular space and subcutaneous tissue of the head. The nematodes from both facilities were confirmed to be morphologically identical and most closely resembled Rhabdias species. PCR sequencing and morphological characterization indicate this is likely a previously undescribed Rhabdiasid nematode. The Rhabdiasidae are obligate zooparasitic nematodes with heterogonic life-cycles. The mulch substrate was suspected to be the most likely source of infection in the Wisconsin cases, since the snakes were hatched and kept in isolation by a breeder and full necropsies of feeder rodents and fecal exams of other adult snakes were negative for nematodes. This is the first report of subspectacular nematodiasis in captive snakes, caused by a novel Rhabdias species.

LITERATURE CITED

LATERAL DIGIT AMPUTATION AT THE PROXIMAL INTERPHALANGEAL JOINT IN AN OKAPI (Okapia johnstoni): SURGICAL TECHNIQUE AND OUTCOME

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Abstract

A 9-year-old male okapi (Okapia johnstoni) was examined by Tampa’s Lowry Park Zoo veterinary staff on 13 November 2012 for acute onset right thoracic non-weight bearing limb lameness. The animal reportedly injured himself on the fencing from the enclosure. The initial examination revealed crepitus and laxity of the right carpus when flexed mediolaterally. Radiographs revealed soft tissue swelling overlying the first row of carpal bones. Ultrasound exam showed tears in the latero-distal suspensory ligament. The animal was managed conservatively with bandaging, non-steroidal anti-inflammatories, and stall rest. On 11 February 2013, radiographs revealed mineralization of the abaxial and collateral ligaments between P2 and P3 of the lateral digit, periosteal exostosis and extensive mineralization of the torn suspensory ligament. Surgery performed on 21 February 2013 removed osteophytes and bony exostosis associated with the proximal interphalangeal joint, suspensory ligament and damage to the retinaculum. The animal remained clinically lame, and recheck radiographs on 19 July 2013 revealed recurrence of severe boney exostosis bridging the proximal interphalangeal joint. Due to concerns for quality of life, surgery for digital amputation with disarticulation at the proximal interphalangeal joint was performed on 2 August 2013. This technique was preferred over amputation at the distal mid-phalanx due to surgical access and suspected ease of post-operative management. Six months post-operatively, the okapi remained mildly lame, but was overall clinically improved. Limb salvage procedure can be adapted from domestic livestock to endangered species to provide higher welfare standards while maintaining opportunities for breeding.

ACKNOWLEDGEMENTS
The authors graciously acknowledge Tampa’s Lowry Park Zoo’s section curator and husbandry staff.
PERCUTANEOUS URETERAL STENT PLACEMENT FOR THE TREATMENT OF A BENIGN URETERAL OBSTRUCTION IN A SUMATRAN TIGER (*Panthera tigris sumatrae*)

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Abstract

A 15-year-old, 113 kg male intact Sumatran tiger (*Panthera tigris sumatrae*) was evaluated for weight loss, polydipsia and intermittent hematuria. Clinical laboratory testing demonstrated macro- and microhematuria, mild azotemia and an increased urine protein:creatinine ratio (0.97). Abdominal ultrasound revealed bilateral ureterolithiasis as well as hydronephrosis/hydroureter. As ureteral obstruction was diagnosed, treatment to relieve the obstruction via the use of ureteral stents was elected. The tiger was immobilized with ketamine (2 mg/kg), medetomidine (0.025 mg/kg), and midazolam (0.15 mg/kg) given intramuscularly via a remotely delivered dart. After the induction of anesthesia, an abdominal ultrasound scan was repeated and revealed worsening of the right-sided hydronephrosis and hydroureter and a decrease in the severity of dilation on the left side presumably from passage of the left-sided ureteral stones. A pigtail ureteral catheter (8.2 French x 56 cm) was placed in the right ureter via a percutaneous approach utilizing fluoroscopic-guidance. The catheter was left in place as an indwelling ureteral stent. Following stent placement, macrohematuria resolved although occasional microhematuria was noted. At follow-up examination six months after stent placement, the azotemia had mildly progressed but the urine protein:creatinine ratio was normal (0.5), the right hydronephrosis and hydroureter had resolved, and the ureteral stent remained in the correct position. The tiger also clinically improved with increased weight and activity level. Ureteral stenting provided a minimally invasive method of managing ureteral obstruction in the captive large felid of this report and could be considered in future cases due to the clinical improvement and low morbidity.

LITERATURE CITED

ABDOMINAL WALL RECONSTRUCTION IN A BROWN PELICAN (Pelecanus occidentalis)

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Abstract

Abdominal wall hernias are generally either congenital or acquired. Common etiologies in birds include obesity, endocrine abnormalities, trauma, and intra-coelomic masses.¹⁻⁷ Repair of hernias has been successful in various avian species, although most reports have been in smaller birds with minor defects.⁴⁻⁷ This case report describes the successful reconstruction of a large defect in the left abdominal wall of a wild brown pelican (Pelecanus occidentalis).

An immature brown pelican presented to the South Florida Wildlife Center with a large abdominal swelling, which was diagnosed as a hernia of the left abdominal wall. An initial unsuccessful attempt at repair found that there was no discernible remnant of the left abdominal wall, suggesting a congenital or traumatic etiology. Two months later the hernia was repaired using a polypropylene⁴ mesh implant. The absent abdominal wall was reconstructed by tacking the mesh to the linea alba, the epaxial muscles, and around the last rib and pubis. Nonabsorbable polypropylene⁵ suture was used in a simple interrupted pattern to secure the mesh in place. The subcutaneous tissues and skin were closed in a single layer using absorbable polydioxanone⁶ suture in a continuous pattern. Post-surgically an infection developed in the subcutaneous tissues at the surgical site. Exploration of the area confirmed that the mesh was not infected and was incorporated into a healthy granulation bed. After removal of infectious subcutaneous exudate, the patient recovered quickly and exhibited normal behavior in an outdoor enclosure. Three months later, the pelican was released off the east coast of South Florida.

ACKNOWLEDGEMENT
Thanks to Avery Bennett, DVM, MS, DACVS for his assistance with this abstract.

LITERATURE CITED
TESTICULAR SEMINOMAS IN TWO GIANT PANDAS (*Ailuropoda melanoleuca*)

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Abstract

Seminomas are a common neoplasm in domestic dogs, that arise from testicular germ cells in both cryptorchid and scrotal testicles. Although surgical castration is considered curative in most cases, seminomas have the potential to metastasize. A seminoma has been reported as an incidental finding in an American black bear (*Ursus americanus*), but is not well described. This case series documents two cases of testicular seminoma in aged giant pandas (*Ailuropoda melanoleuca*) in North American zoological institutions. The first case involves a 26 year old male giant panda, who presented with an enlarged, firm right testicle during routine examination. A fine needle aspirate of the testicle indicated a neoplastic process and a bilateral castration with subsequent histopathology revealed a seminoma of the right testicle. Surgical castration was believed to be curative, as no metastasis or evidence of recurrent seminoma was observed at necropsy 2.5 years later. The second case involves an approximately 24 year old male giant panda, who presented with a mildly enlarged, firm right testicle during a routine exam. Ultrasound revealed a hypoechoic nodule within the right testicular parenchyma, but a fine needle aspirate of the nodule was non-diagnostic. One year later, the testicle was markedly enlarged with a heterogeneous and hypoechoic mass relative to the remaining normal testicular parenchyma on ultrasound. A core biopsy was taken and indicated a seminoma. A hemicastration was performed and histopathology confirmed a seminoma, which replaced 90% of the testis. No signs of metastasis were noted at time of diagnosis.

LITERATURE CITED

SUCCESSFUL TREATMENT OF MANDIBULAR OSTEOMYELITIS IN TWO RED-NECKED WALLABIES (Macropus rufogriseus) USING LONG-TERM PHARMACEUTICAL THERAPY AND SERIAL MONITORING BY COMPUTED TOMOGRAPHY IMAGING

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Abstract

Mandibular necrobacillosis is a significant cause of morbidity and mortality of macropods and is frequently diagnosed in captive red-necked wallabies (Macropus rufogriseus).1 The prognosis for mandibular osteomyelitis in this species has been reported to be especially poor with only a 16% survival rate even after one year of treatment.3 Macropods are more susceptible to developing this condition when fed a poor quality diet (abrasive or poor quality forage) that results in oral trauma and when maintained in overcrowded environments.2 However, even animals with excellent husbandry and diet are commonly affected with this progressive disease. This report describes the successful treatment of mandibular osteomyelitis in two red-necked wallabies, which presented acutely with mandibular swelling, hypersalivation, and decreased appetite. Long-term parenteral antibiotic therapy with intravenous clindamycin (17-21 mg/kg i.v. q12h, 40 days) and high-dose benzathine penicillin G (80,000 IU/kg s.q. q12h, 150 days) was used in combination with serial computed tomography (CT) imaging to evaluate the response to treatment and resolution of disease. The animals tolerated extended hospitalization, intravenous catheters and daily treatment very well. The use of advanced imaging was integral to the animals’ successful treatment, as the osseous changes visible on CT were not visible on standard radiographs and guided therapeutic decision-making. The duration of treatment was dictated by serial CT assessments of osteolysis and resolution of lesions. Reports of cure with necrobacillosis in macropods are extremely rare. This report provides new therapeutic and diagnostic monitoring recommendations to assist clinicians presented with similar cases of mandibular necrobacillosis in macropod species.

LITERATURE CITED

NON-SURGICAL GASTRIC FOREIGN BODY REMOVAL IN A CALIFORNIA SEA LION (Zalophus californianus) USING A NOVEL DYNAMIC FLUSH-SUCTION-TILT METHOD

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Abstract

A 10-year old male California sea lion (Zalophus californianus) presented for removal of numerous small stones that had accumulated in the stomach. Two procedures were performed under anesthesia to remove the stones. The first used restaurant-grade plastic tubing (4.8/3.5cm external/internal diameter, 185cm long), within which a smaller tube (0.9/0.6cm, 190cm long) was placed, exiting through a hole made in the side of the larger tube. This tube combination was placed per os into the stomach. The small tubing was attached to a faucet and the larger tubing to a commercial wet/dry vacuum. Water was delivered continuously through the small tubing while suction was applied using the vacuum. The animal was placed in dorsal, ventral, and lateral recumbency, and was tipped head-down, but only a few stones were retrieved. For the second procedure, a similar technique was performed using a larger gauge tubing (6.3/5.1 cm external/internal diameter, 193cm long) and a larger tube for water delivery (1.9/1.3 cm diameters). In addition, the animal was placed on a custom-built table-top that could be tilted across a fulcrum approximately 60° in either direction. The animal was tilted tail-down, the stomach filled with water and the suction applied. While keeping the suction applied and water flowing, the animal was tilted into a head-down position to allow the stones to roll out of the tube into the vacuum. This process was repeated until no further stones were removed. This novel technique may be adapted for future attempts at gastric foreign body removal in large pinnipeds.

ACKNOWLEDGMENTS
Special thanks to the Mammal Department at the Bronx Zoo for assistance with these procedures and for construction of the tilt table.
EVALUATION OF NEONATAL OKAPI (Okapia johnstoni) MORTALITY AND ITS ASSOCIATIONS WITH EARLY DEFECATION

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Abstract

Captive breeding success of okapi (Okapia johnstoni) has improved over the past three decades with much about their reproduction and calf-rearing having been characterized.¹,² Retrospective analysis of okapi calves from North America and Europe evaluated neonatal mortality and risk factors, including frequency of defecation. Data were collected for 97 calves from eleven institutions from 1976-2013. The calves were born to 28 dams at an average 9 yrs old. Neonatal mortality in this study was 12.3%. The average age at first defecation was 43d; the median, 48d (range 0-93d). Early defecation (before 40d) was not uncommon (n = 35), including individuals where first defecation occurred before 20d (n = 22). In calves that did not survive (n = 12), however, average age at first defecation was 19d; median, 10d. Early defecation was described as a one-time occurrence in most calves (n = 26). A subset had episodic or recurrent defecation (n = 5) and progressive diarrhea (n = 4). No calves with progressive diarrhea survived. Neonatal mortality was most often due to viral enteritis (n = 3) and other gastrointestinal disorders (n = 3). Sick calves were often septic, highlighting the need for aggressive medical interventions to manage a debilitated calf. This study reinforces that delayed first defecation is normal in this species. Early defecation is often the first sign of a sick calf, but as a one-time event can occur in healthy calves.

ACKNOWLEDGEMENTS

The authors wish to thank participating institutions and their veterinary and husbandry staff that contributed data on their okapi calves: Bristol Zoo Gardens, the Chicago Zoological Society’s Brookfield Zoo, the Columbus Zoo and Aquarium, the Dallas Zoo and Children’s Aquarium at Fair Park, Disney’s Animal Kingdom and Animal Kingdom Lodge, the Houston Zoo, Sedgwick County Zoo, Tampa’s Lowry Park Zoo, Marwell Wildlife, White Oak Conservation Center, and the Wildlife Conservation Society’s Bronx Zoo.

LITERATURE CITED

MYCOBACTERIAL INFECTION AND TUBERCULOSIS IN FREE-RANGING AFRICAN LIONS (*Panthera leo*) – POTENTIAL IMPACT OF ENVIRONMENTAL MYCOBACTERIA ON DIAGNOSTIC TESTING

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Abstract

Tuberculosis has been a growing concern in the free-ranging lion population in Kruger National Park since its initial discovery in 1995.1 Understanding the impact of tuberculosis on lions requires accurate methods of detecting pathogenic mycobacterial infection. Therefore, we undertook a study to identify and evaluate associations between culture results and other immunological tests.

Samples were collected in Kruger National Park from 242 free-ranging immobilized lions and a cohort of 31 necropsied lions. Sera were tested using the ElephantTB STAT-PAKa as previously described.2 One hundred and forty-five tracheal lavage samples were obtained for mycobacterial culture using an adapted field technique and typing was used to identify different mycobacterial species. The tuberculin skin test (TST) was performed in 44 of these lions.

*Mycobacterium* species were identified in 50 lions. Fifteen isolates were *M. bovis* (8 ante-mortem and 7 post-mortem samples) and the remaining 35 isolates were classified as species belonging to non-tuberculous mycobacteria (NTM). All *M. bovis*-infected lions with TST results had positive reactions. Nine out of fourteen lions that were *M. bovis*-infected were seropositive on STAT-PAK (64.3%). In 16 lions with skin test results from which NTMs were isolated, the majority (81.2%) reacted positively to the skin test. There were only 3 STAT-PAK positive results out of 35 NTM-positive lions tested (8.6%); none were positive using VetTB DPPa. These results suggest that the role of different mycobacterial infections on immunological responses used for screening and diagnosing TB in lions deserves further attention.

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LITERATURE CITED
NECROTIZING ENCEPHALITIS IN TWO ARCTIC FOXES (Alopex lagopus): ANTEMORTEM AND POST MORTEM INVESTIGATIONS

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Abstract

Two unrelated captive-born arctic foxes (Alopex lagopus) developed a similar unusual progressive neurological disease while at the same institution. A 2½ year-old female developed episodes of abnormal mentation, somnolence, temporary collapse, difficulty to rouse, lack of fear, and aggression. The clinical condition deteriorated over 3 months with loss of body condition and development of generalized seizures, ataxia and circling. Cytology of cerebrospinal fluid demonstrated increased proteins and lymphocytic inflammation. Euthanasia was elected. Post mortem examination revealed a severe necrotizing meningo-encephalitis with extensive malacia, mononuclear perivascular cuffing, gliosis and Wallerian degeneration of the most rostral forebrain. The histopathological features suggested a viral etiology. Tests for the most common infectious agents associated with encephalitis in carnivores were negative.

Six months later, a 5 year-old male cagemate developed a similar milder syndrome. Magnetic resonance imaging of the brain revealed pronounced bilaterally symmetrical intra-axial lesions in the frontal cortices and olfactory bulbs that were consistent with the lesions seen in the female. Given the poor prognosis and the suspicion of viral encephalitis, an empirical anti-viral treatment (famciclovir 10 mg/kg q12h PO) was administered for 6 months. The clinical condition of this individual has been stable now for over 8 months.

The clinical and pathological findings in these animals are very similar to several cases of necrotizing encephalitis that may be associated with a novel herpesvirus recently described in arctic foxes in Sweden.1,3 This condition, which has not been reported in North America, also bears similarity to the necrotizing meningo-encephalitis described in small breed dogs.2

ACKNOWLEDGEMENTS
The authors would like to thank Drs. Colleen Mitchell and Jonathan Huska from the Toronto Veterinary Emergency Hospital for their help in the interpretation of the MRI and for guidance regarding medical treatment in this case. The authors also acknowledge Dr. Frederik Widén from the Swedish University of Agricultural Sciences, Dr. Liljana Petrovska from the Animal Health and Veterinary Laboratories Agency (Weybridge, UK) and the Wildtech project (EU 7th Framework Program for Research and Technological Development, grant agreement no. 222633) for assisting with and supporting the virology and molecular work. We finally would like to thank the Animal Care staff of the Toronto Zoo.

LITERATURE CITED

DIAGNOSIS AND MANAGEMENT OF PEDAL OSTEITIS AND PEDAL FRACTURES FOR A LARGE HERD OF RETICULATED GIRAFFES (Giraffa camelopardalis reticulata)

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Abstract

Over four years, ~60% of a herd of 20 reticulated giraffes, Giraffa camelopardalis reticulata, were prescribed NSAID’s for at least one lameness episode. As of March 2013, almost all had hoof overgrowth of one or more front feet.

Using operant conditioning training over the next year, zoo staff trained most of the herd for front foot assessments in a non-chute, protected contact setting, including palmar evaluations, radiographs, and farrier trims. There was a high incidence of radiographic abnormalities including: pedal osteitis, pedal fractures, abnormal joint angles, arthritis, and sole foreign bodies. Farrier trims corrected toe, heel, and sole overgrowth, with the goal of restoring normal hoof symmetry and foot weight distribution. These farrier trims are now performed every four to eight weeks in an effort to maintain normal symmetry. Supplemental husbandry medication and pharmacological modifications were also implemented, varying by individual situation.

Computed tomography (CT) and histopathology were performed on three deceased individuals to improve our understanding of the pathophysiology, to assess for etiologies/contributing factors, and to develop hoof trim metrics/parameters.

Lameness and hoof overgrowth are common health concerns in captive giraffe. Zoos with giraffe will benefit from evaluating hoof health before severe lameness or hoof overgrowth develops. We hypothesize that operant conditioning training of giraffe for foot care/management and radiographs may minimize/prevent future lameness and foot pathologies.

ACKNOWLEDGEMENTS

Thanks to the entire giraffe team at the Cheyenne Mountain Zoo: the keepers for incredible training, the vet technologists for taking so many radiographs, and to Bob Chastain, Tracy Thessing, Jason Bredahl, and Jeremy Dillon for helping identify possible husbandry modifications and setting training goals. Thanks also to the CSU radiology department for performing the foot CT’s.
BABESIOSIS IN CAPTIVE NORTH AMERICAN POPULATIONS OF MANED WOLVES (Chrysocyon brachyurus)

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Abstract

Canine babesiosis is an important tick borne disease that is characterized by acute onset, hemolytic anemia and thrombocytopenia. Over the last 10 years, five cases of Babesia species have been diagnosed in maned wolves (Chrysocyon brachyurus) in U.S. zoos. Common presenting clinical signs are acute onset inappetance, vomiting, distended abdomen, and lethargy. Physical exam findings include icteric, pale mucous membranes, hypothermia, hyperthermia, severe dehydration, and brown to port-wine urine. Clinical pathology usually reveals a severe hemolytic anemia with profound parasitemia on blood smears, thrombocytopenia, elevated urea nitrogen, hyperbilirubinemia, hypocalcemia and hypokalemia.

Five cases originating from Fossil Rim Wildlife Center have been diagnosed in the last two years. One male and two females were diagnosed post mortem. Three were successfully treated with atovaquone and azithromycin. All cases presented with acute clinical signs, with PCVs ranging from 2-9%. Blood smears were conducted on site and confirmed babesiosis. Based on sequencing of partial 18S ribosomal RNA genes, the Babesia species is most similar (99.6% identity) to a B. microti-like parasite identified in raccoons (Procyon lotor). The dam of all five was found to be negative on PCR testing and negative for clinical signs, raising the question of transplacental transmission. Surveys to the maned wolf holding institutions were sent December 2013. One female at Houston Zoo was found to have a babesia titer of 1:32, which was found when she presented with seizures. Blood smears and PCR testing have shown to be helpful for confirmation of disease, but unsuccessful for regular screening.

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The authors would like to thank all institutions who participated in the survey: Abilene Zoo, Alexandria Zoological Park, Audubon Park and Zoological Garden, BREC’s Baton Rouge Zoo, Denver Zoological Garden, Zoo Boise, Fossil Rim Wildlife Center, Connecticut’s Beardsley Zoo, Houston Zoological Gardens, John Ball Zoo, Birmingham Zoo, Lee Richardson Zoo, Dickerson Park Zoo, Buffalo Zoological Gardens, Little Rock Zoo, Oklahoma City Zoo, Philadelphia Zoo, Phoenix Zoo, Louisville Zoological Garden, Los Angeles Zoo, Montgomery Zoo, Smithsonian Conservation Biology Institution, Rolling Hills Zoo, Pueblo Zoo, National Zoological Park, Sand Diego Zoo, Natural Science Center, Sedgwick County Zoo, Wildlife Safari, Endangered Wolf Center, Sunset Zoological Park and White Oak Conservation Center.

LITERATURE CITED

ASSOCIATIONS BETWEEN GASTRITIS, TEMPERAMENT AND MANAGEMENT RISK FACTORS IN CAPTIVE CHEETAHS (*Acinonyx jubatus*)

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Abstract

Captive cheetahs commonly have gastritis associated with *Helicobacter* infection that is thought, in part, to be associated with stress responses. The impact of temperament and management on stress responses and gastritis was evaluated by assessing temperament, fecal glucocorticoid metabolites, and gastric biopsies in 36 (18.18) captive cheetahs housed at six captive facilities. Study animals ranged from 3-14 years (average 7.4) and had no other clinically apparent disease at the time of study. Male cheetahs were more likely (*p*=0.0237) to have more severe gastritis. Gastritis severity was positively correlated with high individual temperament scores for the adjectives “eccentric” (*R*=0.4141; *p*=0.0134) and “easy to work with” (*R*=0.3672; *p*=0.03) and negatively correlated with “excitable” and “aggressive” (*R*=-0.5259; *p*=0.0012). Thus, cheetahs with a behavioral phenotype more often seen in wild-caught cheetahs, had lower levels of gastritis. A similar negative correlation with “aggressive” was noted with glucocorticoid concentrations (*p*=0.0505). Specific management variables that positively correlated with gastritis included the number of institutions an animal had been housed at during its lifetime (*R*=0.4712; *p*=0.0075), the degree of public exposure (*R*=0.3749; *p*=0.0265), and density of cheetahs (*R*=0.4594; *p*=0.0055) while enclosure size was negatively correlated (*R*= -0.4206; *p*=0.0206) (e.g. cheetahs with severe gastritis were more likely to live in smaller enclosures). In contrast, cheetahs with opportunities for exercise had lower fecal glucocorticoid concentrations (*p*=0.0014). By considering these management risk factors, incorporating an individual’s temperament into housing determinations and implementing exercise programs we should be able to significantly improve the health and well-being of our captive cheetah population.

ACKNOWLEDGMENTS

Thank you to the cheetahs, animal care and veterinary staffs at Cheetah Conservation Fund, Fort Worth Zoo, Fossil Rim Wildlife Center, Smithsonian Conservation Biology Institute, Smithsonian National Zoological Park, Saint Louis Zoo, and White Oak Conservation Center for participating in this study. This study was made possible through support from Morris Animal Foundation, the global leader in supporting science that advances veterinary medicine. The authors thank Stacy Schultz, Jocelyn Bryant, and the University of Illinois Veterinary Diagnostic Laboratory Histology Laboratory for superb technical assistance. At the time of this study, Dr. Sanchez was affiliated with the Smithsonian Institution’s National Zoological Park and Dr. Wielebnowski was affiliated with the Chicago Zoological Society and we thank these institutions for their support of this research.
EPIDEMIOLOGY OF ULCERATIVE SHELL DISEASE IN COLOMBIAN SLIDER TURTLES (Trachemys callirostris) IN A WILDLIFE FACILITY IN COLOMBIA BETWEEN 2005 AND 2009

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Abstract

Ulcerative Shell Disease (USD) is a dermatologic disease associated with inadequate husbandry in captive turtles, characterized by cutaneous ulceration in the shell. Turtles affected by USD take longer to rehabilitate, which decreases the flux and release of turtles from wildlife facilities. Medical records from 568 Colombian slider turtles (Trachemys callirostris) admitted for rehabilitation to a wildlife facility in Colombia were reviewed to determine the incidence, prevalence and describe characteristics of USD over a 5 year-period. Prevalence of USD was 23.8% (135/568). Among cases, 106 (106/135; 78.5%) presented with USD upon admission, while the remaining 29 turtles developed USD during rehabilitation. Thus, cumulative incidence and the incidence rate were estimated at 6.3% (29/462) and 0.15 (29 cases/193 total turtle-years at-risk), respectively. Mortality was 2.6 times more likely (95% CI: 1.7-4.0, p<0.01) among turtles with USD compared to those without USD. The most common co-morbidities recorded with USD upon admission were metabolic bone disease and dysecdysis. Different treatments lasting an average of 132.9±125.4 days were used for turtles affected by USD; 94.8% (128/135) were treated, and 39.8% (51/128) finished treatment. Only 37 (27.4%; 37/135) turtles affected by USD were released back into the wild, highlighting the importance of USD in turtle conservation programs and the need to improve treatment protocols. Additional analyses are underway to advance our understanding of the epidemiology of USD and increase the survival rates for future releases of this species. This is the first epidemiological study of this disease in turtles in a wildlife rehabilitation facility anywhere in the world.

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LITERATURE CITED
THE CHANGING EPIDEMIOLOGY OF OPHIDIOMYCES IN FREE-RANGING SNAKES: SURVEILLANCE, EXPERIMENTAL CHALLENGE, AND DEVELOPMENT OF NEW DIAGNOSTICS

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Abstract

With the current rate of declines in global biodiversity, it is apparent that wildlife diseases are serving as additional threats to population declines and potentially species extinctions. The emerging fungal pathogen, Ophidiomyces ophidiicola, (snake fungal disease; SFD) has been recently reported in free-ranging pit viper populations from at least ten states. Health assessments prior to and after the emergence of this pathogen in a population of massasaugas demonstrate the utility of active clinical surveillance for identifying this pathogen. The disease presents as facial disfiguration due to granulomatous dermatitis, myositis, and osteomyelitis with intralesional fungi. Since 2012, more than a dozen new species of venomous and non-venomous species have been confirmed with SFD across more than 15 states. An experimental challenge was performed in the cottonmouth (Agkistrodon piscivorus) to describe the progression of disease, identify antemortem testing strategies, and develop a model for future studies. Concurrently, a real-time PCR was developed that is 1000 times more sensitive than conventional PCR and allowed detection of subclinical infections in these animals. Furthermore, this assay allowed detection of Ophidiomyces in swab samples, thus providing another means to monitor populations. The prevalence of SFD is variable over time and trends in hematological and biochemical data are fairly consistent with results obtained prior to the emergence. However, future efforts should continue to evaluate all possible mechanisms to identify this disease to assess the health of the population in the face of new unknown threats.
FATAL LEAD TOXICITY IN CAPTIVE NILE CROCODILES (CROCODYLUS NILOTICUS): CLINICAL SYNDROME AND ATTEMPTED CHELATION THERAPY WITH ORAL D-PENICILLAMINE

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Abstract

Crocodilians are reported to have a low susceptibility to the toxic effects of lead.1, 2 Cumulative effects of iatrogenic lead toxicity were observed in a group of Nile crocodiles at a private collection following the prolonged intermittent feeding of bird carcasses contaminated with ammunition pellets. Ante mortem lesions included extensive tooth loss, anorexia, weakness, lethargy; limb paresis and deep skin ulceration. Hematological and chemistry changes included chronic non-regenerative anemia and elevations of aspartate aminotransferase (AST) and creatine kinase (CK). Mean blood lead concentrations in the group were 3.86 ppm. The group was treated using d-penicillamine administered orally at doses and frequencies calculated based upon the principles of allometric scaling.3 After three weeks of treatment, blood lead concentrations within the group had dropped significantly (mean +/- SD; P < 0.03). Despite therapy, all animals died. Lead ammunition pellets at varying stages of degradation were present in the stomachs of two animals at necropsy. Dominant histopathological findings included moderate to severe demyelination of the brain stem, renal tubular necrosis and hyaline necrosis of skeletal muscle suggestive of secondary myopathy. Contrary to anecdotal evidence, Nile crocodiles appear susceptible to fatal lead poisoning after cumulative exposure to high levels of this heavy metal.

LITERATURE CITED
RANAVIRUSES IN REPTILES IN EUROPE

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Abstract

Ranaviruses are increasingly important pathogens of ectothermic vertebrates. Numerous disease outbreaks in amphibians have been documented all over the world, but with the exception of several cases of ranaviral disease in chelonians, infections in reptiles are rarely described. Diagnostic samples from a total of 890 reptiles (chelonians, lizards, snakes) were screened for the presence of ranaviruses by PCR and virus isolation over three years (2010 - 2013). In 2010, none of the examined animals (n=237) tested positive for the presence of ranavirus. In 2011, ranavirus was isolated from green striped tree dragons (Japalura splendida), all other samples (31 chelonians, 189 lizards, 68 snakes) tested negative. In 2012, ranavirus was detected by PCR in 4/77 tested snakes: a ball python (Python regius), two Indian pythons (P. molurus) and one Anaconda (Eunectes murinus). 7/63 examined lizards tested positive: an Asian glass lizard (Dopasia gracilis), a green anole (Anolis carolinensis), a green iguana (Iguana iguana), a bearded dragon (Pogona vitticeps), two sand lizards (Lacerta agilis) and a blue-spotted tree monitor (Varanus macraei). 6/67 samples from chelonians (European pond turtle (Emys orbicularis), leopard tortoise (Stigmochelys pardalis), spur-thighed tortoise (T. graeca), Hermann’s tortoise (T. hermanni) and Horsfield’s tortoise (T. horsfieldii)) were also positive. In 2013, a ranavirus was found in 1/50 tested snakes (P. regius), in 1/35 lizards (bearded dragon) and in 3/71 chelonians (red-eared slider (Trachemys scripta elegans) and Hermann’s tortoise) by PCR. The increasing detection of ranaviruses in various reptilian species underlines their wide host range and the need for testing uncommon species.
VIRUS DISCOVERY WORK IN MARINE IGUANAS (Amblyrhynchus cristatus) IN ASSOCIATION WITH AN UNUSUAL MORTALITY EVENT

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Abstract

The marine iguana (Amblyrhynchus cristatus) is a vulnerable species composed of 10 recognized subpopulations endemic to the Galapagos Islands. El Niño events can cause up to 85% mortality. Other threats described include pollution and predation by invasive and domestic species. An unusual mortality event (UME) impacted multiple marine iguana colonies starting in early September 2013. Some animals presented with vomiting, and at necropsy, many animals had oral ulceration, stomatitis, and enteritis. Lesions were especially severe in the dorsal mucosa of the tongue and suggested a possible viral infection. We focused initially on viruses that have caused similar clinical presentations in other reptiles. We used previously established protocols for virus detection that have been proven in our laboratory. Consensus PCR protocols were used for detection of adenoviruses, herpesviruses, polyomaviruses, orthoreoviruses, and iridoviruses. Sixteen ethanol-stored samples from six animals have been tested. A novel herpesvirus has been identified in a low percentage of the samples analyzed. Phylogenetic analysis indicates that this is a new Alphaherpesvirus, here called Iguanid Herpesvirus-3 (IHV-3). IHV-3 is 77% similar to Iguanid Herpesvirus-2 (IHV-2) at the amino acid level. IHV-2 has been associated with hepatic necrosis in San Esteban chuckwallas (Sauromalus varius). IHV-3 and IHV-2 form a clade with 94% bootstrap support in the phylogenetic analysis.

ACKNOWLEDGEMENTS

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LITERATURE CITED


VARICELLA ZOSTER VIRUS (VZV) EPIDEMIC IN A BREEDING AND A BACHELOR GROUP OF WESTERN LOWLAND GORILLAS (Gorilla gorilla gorilla) WITH FATAL VARICELLA PNEUMONIA

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Abstract

ZooParc de Beauval houses two groups of western lowland gorillas (Gorilla gorilla gorilla): one familial group of 13 individuals, which coexists with patas monkeys (Erythrocebus patas) and colobus monkeys (Colobus guereza), and a bachelor group of 3 males. In early December 2013, an epidemic of varicella was observed in both groups, starting in the familial group, causing the death of a 10 month old male, and subsequently to the bachelor group. The first case was a young male showing lethargy, dysorexia, strong nasal discharge and cough, bumps and blisters observed a few hours later. He was monitored for two days with supportive treatment attempts. Anesthesia was scheduled on day four but he was found dead in the morning. Gross lesions included papular skin lesions on the entire body, ulcerative stomatitis and glossitis and multifocal necrohemorragic pneumonia. Histologically lesions showed characteristic vesicular dermatitis, ulcerative glossitis and stomatitis and fibrinonecrotizing pneumonia, all with intranuclear inclusions and syncitia. Clinical signs for the other animals included bumps and blisters, with some individuals presenting cough and nasal discharge. All observed symptoms resolved within a week. Swabs of skin lesions from several individual were PCR positive for VZV. PCR and virus isolation on organs confirmed the human VZV infection in the dead individual. While case reports of Varicella in great apes have previously been published, there rarely is a distinction between VZV and Simian Varicella Virus and, to our knowledge, this is the first fatal VZV infection in gorillas. The origin of the infection remains unknown.
CARDIOVASCULAR AND HEPATIC DISEASE IN WILD EASTERN LOWLAND GORILLAS (*Gorilla beringei graueri*)

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Abstract

Eastern lowland gorillas (*Gorilla beringei graueri*) are listed on the IUCN Red List as an endangered species. They are endemic to the forests of eastern Democratic Republic of Congo (DRC) and are thought to be decreasing in number. A very small population of habituated eastern lowland gorillas lives in an isolated forest remnant of Virunga National Park in eastern DRC. Another larger and more stable population of habituated eastern lowland gorillas inhabits Kahuzi Biega National Park in South Kivu province of DRC. All habituated gorillas in these populations are monitored for health, treated for life threatening conditions, and post mortem examinations are performed by Gorilla Doctors when bodies are recovered. Although no clinical monitoring or intervention examinations have revealed clinical elements related to liver or cardiovascular disease, subclinical to significant hepatic disease was noted in 3/8 and cardiovascular disease in 6/8 post mortem examinations performed between 2008 and 2012. Heart disease was found in both geographically isolated populations.

Heart disease is well described in western lowland gorillas (*Gorilla gorilla gorilla*) in human care,¹-⁵ and there is one case of heart disease reported in an eastern lowland gorilla who lived for years in the Houston Zoo (Clubb; personal communication). Etiology of heart disease in captive gorilla remains unclear. This is the first report of heart disease in wild eastern lowland gorillas.

**LITERATURE CITED**

GIARDIA AND CRYPTOSPORIDIUM IN PEOPLE, DOMESTIC ANIMALS AND LEMURS FROM THE RANOMAFANA ECOSYSTEM, MADAGASCAR

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Abstract

Increasing human activities in the vicinity of natural habitats may facilitate the emergence and transmission of diseases between humans, domestic animals and wildlife species. Giardia and Cryptosporidium are two ubiquitous and potentially zoonotic protozoan parasites. They are highly prevalent in humans and domestic animals and caused significant morbidity and mortality in captive lemurs. We hypothesized that these parasites are present in the Ranomafana National Park (RNP) ecosystem, Madagascar and may constitute a threat to endangered and endemic lemur species. The objectives of the present study were to estimate the prevalence and identify variables associated with the infections by Giardia and Cryptosporidium in various populations of humans and animals from the RNP ecosystem. Fecal samples were obtained non-invasively from human volunteers, domestic animals and introduced rodents inhabiting three villages in the vicinity of the national park and from four species of free-ranging lemurs from the RNP. This study reports the prevalence of both protozoan in humans, domestic animals and introduced rodents and identifies risk factors for infections in these species. Additionally, we documented for the first time the occurrence of Cryptosporidium in two species of endangered lemurs from the RNP. Endemic wildlife species may be infected by a “spill-over” of protozoan parasites from human or domestic animals.
KNOWLEDGE IS POWER: EFFECTIVE ANESTHETIC MONITORING AND LOGICAL CRISIS MANAGEMENT

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Abstract

This lecture serves as a refresher on the effective use of common anesthetic monitors, including the challenges of using those monitors in non-domestic species. We will discuss how the machines work, the relevant physiology and nuances with some zoo species. In addition to a review of the function of monitors, we will discuss a systematic approach to the diagnosis and treatment of common anesthetic problems. We will focus on respiratory derangements such as hypoxemia and hypoventilation and briefly discuss hypotension.

Introduction

In veterinary school, students are taught to identify a problem, generate a list of differentials and systematically rule in or rule out those differentials, until we come to a diagnosis. Unfortunately, when it comes to anesthetic management, and especially anesthetic emergency management, we often fail to take the same linear and logical approach.

The first step in diagnosing an anesthetic problem is determining if you have a machine problem or a patient problem. We do this by instinct sometimes, but too often, we write off a real problem as an equipment problem. The easiest way to distinguish patient problems from equipment problems is employ redundant monitors. If the patient is bradycardic on the ECG, check the pulse oximeter or auscultate with a stethoscope. Sometimes the interpretation of the redundant monitor is less straightforward. If the patient’s blood pressure drops suddenly, check the heart rate. A normal animal should compensate for a sudden drop in blood pressure with a compensatory increase in heart rate. Very rarely does an acute change in heart rate, respiratory rate, blood pressure, oxygen saturation or expired CO₂ occur without a deviation in another parameter.

Before we start talking about treating anesthetic problems, we need to spend time talking about anesthetic monitors. Without a solid understanding of how the monitors work, we cannot know how accurate the information we are relying on is. The pulse oximeter, capnograph and oscillometric blood pressure monitor are the commonly used “standard anesthetic monitors.” It is important to remember that even though these devices are widely used in zoo medicine, very few have been objectively evaluated in a non-domestic species.

Anesthetic monitor review

The pulse oximeter: The pulse oximeter uses photoplethysmography to determine arterial hemoglobin saturation. It uses light emitting diodes and photosensors to detect pulsatile blood flow and determine a ratio of oxygenated to deoxygenated hemoglobin based on differential light absorption. Accurate performance depends on multiple factors including, good tissue perfusion,
good pulse quality, thin epidermis, hemoglobin and oxyhemoglobin that absorb light at the required frequencies. \(^1\) Species difference in hemoglobin structure could affect the accuracy of the reading. In cases of anemia, a patient may have excellent hemoglobin saturation, but an overall deficiency in hemoglobin will still result in poor oxygen delivery. Other sources of error include, patient movement, bright ambient light and the fact that most devices are not calibrated to read accurately below 80%.

The capnograph: Capnography is arguably the most useful anesthetic monitor and often the most underused. Effective capnography can identify conditions which might lead to hypoxia, before a patient is hypoxic. It is one of the most reliable ways of detecting cardiac arrest and airway obstruction. The capnograph can also be used for confirming endotracheal tube placement in challenging intubations, detecting disconnections and leaks and problems with sodalime and one-way valves.

The capnograph typically uses infrared spectrometry to determine partial pressure of CO\(_2\) in expired gas. \(^1\) This generates three pieces of information 1) end-tidal CO\(_2\) partial pressure, 2) a capnograph waveform and 3) a respiratory rate. In order for CO\(_2\) to be detected and read out on a capnograph, 3 steps have to take place:

1. Cellular metabolism has to produce CO\(_2\)
2. Circulation has to bring CO\(_2\) from the periphery to the lungs
3. The lungs have to be ventilating for the CO\(_2\) to be exhaled and detected by the monitor.

Abnormalities in end-tidal CO\(_2\) can occur due to derangements in any of those 3 parameters. In a healthy “normal” animal, end-tidal CO\(_2\) provides a close approximation of arterial partial pressure of CO\(_2\), the indicator of ventilatory function and respiratory pH balance. Hypoventilation can cause increases in ETCO\(_2\) and PaCO\(_2\). Hyperventilation can cause decreases in both. There are also numerous scenarios when the discrepancy between expired and arterial CO\(_2\) may grow. These include any state of poor perfusion, which decreases cardiac output and pulmonary perfusion. With less blood delivered to the lungs, there is less CO\(_2\) exhaled, but there is no change in CO\(_2\) production.

Many practitioners use their capnograph simply for one value: end-tidal CO\(_2\). That single number can be used as an effective indicator of ventilatory function, but the capnograph waveform provides many more valuable pieces of information about equipment and animal function. It can track changes in not only ventilation, but cardiac output and metabolic rate. The four phases of the capnogram that should be interpreted are pictured below.
The oscillometric blood pressure monitor: In many cases, blood pressure itself is not a primary concern. Blood pressure is an easily measured surrogate for cardiac output and perfusion. Blood pressure is composed of two things: Cardiac output and systemic vascular resistance (SVR). Cardiac output is made of two things, heart rate (HR) and stroke volume (SV). Most derangements of blood pressure involve a change in HR, SV or SVR.

The device inflates an air-filled cuff to occlude blood flow in an artery. It then decreases pressure in the cuff in a step-wise fashion to detect changes in the frequency of oscillation produced by pulses in blood vessels. If the time between successive pulses is sufficiently long, the device may provide an inaccurate reading. This source of error is commonly seen when oscillometric devices are used on animals with low heart rates, such as reptiles or equids. Other sources for failure of the oscillometric device include movement by the patient and poor signal quality. Hypotensive patients with poor peripheral perfusion often generate errors in blood pressure measurement. Unfortunately, these are often the patients that need accurate readings the most.

Systematic anesthetic trouble shooting:

Years of clinical practice, often result in some instinctual responses to anesthetic problems. The patient is tachycardic, it must be light, and the anesthetist should turn up the gas. This approach is very piecemeal and often ends up in misdiagnosis and mistreatment. We will look at some of the most common anesthetic complications that we deal with every day, but we will look at them with a problem based approach. With each problem “symptom” we will list 3-4 differentials.

Hypotension: Most causes of hypotension involve a change in HR, SV or SVR. Changes in the different parameters are interrelated. Aside from being important for basic physiology, remembering these three components gives you a set list of differentials for why your patient is hypotensive.

1. Decreased HR: Opioids, High vagal tone, α₂ agonists
2. Decreased SVR: Vasodilation: gas anesthesia, acepromazine, sepsis
3. Decreased SV: Decreased preload/venous return: Dehydration, abdominal mass, positive pressure ventilation
Steps in treating hypotension:

1. Assess and adjust anesthetic depth. Too often, a vaporizer is set at a given percent and forgotten for the remainder of the procedure. Inhalant gases affect vascular tone and contractility and are potent hypotensive agents. Use only as much as you need.
2. Fix preload. This can involve fluids such as crystalloids and colloids. This could also be due to poor venous return. Animals with abdominal masses or large fetuses have decreased return of venous blood through the caudal vena cava to the heart, especially in dorsal recumbency and may benefit from being rolled into lateral recumbency. Additionally, positive pressure ventilation also decreases venous return and may need to be adjusted in the face of hypotension.
3. Fix vascular tone; adjusting depth may increase sympathetic stimulation and promote vasoconstriction. Drugs such as ephedrine, phenylephrine stimulate $\alpha_1$ receptors and cause vasoconstriction.
4. Fix cardiac output:
   - If animal is bradycardic, consider atropine or glycopyrrolate
   - Increase contractile force of the heart by using pressors such as dopamine or dobutamine

Tachycardia and bradycardia: Both are integrally tied to the changes in blood pressure. In most situations the absolute heart rate is not nearly as important as the role heart rate plays in cardiac output and perfusion. Instinctually people want to treat brady and tachycardia. Especially since we often are just measuring heart rate and respiratory rate. It is crucial to interpret heart rate in relation to blood pressure and cardiac output. It is rarely necessary to treat bradycardia in a normotensive, non-arrrhythmic patient. For abnormalities in heart rate, treating the primary problem is the primary concern.

Reasons for tachycardia

1. Compensation for low blood pressure (baroreceptor response)
2. Compensation for hypoxemia (chemoreceptor response)
3. Sympathetic stimulation from noxious stimuli (i.e. patient is too light)

Reasons for bradycardia

1. Response to high blood pressure (baroreceptor response)
2. Direct vagal stimulation from anesthetic drugs (opioids, $\alpha_2$ agonists)
3. Excessive anesthetic depth.

Hypoxia: In terrestrial mammals, hypoxemia is defined as an arterial partial pressure of oxygen less than 60mmHg or and SpO$_2$ of less than 90%. Hypoxia occurs for one of 5 reasons:

1. True hypoventilation: Either the patient is not breathing enough or it has an obstruction, keeping it from breathing. In these cases, the patient has a high PaCO$_2$ and a low PaO$_2$
2. Ventilation/perfusion mismatch:
   a. Atelectasis
b. Dead space ventilation

3. Anatomic right-left shunt: uncommon, unless you are a reptile and are built for this

4. Low inspired FiO₂ (the animal is breathing a low oxygen mixture): this is rare under anesthesia

5. Diffusion impairment: Very rare

Off the above choices, 1 and 2 are, by far, the most common. Hypoventilation can be ruled in or out only with a capnograph or blood gas to determine CO₂. If the ETCO₂ is high and the SpO₂ is low, breathe more frequently. If the ETCO₂ is low or normal and the SpO₂ is low, there is most likely a ventilation-perfusion mismatch, such as atelectasis. In this case fewer, deeper, larger breaths will help but only increasing rate will not.

Tachypnea: Again, we often assume that if a patient’s respiratory rate increases, that it is light. In truth, there are likely 4 reasons why a patient is tachypneic under anesthesia:

1. It is hypercapneic
2. It is hypoxemic
3. It is light and responding to noxious stimulus
4. It is hot and trying to lose heat

Either CO₂ is too high, oxygen is too low, the patient is light/stressed/painful (i.e. inadequately anesthetized) or it is too hot. Instinctually turning up the gas only addresses one of these options. When noticing any change in respiratory rate and character, do a spot check. What is the ETCO₂, the SpO₂, body temperature and depth of anesthesia? If something does not make sense, run a blood gas and make sure your equipment is working.

LITERATURE CITED
COMPLICATIONS ASSOCIATED WITH ELEPHANT TUSKS

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Abstract

Elephants in both the wild and in captive environments are known to have a variety of tusk problems. In the wild, these range from minor chips & cracks to major fractures with pulpal exposures to complete avulsion of the tusk. In captive environments, thanks to the necessity for an abundance of steel and concrete, one also finds an identical assortment of tusk problems & injuries. Relatively minor tusk chips & cracks generally do not require intervention. However, when the pulp tissue within the tusk is exposed or the animal’s immune system is not able to resolve the problem, some degree of surgical intervention may be required. In severely infected cases with apical osteomyelitis with or without soft tissue cellulitis, tusk extraction may be the only possible resolution indicated.

Beginning in the early 1980’s, this author has been involved in the examination, immobilization, trans-location, treatment, and surgical operation on a multitude of elephants – both African and Asian. Drawn from this deep well of practical clinical experience, the author presents a variety of general principles to help the concerned clinician effectively resolve clinical tusk problems. Attention to diagnosis, radiographic technique and classification of tusk damage will be discussed with examples provided. Repair by partial pulpotomy with and without custom made instrumentation will be described. A new surgical technique for the removal of an intact tusk will be shown.
MANAGEMENT OF A BREEDING HERD OF AFRICAN ELEPHANTS (*Loxodonta africana*) ON A PREDOMINATELY FORAGE DIET

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Abstract

The breeding herd of 1.3 African elephants at Tampa’s Lowry Park Zoo was transitioned from a traditional zoo diet consisting of large proportions of concentrates to one with predominately forage (hay and browse) with produce and concentrates used only as training items. Body weights were taken on a regular basis and two of the females conceived while on this diet. Weight gain for the pregnant females were relatively small, but positive on this feeding plan. Both calves were delivered without complications, and each female has lactated normally. Blood samples on the adults were collected weekly for hormone analysis and serum banking. Retrospective analysis of essential fatty acids, minerals, and fat soluble vitamins was conducted on an opportunistic basis as sampling allowed. Comparisons are limited on certain parameters, but can be made before and after the diet shift and compared to accepted norms. Feeding a forage only diet to African elephants appears to be beneficial as it has been in gorillas and white rhinos fed in similar fashion. Improvements in hydration and possibly renal health are noted changes. Potential benefits include weight management, and more appropriate fatty acids may lead to better health of the digital cushion and skin. Increased feeding times can lead to less stereotypy. A decrease in dietary fats has potential to lessen effects of adipose-derive, detrimental hormonal affects (leptin). It may also improve thermoregulation, specifically as it pertains to heat stress and reproductive health.

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DIETARY MANIPULATION TO REDUCE HYPERCHOLESTEROLAEMIA IN MANAGED MEERKAT (*Suricata suricatta*) POPULATIONS

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Abstract

Captive meerkat populations are known to suffer from cholesterol-related diseases1,3 These appear linked to the high serum cholesterol levels found in many captive meerkats compared to their wild counterparts. At the Zoological Society of London (ZSL) we have found cholesterol granulomas in the calvarium of meerkats, prompting this investigation of dietary management.

Free-ranging meerkats are primarily insectivorous carnivores occasionally eating vertebrates and plants.2 The diet of managed meerkat populations is traditionally based on meat, mice, chicks and eggs, all high in cholesterol. ZSL, therefore, formulated new diets based on complete dry pet foods augmented with calcium-supplemented invertebrates, fruit and vegetables.

In 2007, over a 5 month period meerkats fed 25g per day of dry cat food a, calcium gut-loaded live invertebrate prey and 20g of mixed fruit and vegetable showed a significant (p<0.05) decrease in their serum cholesterol levels (11.6 ± 2.12 mmol/l, n=10) compared to a control group fed a mouse-based diet (19.1 ± 2.16 mmol/l, n=5).

Following the trial, the control group was switched to the new diet. To date, cholesterol levels of all meerkats have remained low (10.6 ± 2.4 mmol/l), although higher than in free-living meerkat populations (5.93 ± 0.973 mmol/l) (Gledhill, L., unpubl. data). No cholesterol-related gross pathology has been seen since the change in diet. Cholesterol rises rapidly, however, in individual animals experiencing a shift in diet (hospitalisation, public interference, etc.), re-enforcing the requirement for strict ongoing dietary control to manage this condition in this captive species.

aHills Science Plan® Feline Light Mature Adult/Senior 7+ (Hill’s Pet Nutrition Ltd, Watford, Hertforshire, WD18 8YL, UK)

ACKNOWLEDGEMENTS

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LITERATURE CITED

COBALAMIN DEFICIENCY IN A LESSER KUDU (*Tragelaphus imberbis*): CLINICAL MANIFESTATIONS, DIAGNOSIS, AND RESPONSE TO TREATMENT

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**Abstract**

A ten-year old captive Lesser Kudu (*Tragelaphus imberbis*), housed in a mixed-species exhibit, presented with ill-thrift, weight loss, roughened hair-coat, and decreased activity. The animal had a chronic history of abnormal hoof-growth requiring semi-annual immobilization for hoof trim. Hematology and serum chemistry abnormalities identified during recent examinations included worsening normocytic, normochromic anemia as well as blood urea nitrogen and creatinine levels at the high-end of normal for the species. Chronic renal disease was suspected as the cause of clinical signs. Results of physical exam and nutritional testing identified cobalamin deficiency.1-4 The kudu responded to treatment with intramuscular injections of cyanocobalamin (Vitamin B12), followed by supplementation with a commercial cobalt salt-lick. Clinical improvement was noted with weight gain, improved body and coat condition and increased energy levels. Diagnostic testing four months following treatment identified complete resolution of anemia, and serum cobalamin levels elevated to within bovine normal reference ranges. To the author’s knowledge, this is the first report of cobalamin deficiency in *Tragelaphus imberbis*, and may indicate the need for surveillance of serum cobalamin levels or dietary cobalt levels for captive exotic ruminant species.

**ACKNOWLEDGEMENTS**

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**LITERATURE CITED**

EVALUATION OF A NOVEL TECHNIQUE AS AN INDICATOR OF IMMUNOGLOBULIN PASSIVE TRANSFER IN SIX SPECIES OF NON-DOMESTIC RUMINANT

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Abstract

Many tests are available to evaluate immunoglobulin (Ig) passive transfer,1,3 but an ideal assay that is accurate, specific, quantitative, economical, easily performed, and rapid is not available to date. A novel technique to assess passive transfer, termed the Ig Immunocrit has recently been described in swine.2 Briefly, 100 μl of serum is mixed with 100 μl of 40% (NH4)2SO4, a non-heparinized hematocrit tube is filled with the mixture, one end of the tube sealed with clay, and then tubes are centrifuged for 5 minutes. The resulting precipitate is read as a percentage of the total fluid column using a standard hematocrit card. The correlation between the Ig Immunocrit and serum gamma globulin concentrations measured by protein electrophoresis in Roan antelope (Hippotragus equinus, n=10), Southern Gerenuk (Litocranius walleri walleri, n=8), Addra gazelle (Nanger dama ruficolis, n=10), Giant Eland (Taurotragus derbianus gigas, n=9), Lesser Kudu (Tragelaphus imberbis, n=8), and Eastern Bongo (Tragelaphus eurycerus isaaci, n=10) was evaluated in neonates with evidence of adequate or failure of passive transfer. Linear regression correlation was strongly positive for all and ranged from an R² of 0.8750 to 0.9813 depending on species. There was no statistically significant difference between species in the Ig Immunocrit of animals that appeared to have adequate passive transfer (P=0.83) and a mean of 11.55% with a standard deviation of 3.28% was noted (Min. 5%, Max. 18.25%, n=52). The Ig Immunocrit should be evaluated in additional Artiodactylids and increased sample sizes to further determine the scope of applicability.

LITERATURE CITED

EVALUATION OF IN-HOUSE URINE DIPSTICK, REFERENCE LABORATORY URINALYSIS, AND URINE PROTEIN:CREATININE RATIO FROM A COLONY OF GOELDI’S MONKEYS (*Callimico goeldii*)

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Abstract

This study evaluated results from an in-house (IH) laboratory dipstick, a reference laboratory (RL) urinalysis, and urine protein:creatinine (UPC) ratios from Goeldi’s monkeys (*Callimico goeldii*). Urine was collected on two occasions from 25 individuals comprising a single captive colony in North America and compared based on laboratory, sex, age class, and presence/absence of a normal urinalysis. Urine specific gravity and pH between laboratories were statistically different and compared separately, but all other analytes were combined for the statistical analysis. Overall, 42-100% of animals had at least a trace amount of protein in their urine. In comparing normal and abnormal urinalyses, UPC, quantitative protein measurement, RL dipstick protein, and RL pH were all statistically different. Eleven animals (44%) in round 1 and 9 animals (36%) in round 2 had UPC ratios ≥ 0.5. Based on results of this study, UPC for *Callimico* sp. > 0.3 was found to be abnormal and supportive of renal compromise. Higher protein in the 1-4 year age class was the only significant age related difference. There was no association between any categorical variable (glucose, blood, bilirubin, ketones, urobilinogen) and abnormal urinalysis. Since renal disease is a major cause of morbidity and mortality in this species,1,2 we recommend including routine urinalyses and UPC ratios as part of preventive care programs for this species. These data provide the first published information on urinalysis and UPC ratios in this species and will serve as a helpful reference for interpreting results and evaluating patients with renal disease.

ACKNOWLEDGEMENTS

The authors would like to thank the animal care staff at the Brookfield Zoo for collecting the urine samples for this study.

LITERATURE CITED
QUARANTINE CONSIDERATIONS DURING COORDINATION OF A MULTI-INSTITUTIONAL SHIPMENT OF TEMPERATE AND ANTARCTIC PENGUINS TO THE KANSAS CITY ZOO

Wm. Kirk Suedmeyer, DVM, Dipl ACZM†*, and Brian Stockinger, DVM†

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Abstract

The Kansas City zoo opened the Helzberg penguin plaza exhibit in October 2013. Forty-four penguins, including six king (Aptenodytes patagonicus), 23 gentoo (Pygoscelis papua), four rockhopper (Eudyptes chrysocome), and 11 Humboldt (Spheniscus humboldti) along with coral reef, schooling teleosts and various invertebrates were obtained from six other institutions and private hobbyist suppliers.

A medical background questionnaire and pre-testing requests were sent to each institution several months prior to shipment. A complete physical exam, including weight, direct ophthalmoscopy, tonometry, thermography, whole body radiographs, choanal swabs for Mycoplasma sp. and Chlamydophila sp, blood samples for a complete blood cell count, select sera chemistries, direct evaluation for Haemoproteus sp., fecal ova & parasite exam, vaccination, microchip placement, calculation of dietary needs and supplementation were performed for each bird. Itraconazole and tetracycline hydrochloride were initiated with each bird upon arrival, and all Humboldt penguins were continued or initiated on antimalarials.

Radiographic evaluation demonstrated four birds with metallic foreign bodies; three within the ventriculus and one that penetrated the ventriculus into the coelom. Additionally, several older birds were diagnosed with degenerative osteoarthritis and pododermatitis.

All 44 birds tested negative for Chlamydophila. Twenty-six of the 44 birds tested positive for two species of Mycoplasma, which has not been previously reported in penguins. All birds were treated until tests were negative for Mycoplasma.

The coordination of such a large scale receipt of animals presents significant logistical, political and medical challenges for quarantine and health assessment. Close communication with all parties involved is integral to success.
EMBRACING THE ONE HEALTH INITIATIVE: FROM ZOO MEDICINE TO IN-SITU MEDICINE AND CONSERVATION

Michael R. Cranfield, DVM¹*

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Abstract

Dr. Cranfield served as chief veterinarian at the Maryland Zoo in Baltimore from 1982 until 2003, when he became the zoo’s Director of the Animal Management, Research and Conservation Department. He also focused on a variety of research topics, including avian malaria, reptilian cryptosporidiosis, and primate reproductive physiology. In 1999, Dr. Cranfield took on leadership of Gorilla Doctors, an organization that provides medical care to the critically endangered mountain gorillas (*Gorilla beringei beringei*) that call Rwanda, Democratic Republic of Congo, and Uganda home. With a one-health focus, the organization also supports health programs for the people and their animals living and working in gorilla habitat. Recently, Dr. Cranfield transitioned to a full time position at the Drayer Wildlife Health Center at the University of California, Davis, where he splits his time between overseeing Gorilla Doctors operations in Africa, fundraising on the road, and administering the project from the U.S.

Dr. Cranfield will share his experiences between practicing clinical medicine in a zoo setting, and contributing to a field conservation project which eventually required full time commitment. This presentation will attempt to highlight the pros and cons of working in these two very different environments.
ZOOLOGICAL MEDICINE: OUR SEDUCTIVE PROFESSION

Roy B. Burns, DVM

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Abstract

Becoming a veterinarian in zoological medicine requires great focus, sacrifice, discipline and a bit of luck. Securing a position occurs after years of demanding academic study and building a resume of experience and achievements. Once “in” the profession, zoological veterinarians often continue at a similar pace. Zoo veterinarians typically possess great passion and sense of mission in their work. We receive abundant positive reinforcement from society, friends, students, and colleagues from our identity as a zoo veterinarian, for working long hours, and for being available “24/7”. As a result, our personal, spiritual, physical, and relationship identities may become secondary. A counter intuitive approach of predictable and spontaneous time off improves efficiency and efficacy1. Re-balancing of one’s professional, personal, spiritual, and relationship identities requires a redefinition of success. Such rebalancing can require the same focus, sacrifice, and discipline required to enter our profession with much less positive reinforcement from outside of ourselves. However, as one’s definition of success changes, so too does one’s behavior.

LITERATURE CITED
ZOONOLOGICAL CONTORTIONS: ADVANTAGES AND DISADVANTAGES OF JOINING VETERINARIAN AND CURATOR POSITIONS

Tara M. Harrison, D.V.M., M.P.V.M., Dipl. A.C.Z.M.

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Abstract

Zoos have become “living museums,” and curator positions have evolved this trend.1-2 As zoos have grown and matured, the number of curators, and specialized managers have developed. The Association of Zoos and Aquariums (AZA) has required certain positions, including curators and veterinarians, and thus, many small to medium sized zoos have been forced into creating curator and full-time veterinarian positions. Some zoos, however, have chosen to save money and created a dual role of veterinarian/curator.

As a veterinarian/curator for almost 10 years, there are certainly some advantages, and many disadvantages. Advantages include 1) learning and being more involved in animal husbandry, 2) knowing the ins and outs of zookeeping staff, 3) extensive involvement in Species Survival Plans (SSP), and 4) avoiding inevitable conflicts between a curator and a veterinarian. Disadvantages include 1) it is discouraged by the AZA, 2) it is challenging to balance curator duties and veterinary medicine, 3) both jobs alone qualify as a full time job at even a small zoo, and 4) the zoos lose the often useful “separation of powers” effect of having two different people serving in these roles.

Overall, although it may be a cost savings, it can be a challenging position that is hard to devote adequate time to both positions. It is important for AZA and its members to consider all factors and allow flexibility in development of both curator and veterinary positions, as this will continue to encourage AZA institutions to expand and improve in care of their animals.

LITERATURE CITED
“ONLY THOSE WITH VISION, PASSION, AND TREMENDOUS FORTITUDE NEED APPLY....” THE ROLE OF PRESIDENT AND CEO (AND MOM) IN TODAY’S ZOOS AND AQUARIUMS

Barbara Baker, D.V.M., M.B.A.

Pittsburgh Zoo and PPG Aquarium, One Wild Place, Pittsburgh, PA 15206, USA

Abstract

Dr. Barbara Baker is President and CEO of the Pittsburgh Zoo & PPG Aquarium, and it’s International Conservation Center. From that position, she leads one of the nation’s major zoological parks of 77 acres and an animal collection of over 9,000 animals. Dr. Baker has an ideal combination of management and scientific training, with a Doctor of Veterinary Medicine degree from Auburn University and a Masters in Business Administration, majoring in marketing, from the University of South Carolina. She began her career as an intern at the Bronx Zoo, was Associate Veterinarian at the Lincoln Park Zoo, then Director of Animal Health and Research at the Riverbanks Zoo, working as a zoo veterinarian for 8.5 years. Dr. Baker has led the Pittsburgh Zoo for 24 years, one of only three veterinarians in the top role in the country. Dr. Baker has seven children, six who joined the family through older child adoption.

What’s required to be successful in the role of President and CEO, or Director of a major zoo? Passion, passion, passion, strong drive, vision to see what isn’t there yet, ability to persevere against all odds, and strong leadership skills, just to name a few.

And can you balance the role with a happy and involved family life? Of course you can, if you also have strong organizational skills, tremendous energy reserves, coaching skills, laugh a lot, and have a great empowered team at the zoo.

With enthusiasm and humor, Dr. Baker will share her insights into what someone in her role actually does, and how one can balance the responsibilities of wife, mother, and the top job at a zoo.
FROM NON-PROFIT, TO CORPORATE, TO COLLEGE DEAN. PROS AND CONS OF WORKING AND LIVING IN EACH WORLD

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1Dean, Professor of Zoological Medicine, College of Veterinary Medicine and Biomedical Science, Colorado State University, Fort Collins, CO 80523 USA

Abstract

Zoological veterinarians are increasingly finding interesting careers in a variety of organizations. As these opportunities grow, how might one decide what role is best? Each role and each organization has different pieces which can be wonderful or not.

Having worked as a clinical veterinarian at several nonprofit zoos and aquariums, then spent time as a corporate executive and now employed as a dean of a veterinary college, I have enjoyed various aspects of these different career options. No job is perfect in every way and, depending on your personal and professional goals, one may be a better fit then another. This presentation will attempt to highlight the pros and cons of working in these different roles and varied organizations.
FROM FROG AND MOUSE TO DOLPHIN AND ELEPHANT: COMPARATIVE HEMATOLOGY AND ITS USE AS A DIAGNOSTIC TOOL

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Abstract

Hematologic evaluation provides valuable information for diagnosis, treatment, monitoring, and prognosis of the individual patient, and for health assessment of animal populations. Differences in mammalian and non-mammalian species extend from basic anatomy and physiology to morphologic and functional features of blood cells.¹² A major difference is the presence of nucleated erythrocytes and thrombocytes in non-mammalian species. As automated hematology analyzers are programmed to consider all nucleated cells as white blood cells, hematologic analysis of non-mammalian blood relies on manual methods. Accurate interpretation of hemogram results requires knowledge and expertise in sample collection, handling, and analysis, as well as species (or strain)-specific variations in blood cell morphology and pathophysiologic responses. Understanding of the hematology of non-domestic species is continuously expanding, and laboratory reference intervals are being defined for an increasing number of exotic species. If population-based reference intervals are not available for a given species, subject-based reference intervals can be helpful in the evaluation during treatment and/or monitoring of the individual patient.³ The objective of this overview is to highlight major differences in morphology, function, and physiologic and pathologic blood cell responses across various taxa of mammalian and non-mammalian vertebrate species, and to summarize important factors that should be considered when interpreting hemogram results.

LITERATURE CITED
CLINICAL SIGNIFICANCE OF MICROBIAL EVOLUTION AND ECOLOGY: WHY YOU SHOULD CARE ABOUT PHYLOGENETIC TREES

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Abstract

Evolution is a central concept in biology. Indeed, when one considers definitions for life, perhaps the simplest and most elegant definition for life is that life consists of things that evolve. As medicine is a subfield of biology, evolution is central. Microbes are essential for all vertebrate life, for functions including digestion, nutrition, and defense. A microbe does not “want” to cause disease or not cause disease. All life on earth has been selected for billions of years to reproduce successfully, and this is all that matters from an evolutionary standpoint. If pathogenic traits provide an evolutionary advantage in a given situation, they will be selected for. If they provide a disadvantage, they will be selected against.

In comparative medicine, we often lack information regarding both host and pathogen species. When information is lacking on a given species, the best model to use is typically the closest relative from which data is available. This requires knowledge of species relationships. There are a number of important selective pressures impacting microbes in a vertebrate host, which lead to differing degrees of host/microbe relationships and differing host fidelity. Significant factors impacting host/microbe relationships will be discussed, and examples given. Understanding pathogen ecology and evolution may identify agents of concern before significant outbreaks occur, enabling management strategies for risk mitigation to be proactive rather than reactive.
Abstract

Chronic kidney disease is a commonly encountered problem in cats and dogs as well as many other species. Because of the frequency of disease in small animal medicine, much interest and research has been given to the topic in recent years. Staging guidelines have been developed by the International Renal Interest Society (IRIS) to help direct diagnosis, treatment, and monitoring of patients. Therapies that have been anecdotal in the past are now being explored via evidence-based medicine. Prognostic factors have been identified which can assist owners in decision-making. This lecture will cover the current management of chronic kidney disease in dogs and cats and how these strategies might apply to zoological species.

Introduction

Chronic kidney disease is a common entity in cats and dogs. Much has changed over the years in our understanding of kidney disease in these species resulting in changes in terminology, diagnosis, and treatment. In addition, markers of prognosis and effect of treatment have been identified. The goal of this lecture is to provide an update on approach to chronic kidney disease from the perspective of small animal medicine.

Terminology

For years, terms such as renal insufficiency or renal failure were used to describe patients with chronic kidney disease. These terms were difficult to define (e.g., when does disease go from insufficiency to failure?) and centered on only specific functions of the kidney. The term chronic kidney disease (CKD) is more encompassing of the primary disease processes that can occur. Additionally, owners are more likely to understand the term “kidney” than “renal.” CKD is defined as the presence of functional or structural abnormalities in one or both kidneys that result in reduced function or tissue damage. Damage may be microscopic (e.g., glomerular injury) or macroscopic (e.g., renal infarcts with fibrosis).

The International Renal Interest Society (IRIS) was originally formed in 1998 and has established guidelines for staging CKD based on creatinine concentration and presence or absence of proteinuria or hypertension (www.iris-kidney.com). The staging provides a system to categorize different degrees of CKD and provide guidelines for diagnosis and treatment depending on the stage of disease. Recently, guidelines for the diagnosis and management of canine proteinuria have also been published.

Diagnosis

CKD is most often defined by the loss of renal concentrating ability with or without the presence of azotemia. As it requires 66% loss of renal function before concentrating ability is affected.
and 75% loss of function prior to azotemia developing, there can be disease present long before we are able to detect it. This is in part due to the poor sensitivity of creatinine and BUN to detect significant changes in glomerular filtration rate.

Evaluation of other biomarkers is underway to find a more sensitive indicator of renal dysfunction and include cystatin C and neutrophil gelatinase-associated lipocalin (NGAL). In people, serum cystatin C is considered better than creatinine in detecting renal dysfunction. Studies in cats and dogs are limited and currently hindered by variable cross-reactivity with a human assay. In addition, the effects of non-renal disease on serum cystatin C concentrations need to be established. Measurement of urine cystatin C (as a ratio with creatinine) may be of benefit to detect tubular disease.

NGAL is used in people as a marker of acute kidney injury (AKI). Studies in dogs have evaluated serum and urinary NGAL in both AKI and CKD. It appears to be a sensitive marker of AKI, but may not differentiate AKI from CKD. Serum NGAL may be a useful prognostic indicator, but further studies are needed.

Proteinuria is often the earliest sign of CKD in dogs due to the higher rate of glomerular versus tubular disease, and this may occur in other species. Patients with proteinuria and an inactive urinary sediment should have a urine protein:creatinine ratio (UPC) performed to establish the severity of the proteinuria.

Imaging such as radiographs, ultrasound or CT should be considered in all patients newly diagnosed with CKD. Imaging will allow assessment for stones or tumors that may be causing obstructive disease or be a nidus of chronic infections. Contrast studies should be performed with caution as further renal damage could occur.

Renal biopsy is important in evaluating patients with suspected glomerular disease. Some forms of glomerular disease may be responsive to immunosuppressive therapy, but biopsy diagnosis is recommended before starting immunosuppressive therapies. Ideally, samples are collected for standard H&E stain, immunohistochemistry, and electron microscopy. A renal biopsy kit can be obtained in advance that contains materials and instructions (International Veterinary Renal Pathology Service, The Ohio State University or Utrecht Veterinary Nephropathology Service, Utrecht University).

**Treatment**

Treatment of CKD centers on: 1) Removing any primary causes such as drugs/toxins, infections, or obstruction; 2) Symptomatic therapy to address fluid, electrolyte, acid-base, endocrine, and nutritional deficiencies; and 3) Minimizing clinical and pathophysiological consequences of disease. Symptomatic therapy is instigated based on the IRIS stage of CKD and the clinical signs of the patient. Recently, evidence-based recommendations for treatment of CKD in cats and dogs were reviewed.11

**Fluid Therapy**

The goal of fluid therapy is to maintain hydration. Most patients with stages 1 and 2 CKD are able to maintain hydration on their own and do not typically require fluid supplementation.
Patients with stage 3 or 4 disease are more likely to benefit. Traditionally, fluid therapy has involved the SQ administration of a balanced electrolyte solution such as Lactated Ringers Solution or 0.9% NaCl. These fluids have a high sodium content which does not match the free water losses that are usually occurring in patients with CKD and could contribute to hypertension or fluid retention. From a physiological standpoint, administration of water enterally (via a feeding tube) would be more appropriate, but not possible in all patients.

*Hyperphosphatemia*

Phosphorus is primarily excreted by the kidneys. As kidney function declines, phosphorus is retained leading to renal secondary hyperparathyroidism. This can result in mineralization of tissues and progression of CKD. Patients with renal secondary hyperparathyroidism may have high total calcium, but the ionized calcium is typically normal or low despite a high PTH. First line therapy for hyperphosphatemia is dietary phosphorus restriction, usually by feeding a “kidney” diet. If diet alone is not effective, the addition of phosphate binding agents such as aluminum hydroxide, salts of calcium, or lanthanum, should be considered. It is important that these are given at the time of feeding as they only bind phosphorus present in the GI tract.

*Calcitriol therapy*

The kidneys are responsible for converting 25-hydroxycholecalciferol to its active form, 1,25-dihydroxycholecalciferol, also known as calcitriol. As kidney disease progresses, calcitriol concentrations decrease which may be a factor in the development of renal secondary hyperparathyroidism. Subsequently, PTH concentrations increase and PTH is thought to be an important uremic toxin. Calcitriol therapy in dogs has shown a survival benefit by decreasing the progression of CKD, but this has not been demonstrated in cats. Prior to therapy, phosphorus concentrations should be normalized and ionized calcium should be normal (or low). Starting dose of calcitriol in dogs is 2.0-2.5 ng/kg q24 hrs and ionized calcium and PTH concentrations are monitored. Calcitriol dose is then adjusted to minimize PTH concentrations without causing hypercalcemia.

*Anemia*

Anemia in CKD is usually due to lack of erythropoietin production by the kidney, though other causes such as hemorrhage (GI or other), poor nutrition, concurrent diseases, or decreased red cell life span may play a role. Erythropoietin deficiency can be treated with hormone replacement. The most frequently used product in cats and dogs has been human recombinant erythropoietin (EPO, Epogen or Procrit). EPO results in a dose dependent rise in hematocrit, but has been associated with the development of antibodies that target the endogenous hormone, resulting in transfusion dependent anemia. Darbopoietin (DBO, Aranesp) is a newer, longer acting form of erythropoietin. Based on anecdotal reports, DBO may be less likely to induce antibodies. The initial dose is 1.0 µg/kg SQ once a week until the target PCV is reached, then every 2-3 weeks. Iron supplementation is recommended when initiating therapy and can be accomplished with iron dextran administration.

*Anti-hypertensive therapy*

Systemic hypertension is a common sequela of CKD in dogs and cats and may contribute to progression of disease. Ideally, hypertension is confirmed based on three separate measurements
prior to treatment. Exceptions would be severe hypertension (>200 mmHg) in a patient with evidence of target organ damage (retinal lesions, neurological signs) in which case therapy may be started after a single measurement. Options for therapy include ACE inhibitors (ACEI) and calcium channel blockers (amlodipine). Generally, ACEI do not have a great effect on lowering blood pressure. However, they may have renoprotective effects by reducing intraglomerular pressure, reducing proteinuria, and altering the profibrotic effects of the intra-renal renin-angiotensin system. Amlodipine is often the treatment of choice for hypertension in cats and in dogs with severe hypertension.

**Dietary therapy**

Diet therapy remains an important component of therapy for patients with CKD. Renal diets are currently recommended for dogs with IRIS stage 3 and 4 and cats with stage 2-4 disease based on studies that show increased survival time compared to maintenance diets. Renal diets are typically formulated to be restricted in protein, phosphorus, and sodium. They have increased B-vitamins, caloric density, omega-3 fatty acids, antioxidants, and sometimes potassium. Simply feeding a lower protein diet is not likely to give the same benefit as a true renal diet. Diet changes should not be done when the patient is clinically ill as this can result in food aversion. If needed, pharmacological interventions can be used to address uremic gastritis, nausea/vomiting, and appetite stimulation. If patients are not consuming adequate nutrition with these efforts, placement of a feeding tube should be considered. A feeding tube also allows easy administration of medications and free water for hydration.

**Hemodialysis**

Hemodialysis is being used with increasing frequency in small animal medicine. This modality is best suited for patients with AKI that need support until renal function improves. Patients with CKD may be treated with hemodialysis, but this becomes a life-long treatment. Currently there are limited centers offering this therapy.

**Obstructive therapies**

CKD may be the result of, or complicated by, renal pelvic or ureteral obstruction. The obstruction may be partial or complete and causes include uroliths, blood clots, strictures, or tumors. Therapy to relieve obstruction can be beneficial to prevent nephron loss and preserve renal function. Early intervention is ideal, but treatment of chronic obstructions may be of benefit. A number of options are currently available to relieve obstructions including surgery (urolith removal, ureteral reimplantation), ureteral stenting, and subcutaneous ureteral bypass.

**Prognostic factors**

IRIS staging of CKD is prognostic for survival times in cats and dogs. Patients with stage 3 or 4 disease have a shorter survival than patient with lower stage disease. Proteinuria has also been shown to be of prognostic value. Cats with a UPC >0.4 and dogs with a UPC >0.5 have shorter survival times and more uremic crises. As noted above NGAL may be useful as a prognostic factor, but further studies are needed.
LITERATURE CITED

THE USE OF WILDLIFE DATABASE RETROSPECTIVE REVIEW AND SURVEILLANCE SYSTEMS IN THE RECENT OUTBREAK OF RABIES IN TAIWAN

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Abstract

Following rabies elimination in 1961, Taiwan has been considered a canine rabies-free country. In July 2013, three Formosan ferret badgers (Melogale moschata subaurantiaca) presenting to the wildlife first aid station of the Taiwan Endemic Species Research Institute (TESRI) with neurologic signs, later died and were confirmed positive for rabies. In response to these cases, the Taiwanese authorities activated the Central Epidemic Command Center (CECC) to coordinate rabies management and to control the epidemic. From January 1, 2013 to March 14, 2014, 3,271 samples were examined including 1,624 domestic dogs, 118 domestic cats, 70 bats, 1,110 carnivores and 349 other wild mammals. Three hundred and thirty one out of 911 ferret badgers were positive, one out of 162 Asian house shrews (Suncus murinus) was positive, and one dog bitten by rabid ferret badger was positive. Based on surveillance results, this rabies outbreak in Taiwan was restricted to ferret badgers living in rural and forested areas.

The wildlife first aid station of TESRI receives sick or injured wild animals from around Taiwan. Due to its location and interface with wildlife including animals from areas determined to have highest rabies prevalence, retrospective reviews of the wildlife database and road kill animals were performed as surveillance systems. Retrospective wildlife database review showed that the submission plateau of ferret badgers began at 2008, and the number of dead ferret badgers dramatically increased since 2006. The result of road kill animals surveillance revealed five ferret badgers were confirmed of rabies, and the earliest one was collected on July 10, 2010. These preliminary results indicate that the rabies had been present in Taiwan for several years prior to the 2013 epidemic.

Active and enhanced surveillance activities were also started after the outbreak to further characterized the epidemiology of rabies in Taiwan. With the enhanced surveillance, opportunistic blood samples were collected from both healthy and rabid ferret badgers. The preliminary hematology and biochemistry profiles of ferret badgers were established (Table 1), and comparisons between healthy and ill animals were done in order to determine more clinical information about rabid ferret badgers.
### Table 1. Hematology and biochemistry values for *Melogale moschata subaurantiaca*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>All healthy ferret badgers (n=41)</th>
<th>Minimum</th>
<th>Maximum</th>
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<tbody>
<tr>
<td>Hb (g/dL)</td>
<td></td>
<td>10.8</td>
<td>16.6</td>
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<tr>
<td>PCV (%)</td>
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<td>RBC (10⁶/µl)</td>
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<td>MCH (pg)</td>
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<td>309</td>
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<tr>
<td>Na(mmmol/L)</td>
<td></td>
<td>139</td>
<td>149</td>
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<tr>
<td>K(mmmol/L)</td>
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</tr>
<tr>
<td>Cl(mmmol/L)</td>
<td></td>
<td>115</td>
<td>138</td>
</tr>
</tbody>
</table>

PCV = packed cell volume; RBC = red blood cell; MCV = mean corpuscular volume; MCH = mean corpuscular hemoglobin; MCHC = mean corpuscular hemoglobin concentration; WBC = white blood cell; LDH = lactate dehydrogenase; CK = creatine kinase; BUN = blood urea nitrogen; AST = aspartate aminotransferase; ALT = alanine aminotransferase; ALKP = alkaline phosphatase.
SEROLOGICAL RESPONSE IN RED FOX (Vulpes vulpes) TO THE CANINE DISTEMPER VACCINATION WITH RECOMBITEK C6®

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Abstract

The vaccination of captive wild carnivores is a basic tool for wildlife health management.1,4 Unfortunately there is little evidence in Latin America of the usefulness and security of the locally available vaccines. Recombitek® C6a is the only locally available anti-canine distemper virus (CDV) recombinant vaccine. The anti-CDV serological and clinical response to SC administration was evaluated in red fox (Vulpes vulpes) maintained at the Buin Zoo, Chile.

Seventeen clinically healthy red fox were divided in three groups and administered 1 ml of: A) a single vaccination (three animals of 9 months of age without previous vaccination (WPV); B) a series of three vaccinations with 21 days of interval (four animals of 10 months of age WPV); and C) a single vaccination (10 animals older than one year and that had received a previous vaccination more than a year ago). Titers for antibodies against CDV were measured by serum neutralization before vaccination and every 21 days after the first vaccination for 6 months.

After 180 days, only two animals (both belonging to group B, 50% of group B animals) presented adequate antibody protective response (titers > 100).2,3 All animals remained clinically healthy throughout the study period. Based on our results, a single vaccination with Recombitek® C6 does not produce protective antibody titers against CDV in red foxes. Additional research is needed to confirm the antibody titer response to multiple vaccinations.

*LAMWILL LLC., imported and distributed by Sanofi Pasteur S.A. Andres Bello 2711, Las Condes, Chile

LITERATURE CITED

CRYOPRESERVATION OF SEMEN FROM CAPTIVE GOLDEN-HEADED LION TAMARINS (Leontopithecus chrysomelas)

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Abstract

Leontopithecus chrysomelas is part of a genus in which all species are listed as endangered¹ and little is known about reproductive characteristics. Eighteen semen samples were collected using penile vibratory stimulation² from six adult captive males from Fundação Parque Zoológico de São Paulo in Brazil. Immediately after collection, samples were diluted using coconut water solution³ and acetylcysteine, and incubated for 30 min at 37°C to allow coagulum dissolution. After semen analysis, the commercial extender Botubov®a was added. The sample was kept at 4°C for two hours and transferred to 100 µl French straws, which were kept in nitrogen vapor for 10 min and then plunged in liquid nitrogen for storage. Samples were thawed at 37°C for 15s, diluted 1:1 with coconut water solution, incubated for 10 min and analyzed. Mean volume of fresh semen was 46.25 ± 28.6 µL and mean concentration 330 ± 170.18 x 10⁶ sperm/ml. Results (mean ± SD) for pre- and post-thaw analysis, respectively, were as follows: total motility 67.25% ± 3.7 and 27.25% ± 4.58; progressive motility 53.5% ± 5.06 and 17.35% ± 3.44; plasma membrane integrity 74.05% ± 1.86 and 58.9% ± 3.28; acrosome integrity 89.55% ± 1.30 and 79.35% ± 2.97; and mitochondrial activity class I 41.07% ± 4.68 and 25.75% ± 2.90, class II 28.21% ± 2.60 and 40% ± 2.65, class III 13.21% ± 1.95 and 21.45% ± 1.97, and class IV 17.5% ± 4.40 and 12.8% ± 2.98. Means obtained in this study were higher than those obtained for other Neotropical primates. Although there was a decrease in all parameters post-thaw, a good percentage of the sperm were still viable. These results may serve as basis for future studies with this and other Neotropical primate species.

aBotubov- Botupharma Ind. e Com. de Prod. Veterinários Ltda.

LITERATURE CITED

ATTWATER’S PRAIRIE-CHICKEN (Tympanuchus cupido attwateri) RECOVERY PROGRAM AFTER 22 YEARS: HOPE BOOMS ETERNAL

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Abstract

The Attwater’s prairie-chicken (APC) (Tympanuchus cupido attwateri), a grouse species historically found in large numbers on the coastal prairies of Texas and Louisiana, was listed as endangered in 1967 under the Endangered Species Act of 1966. Habitat loss is primarily responsible for APC decline, and already by 1937, 93% of the 6 million acres of coastal prairie habitat was lost.¹ For the last 20 years, the species has been intensively managed with a wild population of fewer than 110 individuals dependent on the release of captive-reared birds. Several factors limit recovery of this species including poor brood survivability in the wild and insufficient numbers of birds for release.¹⁰ However, recent advances for the wild and captive populations promise some long awaited optimism for the full recovery of this species.

Decreased insect abundance was hypothesized to limit APC brood survivability in the wild. Insects are the main source of food for young prairie-chickens⁸ and compared to an increasing population of greater prairie-chickens (GPC) (Tympanuchus cupido pinnatus), APC brood habitat contained 70% fewer insects than GPC brood habitat (Pratt, unpublished data). Red imported fire ants (RIFA) (Solenopsis invicta) have a deleterious effect on insect abundance,⁶ and APC populations declined during the 25 year period following invasion of habitat by RIFA starting around 1970.⁴ A 2009-2012 investigation found that successful brood sites had over twice the number of insects compared to unsuccessful sites, and RIFA-suppressed areas had significantly more insects compared to untreated areas.⁴ These data clearly show that insect availability is a limiting factor for brood survival, and large scale RIFA treatment is planned for the 2014 season with improved brood survivability expected.

Ensuring a successful wild population is a matter of numbers. With an average survival of 17%, the release of 200 birds a year only results in 17 hens producing on average 4 total broods. Captive rearing facilities are at maximum capacity (65 breeding pairs), and are not able to produce enough chicks for release annually to achieve a self-sustaining wild population. The construction of a new facility in Oklahoma, with the eventual capacity to double the existing number of breeding pairs, could potentially tip the balance to a self-sustaining wild population by providing more birds for release.

The APC Recovery Program has achieved important successes. Post release survival of 17% is better than other pen-reared and released galliform species, including GPC,⁹ and grey partridge.⁷ The use of acclimation pens for 2 weeks prior to release improves survivability over a 3-day and 1-week acclimation period by 425%³ and 51%, respectively (Morrow unpublished data). Nest success has been increased with the use of predator deterrent fences; average nest success from
2000-2013 was 72% with fences, whereas nest success averaged 32% historically. Captive-reared birds seem to exhibit normal behavior, despite potential genetic bottlenecks and the selective effects of captivity over time. Released birds utilize habitat normally, although brood survival remains problematic. For hens that successfully reared broods from 2009-2012, there was no significant effect of any hen characteristics hypothesized to affect brood success, including age, whether captive-reared or wild bred, number of years since release, previous nest experience or success with fledging chicks. Availability of invertebrate resources is currently considered the best predictor of brood survival.

Significant improvements have also been made in the captive breeding of APC, resulting in increased production and thus greater numbers available for release. On average across the six breeding facilities, from 1996-2005 the number of chicks surviving to about 8 weeks was 186 (48%) and from 2006-2013 was 294 (59.5%). At the largest captive breeding facility, Fossil Rim Wildlife Center (FRWC), the same statistics show an even greater improvement, with average chick survival going from 52% to 74%. Several factors are likely responsible for this increase. A 2005 dietary study conducted in collaboration with the Fort Worth Zoo, FRWC and Houston Zoo resulted in dietary adjustments with likely the most significant change to the diet being the standardization of pelleted diet offered and decrease in amount of greens and insects offered to chicks. At FRWC the body weight of 4 week old chicks doubled after 2005 (McClements, unpublished data). Additionally, fine tuning and standardization of husbandry techniques, with annual meetings to share successful changes, have contributed to improved captive success. The development of a web-based database has improved record keeping and provided access to collected data for more prompt analysis. While challenges persist for the captive flocks, including inanition deaths during the first week, leg malformations, and population threats associated with reticuloendotheliosis virus, APC Recovery Program partners are encouraged by the overall trend of success.

Literature Cited
METASTATIC MINERALIZATION IN 4 PREHENSILE-TAILED PORCUPINES
(Coendou prehensilis)

Samantha Sander, DVM1*, Jessica Siegal-Willott, DVM, Dipl. ACZM1, Tim Walsh, DVM, Dipl. ACVP1, Kenton Kerns, MA2, Erin Kendrick, MS3, and Steven J. Sarro, BAAS2

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Abstract

Over a three-year period, four prehensile-tailed porcupine (Coendou prehensilis) at the National Zoological Park were diagnosed with hypercalcemia, hyperphosphatemia, and associated extensive soft tissue mineralization. Clinical signs ranged from asymptomatic to polydipsia, weight loss, and decreased mobility. Diagnostic testing, including serial radiographs, ultrasound, magnetic resonance imaging (MRI), computed tomography (CT), complete blood count, serum chemistry and vitamin D levels, as well as endocrine and infectious disease screening, to identify the cause of the aberrant hypercalcemia has been inconclusive to date, though idiopathic, genetic or nutritional hypervitaminosis D is suspected. Dietary hypervitaminosis D has been documented in other species, resulting in similar clinical signs.1-5

Husbandry modifications, including altered exposure to natural and artificial UVB spectrum lighting and nutritional adjustments to lower calcium, phosphorus, and vitamin D intake, were pursued concurrent with medical management, including antibiotic, analgesic, diuretic, steroid, gastroprotectant, fatty acid supplement, and phosphate binding therapeutics. Despite these strategies, persistent decreases in serum calcium and phosphorus derangements were not achieved and soft tissue mineralization progressed in all cases. Three of the four individuals have been euthanized to date. On necropsy, these individuals had reduced body fat stores and extensive soft tissue mineralization, especially notable in the skeletal muscle, heart, and kidneys. Two cases had concurrent pulmonary disease, including one case of fungal tracheitis and one case of Mycobacterium avium pneumonia. Continued medical management and husbandry modifications for the remaining affected individual persist, and collaboration with other institutions to identify pathogenesis and possible intervention points for this disease process is being pursued.

LITERATURE CITED
DILATED CARDIOMYOPATHY IN CAPTIVE SLENDER-TAILED MEERKATS
(Suricatta suricata)

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1University of Florida, Department of Small Animal Clinical Sciences, College of Veterinary Medicine, Gainesville, Florida, 32610, USA; 2Disney’s Animals, Science & Environment, Lake Buena Vista, Florida, 32830, USA

Abstract

A group of five captive-born meerkats and nine wild-caught meerkats underwent cardiovascular evaluations. Clinical signs associated with heart disease such as dyspnea, lethargy, inappetence and collapse were present in two captive-born meerkats. Physical examination under anesthetic restraint identified systolic murmurs and gallop rhythms. Hematologic and biochemical profiles and whole body radiography were performed. Identification of cardiomegaly and pulmonary edema in one animal led to full cardiac evaluations in the group. Echocardiography revealed left ventricular enlargement/dilation and moderate to severe systolic dysfunction in seven meerkats. The most severely affected animal was tested for plasma carnitine and taurine levels. Results were elevated when compared to canine known reference values. Therapy was initiated for all affected animals with an angiotensin converting enzyme inhibitor (benazepril, 0.4 mg/kg p.o. s.i.d.) and pimobendan2 (0.25 mg/kg p.o. b.i.d.). In one animal with suspected congestive heart failure, furosemide therapy (2 mg/kg i.m. q4-12h) was initiated for stabilization and management. This animal initially improved clinically but again became dyspneic and was euthanized 48 hours later due to anorexia and dehydration. Other affected animals developed clinical signs consistent with congestive heart failure 5 to 11 months following initial diagnosis and were euthanized. Ten animals remain alive at the time of writing. Gross and histopathologic examination of the animals confirmed the clinical diagnosis of congestive heart failure due to dilated cardiomyopathy. Dilated cardiomyopathy is a common disease in canine and human patients. Potential causes include genetic, infectious, immune-mediated, toxic, nutritional, and metabolic processes.

ACKNOWLEDGEMENTS

We would like to thank Mrs. Melanie Powell of the University of Florida’s College of Veterinary Medicine, as well as the veterinary pathology department, veterinary clinical and animal care staff for meerkats at Disney’s Animal Kingdom.

LITERATURE CITED

HEMATOLOGY AND CLINICAL CHEMISTRY REFERENCE RANGES OF REEVE’S TURTLE (*Mauremys reevesii*)

*Yuan-peng Kuan, DVM, MS*1*, Ying-hui Wu, DVM, MS1, and Chau-hwa Chi, DVM, PhD2*

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Abstract

The Reeve’s turtle (*Mauremys reevesii*) is one of the four freshwater turtle species endemic to Taiwan. Due to overharvesting and habitat destruction, the Reeve’s turtle is now nearly extinct in Taiwan, and the only stable population is currently restricted to Kinmen Island. The status of this turtle according to the IUCN Red List is currently listed as “endangered” and it is protected in Taiwan as an endangered species under the Wildlife Conservation Law. Hematology and blood biochemical parameters are very useful tools in clinical veterinary medicine, however detailed information on hematologic variables and plasma biochemical profiles of *M. reevesii* has not been reported.

Reference ranges of hematologic and plasma biochemical parameters were established for 27 (12 male and 15 female) captive mature and clinically healthy Reeve’s turtles. Blood samples were collected from the jugular vein from all individuals with samples collected in each of four seasons. Values collected in the fall are provided in Table 1. These blood profiles were further analyzed to determine the effects of sex and season. Significant sex differences were observed in AST, calcium, phosphorus, cholesterol, total protein and triglycerides levels. Seasonal variations related to changes in food intake and metabolic function were noted in most parameters, but not the white blood cell count, AST and ALT levels. The sex and seasonal differences were primarily associated with changes in female reproductive status and the lower temperature in winter (wintering).
Table 1. Hematology and biochemistry ranges for *Mauremys reevesii* in fall

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range(^a)</th>
<th>All turtles n=27</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean Median SD</td>
</tr>
<tr>
<td>Hb (g/dL)</td>
<td>4–7.4</td>
<td>5.8 0.8</td>
</tr>
<tr>
<td>PCV (%)</td>
<td>18–30</td>
<td>25(^b) -</td>
</tr>
<tr>
<td>RBC (10(^6)/µL)</td>
<td>0.44–0.86</td>
<td>0.63 0.11</td>
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<tr>
<td>MCV (fl)</td>
<td>244–547</td>
<td>398 74</td>
</tr>
<tr>
<td>MCH (pg)</td>
<td>63–132</td>
<td>95 16</td>
</tr>
<tr>
<td>MCHC (g/dL)</td>
<td>20–30</td>
<td>24(^b) -</td>
</tr>
<tr>
<td>WBC (10(^3)/µL)</td>
<td>7.7–26.6</td>
<td>12.8(^b) -</td>
</tr>
<tr>
<td>Heterophils (%)</td>
<td>13–66</td>
<td>37 15</td>
</tr>
<tr>
<td>Eosinophils (%)</td>
<td>0–1</td>
<td>- -</td>
</tr>
<tr>
<td>Basophils (%)</td>
<td>26–82</td>
<td>55 16</td>
</tr>
<tr>
<td>Lymphocytes (%)</td>
<td>0–7</td>
<td>2 2</td>
</tr>
<tr>
<td>Monocytes (%)</td>
<td>1–9</td>
<td>5 2</td>
</tr>
<tr>
<td>Heterophils (10(^3)/µL)</td>
<td>1058-8058</td>
<td>5371 1899</td>
</tr>
<tr>
<td>Eosinophils (10(^3)/µL)</td>
<td>0-108</td>
<td>- -</td>
</tr>
<tr>
<td>Basophils (10(^3)/µL)</td>
<td>2541-19391</td>
<td>8732 4527</td>
</tr>
<tr>
<td>Lymphocytes (10(^3)/µL)</td>
<td>0-708</td>
<td>196(^b) -</td>
</tr>
<tr>
<td>Monocytes (10(^3)/µL)</td>
<td>238-2198</td>
<td>809 492</td>
</tr>
<tr>
<td>Total protein (g/dL)</td>
<td>2.9–5.5</td>
<td>3.7(^b) -</td>
</tr>
<tr>
<td>Albumin (g/dL)</td>
<td>0.8–1.9</td>
<td>1.2 0.3</td>
</tr>
<tr>
<td>Ca (mg/dL)</td>
<td>8.8–15.2</td>
<td>12.3 1.6</td>
</tr>
<tr>
<td>Triglyceride (mg/dL)</td>
<td>31–527</td>
<td>241(^b) -</td>
</tr>
<tr>
<td>LDH (U/L)</td>
<td>881–2414</td>
<td>1285 481</td>
</tr>
<tr>
<td>Phosphorous (mg/dL)</td>
<td>2.5–4.6</td>
<td>3.1 0.5</td>
</tr>
<tr>
<td>Creatinine (mg/dL)</td>
<td>0.1–0.2</td>
<td>0.2(^b) -</td>
</tr>
<tr>
<td>CK (U/L)</td>
<td>138–1153</td>
<td>511 239</td>
</tr>
<tr>
<td>Glucose (mg/dL)</td>
<td>36–106</td>
<td>66 16</td>
</tr>
<tr>
<td>Cholesterol (mg/dL)</td>
<td>45–210</td>
<td>128 49</td>
</tr>
<tr>
<td>BUN (mg/dL)</td>
<td>7–64</td>
<td>17(^b) -</td>
</tr>
<tr>
<td>GGT (U/L)</td>
<td>&lt;5</td>
<td>- -</td>
</tr>
<tr>
<td>AST (U/L)</td>
<td>78–409</td>
<td>204(^b) -</td>
</tr>
<tr>
<td>ALT (U/L)</td>
<td>3–26</td>
<td>13 6</td>
</tr>
<tr>
<td>ALKP (U/L)</td>
<td>40–121</td>
<td>60(^b) -</td>
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<tr>
<td>Uric acid (mg/dL)</td>
<td>1.3–3.4</td>
<td>1.8(^b) -</td>
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<td>Na (mmol/L)</td>
<td>129–151</td>
<td>141 5</td>
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<tr>
<td>K (mmol/L)</td>
<td>3.3–5.5</td>
<td>4.5 0.5</td>
</tr>
<tr>
<td>Cl (mmol/L)</td>
<td>95–110</td>
<td>104 3</td>
</tr>
</tbody>
</table>

\(^a\) Reference ranges were defined by minimum and maximum values or the mean ± SD for normally distributed variables.

\(^b\) For non-normally distributed variables, the reference ranges were defined by the median rather than the mean value.

\(^c\) No standard deviations are presented for non-normally distributed variables.

PCV = packed cell volume; RBC = red blood cell; MCV = mean corpuscular volume; MCH = mean corpuscular hemoglobin; MCHC = mean corpuscular hemoglobin concentration; WBC = white blood cell; LDH = lactate dehydrogenase; CK = creatine kinase; BUN = blood urea nitrogen; GGT = \(\gamma\)-glutamyltransferase; AST = aspartate aminotransferase; ALT =alanine aminotransferase; ALKP = alkaline phosphatase.
COLONIC IMPACTIONS IN IBERIAN RIBBED NEWTS (*Pleurodeles waltl*)

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Abstract

The Philadelphia Zoo has maintained a colony of Iberian ribbed newts since their acquisition in 1998. In January 2012, a newt presented for abnormal buoyancy and was found impacted with a palpable hard intracoelomic mass. An enterotomy was performed to remove a colonic mass consisting of firm, dark, unidentifiable material. One month later, additional surgery was performed to repair incisional dehiscence and a markedly dilated distal colon was noted at that time. One year later, the same newt again had surgery to relieve a colonic impaction with similar material. This animal was euthanized 1 mo later after post-operative complications due to recurrent incisional dehiscences. In August 2013, another newt underwent surgery to relieve a colonic impaction. This animal experienced post-operative incisional complications which were resolved using stented sutures. This newt healed completely and remains alive 11 mo post-operatively.

Review of all records from 1998-2014 identified nine additional newts with marked colonic dilation and impactions. Necropsy findings for all cases have been consistent, describing a firm, dark mass markedly distending the distal colon as the likely cause of death. Modified Gimenez (PVK) stains were performed to test for *Chlamydophila* spp. in six cases in which granulomatous inflammation was seen on histology and all were negative. The etiology of these impactions has not been determined although sources from within the enclosure appear unlikely. A dietary source remains a possibility. Following a switch in diet from earthworms to redworms (*Alloloborpha caliginosa*) no addition cases have been seen to date.

ACKNOWLEDGMENTS

The authors are grateful to the technical staff at the Philadelphia Zoo for their assistance during the procedures and to the keepers who care for these animals on a daily basis. The authors acknowledge Alisa L. Newton, VMD, Dipl. ACVP for her diagnostic work in a portion of these cases.
COMPARISON OF THREE ANESTHETIC PROTOCOLS FOR CAPTIVE ANDEAN HAIRY ARMADILLO (*Chaetophractus nationi*)

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Abstract

Between 2010 and 2014 a total of 42 anesthetic events were performed on nine (six male, three female) captive Andean hairy armadillo (*Chaetophractus nationi*) housed at a zoo in Peru. Three different protocols were used: ketamine (15 mg/kg) – xylazine (1 mg/kg) – midazolam (0.4 mg/kg),1 (Ke-Xy-Mi; n=18); ketamine (7 mg/kg) – dexmedetomidine (0.04 mg/kg) – midazolam (0.1 mg/kg), (Ke-Dex-Mi; n=15) and ketamine (7 mg/kg) – medetomidine (0.08 mg/kg) – midazolam (0.1 mg/kg), (Ke-Me-Mi; n=9), with all agents administered by intramuscular injection (IM). Cardiorespiratory parameters were documented and quality of anesthesia was evaluated. Good levels of sedation and anesthesia were attained with all three protocols. Induction times were similar for the three protocols. However, recovery times post-alpha-2 agonist reversal were shorter with the Ke-Me-Mi and Ke-Dex-Mi combinations, where atipamezole (0.4 mg/Kg, IM) was used, in contrast to the Ke-Xy-Mi where yohimbine (0.2 mg/Kg, IM) was used. The degree of sedation and the level of muscle relaxation were of superior quality with the Ke-Me-Mi and Ke-Dex-Mi. Bradycardia was observed in all protocols, with a more pronounced decreased observed in animals anesthetized with Ke-De-Mi. Respiratory rate decreased the most in the Ke-Xy-Mi group. However pulse oximetry values showed mild hypoxia ($SO_2 \leq 90\%$) in the Ke-Dex-Mi and Ke-Me-Mi groups during the first 10 min and 20 min, respectively. Rectal temperature decreased the most in animals anesthetized with Ke-Dex-Mi. In conclusion, all three protocols are considered safe and effective for the chemical immobilization of Andean hairy armadillos, but the Ke-Me-Mi and Ke-Dex-Mi had shorter reversal times.

LITERATURE CITED

EVALUATING DIFFERENT METHODS FOR READING COMPLETE BLOOD COUNTS IN AFRICAN AND SOUTH AMERICAN CICHLIDS: USING AGREEMENT ANALYSIS TO DETERMINE THEIR VALUE

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Department of Veterinary Clinical Medicine, College of Veterinary Medicine, University of Illinois at Urbana-Champaign, Urbana, IL, 61802, USA

Abstract

Fish are stoic animals that are masters at masking their illness. While this evolutionary trait is a protective mechanism for these animals, it can make the job of the veterinarian working with them challenging. To determine the true immunologic status of a fish requires more invasive testing than an external examination. One of the first order diagnostics performed on fish is bloodwork. The complete blood count (CBC) is an important diagnostic for assessing the blood cell status of these animals. One potential pitfall associated with this diagnostic test is that counts must be done manually because all cell types are nucleated. The manual techniques used to assess CBCs in fish include methods that are as simple as reading cell numbers from a slide, to methods that are semi-quantitative and attempt to estimate cell numbers using standardized methods (e.g., hemocytometer). In an attempt to determine the value of these methods, blood samples were collected from 28 different cichlids. Manual slide counts were performed by two different evaluators and cytochemical stains (alkaline phosphatase, periodic acid Schiff) were performed to characterize the different cell types. Cytochemical stains reveal differences in staining characteristics for white blood cells within and between species. Agreement analysis was performed using Bland Altman plots and Passing-Bablok regression was performed to characterize bias. The level of agreement was found to vary from fair to good for cell count and cell types. It is important to recognize that CBC’s in fish should be interpreted using a relative versus absolute scale.
EPIDEMIOLOGY OF NASO-ORAL SQUAMOUS CELL CARCINOMA IN FRANCOIS’ LANGURS (Trachypithecus francoisi)

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1Department of Animal Care, Lincoln Park Zoo, Chicago, IL 60614 USA; 2Texas Veterinary Pathology, San Antonio, TX 78217 USA; 3Northwest ZooPath, Monroe, WA 98272 USA; 4Philadelphia Zoo, Philadelphia, PA 19104 USA

Abstract

With support of the Old World Monkey TAG and the Francois’ langur (Trachypithecus francoisi) studbook, a review of the current and historic captive AZA population was undertaken. During evaluation of a separate disease process in a targeted population (n=158), five cases of naso-oral squamous cell carcinoma (SCC) were identified. Initial epidemiologic analysis of these cases uncovered a familial relationship. Further assessment of records for directly related animals (n = 59) identified six additional SCC cases.1 Median age of death of affected animals (seven males, four females) was 15.6 years. Clinically, affected animals were reported with weight loss, difficulty eating, missing or loose teeth noted during examination, and chronic nasal or ocular discharge. At presentation, affected animals were found with masses or ulcerated swellings of the maxillary gingiva, nasal sinuses, tongue, or oropharynx. Affected animals also were reported with a range of associated oral conditions, including abscesses, glossitis, stomatitis, and mucosal disruptions. Surgical debridement was attempted in four cases but local recurrence was a common sequella, leading to deteriorating clinical condition necessitating euthanasia. Median survival time from onset of clinical signs was five months. Histologic findings included local invasion of anaplastic epithelial cells and peripheral nests of basaloid cells with necrosis. Although a solitary case of oral SCC has been reported in this species from a population separate from this evaluation, this case series suggests a familial predilection for SCC in this species.2 Close monitoring of living animals is recommended, especially for individuals related to identified cases.

LITERATURE CITED

BODY CONDITION SCORING IN THE HOUSTON TOAD (Bufo[Anaxyrus] houstonensis)

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Abstract

The Houston toad (Bufo [Anaxyrus] houstonensis) is an endangered amphibian native to east-central Texas.¹ The Houston Zoo’s amphibian conservation quarantine facility was established to head start wild-collected egg strands, serve as an assurance colony, and provide a site for captive propagation and egg release to the wild. Thus far, body condition scoring (BCS) has been primarily used in domestic mammals such as bovines, equines, canines, and felines. This project combines basic BCS principles used in domestic mammals with toad-specific parameters to create a body condition sheet for the adult Houston toad. A total of 28 adult female toads and 12 adult male toads were observed and measured for this project. Observational parameters included degree of pelvic bone protrusion, degree of parotoid gland protrusion, body fat amount, muscle mass amount, and abdominal size. Measured parameters included body weight (BW), snout to urostyle length (SUL), and head width (HW). Measured parameters were taken from each adult Houston toad and averaged together to create an ideal BW:SUL:HW ratio. The combination of observational parameters and ideal ratios was the basis of the BCS system. A healthy BW:SUL:HW ratio for an adult Houston toad is 2:3:1. Gravid adult female Houston toads should have a ratio of 2.5:3:1. Although this BCS was made specifically for the Houston toad, it may be possible to adapt it for use in other similar species of toads.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the Houston Zoo, in particular the veterinary services department and conservation department. Special thanks to former Houston Zoo amphibian program manager, Paul Crump and Lead Houston toad keeper, Tyler Parker.

LITERATURE CITED

MEDICAL MANAGEMENT OF BLASTOMYCOSIS IN A WILD-BORN YOUNG POLAR BEAR (Ursus maritimus)

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Abstract

Blastomycosis occurs most commonly in humans, dogs, and cats, but cases have also been reported in a variety of non-domestic species, including pinnipeds1,4,8, exotic felids7, and ursids2,3,5 Pathology typically includes thoracic disease with occasional spread to other viscera, the central nervous system, bone, eyes, and skin. Three previous cases of blastomycosis have been reported in Ursidae including one case in a free-ranging American black bear (Ursus americanus)3 and two in zoo housed polar bears (Ursus maritimus)2.

A 2.5 year old female polar bear presented with a mild left rear leg lameness that progressed to a localized draining abscess. Histopathology of granulomas collected at surgical debridement demonstrated a necrotizing pyogranulomatous lymphadenitis with intralesional fungal yeast morphologically consistent with Blastomyces dermatitidis. Additional diagnostics demonstrated a marked leukocytosis and fungal pneumonia. Four days after initiation of treatment withitraconazole, the bear became profoundly weak, anorexic, dyspnic, and unwilling to move. In humans, Acute Respiratory Distress Syndrome (ARDS) can be a complication during treatment of blastomycosis, especially in immunocompromised patients. Corticosteroids have been shown to reduce mortality in human blastomycosis patients suffering from ARDS,6 Addition of corticosteroids to the treatment regime resulted in marked improvement in the bear. This particular bear was likely immunologically naïve as it was wild born and recovered after being abandoned by its dam in northern Alaska.

Results of this case report show the importance of considering blastomycosis as a possible etiology in musculoskeletal disease in polar bears, the benefits of anti-inflammatory doses of corticosteroids as an adjunct to treatment, and the application of antigen detection testing to monitor disease status and assist with determining treatment length.

ACKNOWLEDGEMENTS
The authors thank Drs. Aric Applewhite, Forrest Cummings, Scott Rizzo, Al Legendre, Karen Campbell, Erica Tolar, Ed Ramsay for their consultations and the staff of the Louisville Zoo for their skills in animal care.

LITERATURE CITED
EVALUATION OF DIAGNOSTIC TESTS FOR ANTE-MORTEM TUBERCULOSIS SCREENING IN CAPTIVE SLOTH BEARS (Melursus ursinus)

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Abstract

Confirmatory ante-mortem diagnosis of tuberculosis in wild animals remains a difficult proposition for zoo veterinarians.2 As in the case of many other wild species, there is critical lack of accredited tests for tuberculosis screening in sloth bears (Melursus ursinus). Isolation and identification of the Mycobacterium tuberculosis/bovis by culture is the gold standard for tuberculosis diagnosis in any species. Methods utilizing cell-mediated immune response as well as humoral antibody response have been tried in several wild species. However, the diagnostic sensitivity and specificity of these ante-mortem tests, accredited for use in humans, are unknown in wild species. We evaluated various available techniques and methods for ante-mortem tuberculosis screening in 14 sloth bears. During post mortem examination, M. tuberculosis was isolated and identified by culture from the 14 carcasses, in nodules in lung parenchyma. The culture results were compared with ante-mortem test results (chest radiography, routine blood analysis3, tuberculin skin test, acid-fast staining of tracheal smears, culture and nucleic acid amplification of lung wash, QuantiFERON-TB Gold®, STAT-PAK® and DPP Vet Assay®). None of the ante-mortem tests gave positive results in all the 14 cases, but some tests seem to show better correlation with culture than others. Tuberculosis in captive sloth bears represents a typical case of spillover infection resulting from human cohabitation.1 Ascertaining the diagnostic sensitivity and specificity of the various ante-mortem tuberculosis screening tests will help in the early diagnosis and treatment monitoring of this chronic disease in this endangered species.

LITERATURE CITED
LUNGWORM INFECTION IN STRANDED BELUGA (*Delphinapterus leucas*) FROM THE ST. LAWRENCE ESTUARY (QUEBEC, CANADA)

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¹Centre québécois sur la santé des animaux sauvages / Canadian Cooperative Wildlife Health Centre. Faculté de médecine vétérinaire, Université de Montréal, St. Hyacinthe, Qc J2S 2M2 Canada; ²Maurice Lamontagne Institute, Fisheries and Oceans Canada, Mont-Joli, Qc G5H 3Z4 Canada

Abstract

The present study describes the occurrence of lungworm infections in stranded beluga (*Delphinapterus leucas*) from the St. Lawrence Estuary (Quebec, Canada). Estimated intensities of nematodes were obtained from systematic analysis of both lungs of 33 carcasses sampled from 2004 and 2013. Associations between nematode abundance, sex, age groups, body condition, and cause of death were evaluated. Lungworms were detected in 91% of the cases. Verminous pneumonia was identified as the cause of death in five beluga. Two species of pulmonary nematodes were identified: *Stenurus arctomarinus* and *Halocercus monoceris*. Nematodes of an unidentified species were also present in one beluga. Co-infections with *S. arctomarinus* and *H. monoceris* were present in most of the infected beluga (63%). *Halocercus monoceris* was the most common species of nematode found with a prevalence of 85% (mean intensity: 254 nematodes; min–max: 1–1931; median: 60). The prevalence of *S. arctomarinus* was 61% with a mean intensity of 34 nematodes (min–max: 1–356; median: 2). The mean abundance of *H. monoceris* was significantly higher in animals for which verminous pneumonia was the cause of death. Newborns were significantly less infected by both nematodes (*S. arctomarinus* prevalence: 20%, mean intensity: 2; *H. monoceris* prevalence: 40%, mean intensity: 4.5) than weaned juveniles and adults (*S. arctomarinus* prevalence: 68%, mean intensity: 36; *H. monoceris* prevalence: 93%, mean intensity: 273). This suggests that even if vertical (transplacental or transmammary) transmission occurs; this mode of infection may be less significant than horizontal transmission.
USING VOIED URINE TO MONITOR KIDNEY FUNCTION IN FELIDS AT TARONGA ZOO, AUSTRALIA

Rachel D’Arcy, BVSc(Hons), GradDipEd¹, Kimberly Vinette Herrin, MS, DVM²*, Paul Thompson, BMSc(Path), MS², Louise Ginman BSc², and Jacqueline Norris BVSc(Hons) MVS PhD¹

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Abstract

Chronic kidney disease (CKD) is a common cause of morbidity and mortality in zoo felids. Retrospective analysis (1973-2013) at Taronga (TZ) and Taronga Western Plains Zoos identified CKD as cause of mortality in 15 of 29 felids. Elevated serum creatinine and urea were late and insensitive markers for CKD, with time from onset of azotemia to death ranged from 0 - 15 months. Where prior urine specific gravity (USG) data was available (n=9), urine was inadequately concentrated (USG<1.035) for prolonged periods before onset of azotemia (median 1.6 yrs, range 0.2-9.9 yrs).

This prospective study was designed to investigate urine as an early screening tool for CKD. Fresh voided urine samples (n=101) were collected from night enclosures of all eleven TZ felids, requiring no human-felid contact. Urinalysis included USG (handheld refractometer); glucose, bilirubin, ketones, blood, pH, protein (reagent strip); urine protein:creatinine ratio and microalbuminuria immunoassay⁴.

Voided urine from clinically healthy TZ felids was highly concentrated (USG 1.066 ±0.008) and negative for microalbumin (Table 1). Two snow leopards (Uncia uncia) had high physiological proteinuria. Sequential sampling revealed urine parameters are consistent for individual felids, allowing reliable inferences to be made.

One clinically well 12yo female fishing cat (Prionailurus viverrinus) exhibits persistently inadequate urine concentration (USG 1.018–1.038), warranting further investigation of kidney function.

For large predatory felids, sequential voided urine collection from night dens is a simple, non-invasive, inexpensive tool. Continuation of this longitudinal study aims to demonstrate the value of monitoring urine parameters for earlier detection of CKD.

⁴Heska E.R.D.-HealthScreen® Feline Urine Tests, Heska Corporation, 3760 Rocky Mountain Ave, Loveland, Co, 80538, USA.

ACKNOWLEDGEMENTS
Sincere thanks go to the staff of Taronga Wildlife Hospital and Taronga Zoo Carnivore Department for 16 months of frequent urine collection and analysis, the Jenna Donley Memorial Fund for financial support of this ongoing study and the Morris Animal Foundation for their ongoing support of this research.
Table 1: Summary of USG and UP:C values of voided urine from 11 Taronga Zoo felids.

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<th>VOIDED URINE SPECIFIC GRAVITY</th>
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<td>Median</td>
<td>S.D.</td>
<td>Range</td>
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<td>0.007</td>
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* single sample by cystocentesis at end of general anaesthesia

2014 Proceedings Annual Conference AAZV 163
DEVELOPMENT OF A QUANTITATIVE PCR DIAGNOSTIC TEST FOR A NOVEL ADRENAL COCCIDIAN PARASITE OF LEATHERBACK SEA TURTLES,  
(DERMOCHELYS CORIACEA)

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Abstract

Leatherback turtles (Dermochelys coriacea) are the most critically endangered sea turtle species, with populations decreasing over 70% globally in less than one generation.1 Recently, a novel parasite has been identified histologically in adrenal lesions. While this parasite does not present with typical coccidian morphology, consensus PCR and sequencing yielded a novel coccidian 18S rRNA sequence.2 Bayesian and maximum likelihood phylogenetic analyses identified this as a novel member of the Eimeriidae. A quantitative PCR (qPCR) assay was then designed to determine whether the adrenal lesions corresponded to the coccidian sequence. Specificity was confirmed against leatherback turtle samples without lesions and a variety of other coccidia. Samples taken from various leatherback necropsies known to have the coccidian parasite present were run on the qPCR assay. Copies detected by qPCR correlated significantly with the total histological score with central bodies present, as well as with the overall density with a cellular component. This supports the classification of this parasite as a coccidian life stage, likely a schizont. The development of a qPCR assay greatly decreases the time and cost to test for this parasite and improves the efficiency of diagnosis. This test is useful for screening additional animals and other samples to further understand the life cycle and epidemiology of this adrenal parasite and its possible impacts on the leatherback population as a whole.

ACKNOWLEDGEMENTS

We thank Morris Animal Foundation for a Morris Veterinary Student Scholars Program award to Sara Ferguson and thank Dr. Ammon Peck for additional student funding.

LITERATURE CITED

DEVELOPMENT OF A QUANTITATIVE PCR ASSAY FOR A NOVEL ADENOVIRUS IN THE BOX TURTLE, (Terrapene carolina)

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Abstract

Historically, a number of mortality events have been observed in Eastern box turtles with iridoviruses and other unknown causes. Novel adenoviruses have recently been detected by consensus PCR in several chelonian species, including Eastern box turtles (Terrapene carolina). This species is highly vulnerable to population declines from the loss of a relatively small number of adults. Diagnostic testing has been limited to relatively labor intensive consensus PCR techniques. A qPCR assay targeting a specific and conserved region of the DNA polymerase gene of the novel Box turtle adenovirus 1 was designed to allow for rapid and sensitive diagnosis. The qPCR reaction was run on several samples determined by consensus PCR to be Box turtle adenovirus 1 positive, and was able to detect as little as 10 counts of DNA in a sample. The results were consistent and analytically specific to this virus. The assay was used to screen wild and captive populations of box turtles for the virus.
EVALUATION OF ENDOSCOPIC TUBECTOMY FOR STERILIZATION OF FEMALE FORMOSAN MACAQUES (*Macaca cyclopis*)

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Abstract

Formasan macaque (*Macaca cyclopis*) is a native primate in Taiwan in the Cercopithecidae family. They are highly adapted to all kinds of environments and habitats.3 As in other countries, human-macaque conflict is also present in Taiwan. Therefore, numerous management strategies have been proposed.1,4 Among the various contraceptive techniques, one of them is endoscopic tubectomy. This procedure refers to cautery to cut off a segment of the fallopian tube with laparoscopic and bipolar coagulation set-up to occlude the tubes.2 The purpose of the study reported here was to record the complications encountered during the surgery and the long term effects of endoscopic tubectomy to Formosan macaques. 19 Formosan macaques were anesthetized for endoscopic tubectomy and complications of the surgeries were recorded. Severity of intraoperative hemorrhage was objectively scored. The pattern of serum sex hormones was evaluated for two ovarian cycles following the surgery. Two to thirteen months later, eight of 19 macaques again underwent endoscopic observation of the surgical sites. During the evaluation, inflammatory scores of the cut ends and reproductive system were objectively scored. The most frequent complications were meso-salphingeal and meso-ovarian bleeding. No serious complications were found in the study. The average hemorrhagic score was 1.21. Little postoperative inflammation was recorded and the average inflammatory score was 1.59. 24 of 32 cut ends were identified with no recanalization. The hormone pattern was not affected by tubectomy. In this study, laparoscopic tubectomy was proved to be a safe, effective, lifetime sterile, technique for wild macaques in many aspects.

LITERATURE CITED

LABORATORY DIAGNOSIS OF CYTAUXZOOM FELIS INFECTION IN LIONS
(Panthera leo) IN BANNERGHATTA BIOLOGICAL PARK

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1Scientist, Wild Animal Disease Diagnostic Lab, IAH & VB, Bannerghatta Biological Park, Bangalore – 560083 India; 2Veterinary Officer, Bannerghatta Biological Park, Bangalore - 560083, India

Abstract

Cytauxzoon felis is a protozoal organism found in domestic cats and wild felids that is transmitted by tick bites. During a study to evaluate hematology and biochemistry parameters in captive lions, piroplasms were observed in stained blood films of 26 adult lions (one fourth of the total lion population) housed in a rescue center and lion safari of Bannerghatta Biological Park. Intra-erythrocytic, signet ringed shaped piroplasms measuring 1 to 1.5 µm, were identified in wet blood smears using Hayem’s fluid and Giemsa stained blood films. Eight out of 26 animals subsequently became ill, but the remaining 18 animals did not exhibit any clinical signs of disease. Anorexia, lethargy, weakness, pale mucous membranes, icterus, pancytopenia and thrombocytopenia were the most common clinic-pathologic abnormalities noticed. The hematocrit value in all affected lions decreased below 8g/dL. A regenerative response to anemia was recognized in six lions that were subjected to treatment with azithromycin (10 mg/kg) and supportive therapy for three days. Thrombocytopenia and probable leukopenia occurred in two animals out of eight infected lions which died subsequently without responding to treatment. The most consistent clinical chemistry findings were increased serum bilirubin concentrations, increased alanine aminotransferase and aspartate aminotransferase activities at the time of initial recognition of parasitemia. Serum protein findings were not consistent in those eight infected lions. In this report, we demonstrate the mild hemolytic anemia, and probably liver dysfunction, concomitant with infection of Cytauxzoon felis piroplasms in lions.

ACKNOWLEDGEMENTS
The authors would like to acknowledge Executive Director, Bannerghatta Biological Park and Assistant Director (Veterinary Services), and Bannerghatta Biological Park for their continuing support.
CO-INFECTION WITH CALIFORNIA SEA LION ADENOVIRUS 1 AND A NOVEL POLYOMAVIRUS IN A HAWAIIAN MONK SEAL (Monachus schauinslandi)

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1University of Florida, Department of Small Animal Clinical Sciences, College of Veterinary Medicine Gainesville, Florida, 32610, USA; 2Sea Life Park Hawaii, Waimanalo, Hawaii, 96795, USA; 3Environmental and Global Health, College of Public Health and Health Professions, and Emerging Pathogens Institute; University of Florida, Gainesville, FL 32610, USA; 4University of Illinois Zoological Pathology Program, LUMC Bldg 101 Rm 0745, 2160 S. First Ave, Maywood, IL 60153, USA; 5University of Florida, Infectious Diseases and Pathology, Gainesville, Florida, 32610, USA

Abstract

The Hawaiian monk seal (HMS, Monachus schauinslandi) is a critically endangered species with less than 1,200 individuals left. Here, we present a clinical case of a 26 year old male Hawaiian monk seal with a history of poor appetite followed by the development of renal and heart disease, but no clinical evidence of hepatic disease. Histologic examination found eosinophilic intranuclear inclusions in the liver, compatible with a herpesvirus, adenovirus and/or polyomavirus. We used consensus nested PCR protocols to test for these viruses2-4. Icosahedral virions of 70-80 mm, compatible with adenoviruses, were seen using electron microscopy. Cell culture cytopathic effects were compatible with an adenoviral infection. Finally, the sample was positive for adenovirus and polyomavirus via PCR/sequencing. The adenoviral polymerase sequence obtained was 100% homologous to California sea lion adenovirus-1 (CSLAdV-1). CSLAdV-1 is associated with viral hepatitis in California sea lions and there have been recent reports of fulminant hepatitis in other species of otariids in an aquarium in Japan (Otaria flavescens and Arctocephalus pusillus)4. The sequence has been submitted in GenBank as Otaria flavescens adenovirus-1 in Spain. This is the first report of CSLAdV-1 infection in a phocid, and suggests that this virus may be a concern in diverse pinniped collections. The polyomavirus is novel and is the first polyomavirus found in Hawaiian monk seals. This new virus is 83% homologous to California sea lion polyomavirus-1. This is the first report of viral co-infection in a Hawaiian monk seal. The clinical significance of both viruses in the overall clinical case remains unclear.

ACKNOWLEDGEMENTS

The diagnostic assay for CSLAdV1 was developed using Prescott grant award Number: NA12NMF4390156 to JFXW.

LITERATURE CITED

EQUINE HERPESVIRUS IN POLAR BEARS (*Ursus maritimus*) AND EXOTIC EQUIDS HOUSED IN US AZA INSTITUTIONS

John A. Flanders, DVM1*, Ray F. Wack, DVM, MS, Dipl ACZM2, Darin Collins, DVM3, Nicola Pusterla, DrMedVet4, and Kathryn C. Gamble, DVM, MS, Dipl ACZM, Dipl ECZM (Zoo Health Management)1

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Abstract

Equine herpesvirus (EHV) can cause a range of disease in equids, from respiratory infections [EHV-4] to neurologic disease [EHV-1], while other strains [e.g., EHV-9] have not been shown to cause clinical disease.6 Cross-infection of non-equid zoo species with EHV-1 is rare, but clinical disease has been reported.1, 4, 5, 7 In 2007, a polar bear (*Ursus maritimus*) housed in a US zoological facility died from progressive neurologic disease in which post-mortem analysis revealed EHV-9 within its nervous tissue.2 While the affected polar bear had no direct contact with exotic equids, the same strain of virus had been detected in two Grevy’s zebras (*Equus grevyi*) housed within 200 feet of the bear.8 Similarly, in 2010, two polar bears from a European zoological facility developed neurologic disease, and one died.3 Post-mortem analysis on nervous tissue of the deceased bear revealed a recombinant strain of EHV-1 and -9; these bears also had no direct contact with zebras, although their enclosure was within 200 feet of an enclosure with plains zebra (*Equus quagga*) of unknown serologic status.3 Since these initial cases, EHV-1 has been detected in the nervous tissue of four captive black bears (*Ursus americanus*) that died from neurological disease.9 The present investigation was undertaken to evaluate the serologic status of EHV in US AZA institutions housing polar bears (n=32) with (n=24) and without (n=8) exotic equids in the collection to establish disease prevalence and assess risk factors for disease transmission and prevention.

LITERATURE CITED

IDENTIFICATION AND PHYLOGENETIC ANALYSIS OF TWO NOVEL MICROCEBUS MURINUS HERPESVIRUSES AND POSTERIOR qPCR ASSAY DEVELOPMENT

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Abstract

Herpesviruses are important human and non-human primate pathogens, having their most significant impact, most of the time, after crossing over from their natural host to an aberrant host. Although many studies have been done to characterize catarrhine and platyrrine herpesviruses, nothing is known about their impact in the prosimian population. Herpesvirus-like particles have previously been reported from a loris with lymphoma1. The objective of this study was to identify and characterize possible herpesviruses in prosimians with proliferative lymphocytic disease. DNA was extracted from nine gray mouse lemur (Microcebus murinus) samples and nested PCRs with previously described primers for detection of herpesviruses and polyomaviruses were performed. The amplification products were separated by agarose gel electrophoresis; the bands of interest were cut out and sequenced. Two novel herpesviruses were identified. Phylogenetic analyses were performed to characterize their relationship with other herpesviruses; one of them clustered with other primate herpesviruses within the subfamily Betaherpesvirinae. The other one clustered within the subfamily Gammaherpesvirinae, although the relationship within the subfamily was less resolved. To quantify the amount of virus present in the samples, a qPCR assay was developed with conserved regions of the new viruses, providing specific faster, less expensive, and quantitative diagnostic tools.

LITERATURE CITED
BIOMECHANICAL ANALYSIS OF DIFFERENT ADHESIVE SYSTEMS ON THE BEAK OF THE TOCO TOUCAN (*Ramphastos toco*)

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Abstract

The avian beak is a continuously growing structure composed of bone covered by a keratin layer (rhamphotheca). This study evaluated the biomechanical properties of a variety of adhesives applied to the keratinized stratum corneum of the beak of the toco toucan (*Ramphastos toco*). The goal was to identify the best adhesive to use for beak repair and reconstruction. Nine adhesives were used and each was evaluated three times to determine the average perpendicular forces necessary to produce detachment. Additionally, the surfaces after detachment were examined using electronic microscopy (MEV) to quantitate the amount of residual resin and the morphology of the superficial keratin layers. The force until complete rupture (Newtons, N) were lowest with resinous cementa (2.48 N) and highest for chemically activated Prime & Bondb combined with composite nanoresin (104.21 N) and chemically activated Prime & Bond combined with resinous cement (110.48 N). In conclusion, the chemically activated Prime & Bond adhesive, combined with composite nanoresin or resinous cement, provided the strongest adherence for beak repair in toucans and probably other birds.

aEnforce, 3M Laboratories, St. Paul, MN 55144-1000 USA
bPrime & Bond 2.1/Selfcure, Dentisply International Corporation, West Philadelphia, PA 17405-0872 USA
cZ350, 3M Laboratories, St. Paul, MN 55144-1000 USA.
TECHNIQUE FOR REPEATED HEMOLYMPH SAMPLING FROM THE MADAGASCAR HISSING COCKROACH (Gromphadorhina portentosa)

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Abstract

Despite the increasing attention paid to invertebrates as veterinary patients, guidelines for biomaterial sampling from arthropods remain limited.1-3 To evaluate roaches as a reliable pharmacetic vehicle for exotic vertebrates, a safe, simple, and replicable technique for manual restraint and repeated hemolymph sampling from the Madagascar hissing cockroach (Gromphadorhina portentosa) was developed.

Adult cockroaches (n=24) were group housed in plastic containers of four animals each with bark substrate under standard temperature, lighting, and dietary conditions for their species. Before sampling, each animal was weighed to estimate overall hemolymph volume at 10% of their body weight. To collect hemolymph, roaches were restrained manually between two foam sponges, one of which contained an access window overlying the sampling site. Using an insulin needle, the optimal location for hemolymph collection was determined by collection at two locations: the base of the metathoracic (hind) leg and the dorsal sinus.

Repeated hemolymph collection was performed with each tank of roaches serving as a single time point twice so that each collection site could be assessed. Extracted sample volumes were targeted at 1% of body weight for total volume of both time points. Excessive hemolymph leakage was controlled by external seal with surgical glue. While few roaches died or were euthanized during the procedure due to injury, freshly presented individuals were examined to assess hemolymph sampling techniques. After the second sampling, roaches were provided an equal volume of 0.9% saline to replace hemolymph removed.4

LITERATURE CITED
RESULTS OF THE 2012-2013 MEGAVECTERBATE ANALGESIA SURVEY: HIPPOPOTAMUS AND GIRAFFE

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Abstract

There is little scientific data on analgesic doses in megavertebrates. An online survey posted on the AAZV listserv from September 2012 through March 2013 examined analgesics administered to captive megavertebrates. Compiled data included signalment, drugs administered, dosing regimens, subjective efficacy scores, ease of administration, and any adverse events.

NSAID use data reflects institutions exhibiting hippopotami (Hippopotamus amphibius) and pygmy hippopotamus (Choeropsis liberiensis) (19 total) or giraffe (45 total). Phenylbutazone (12/19 hippopotami institutions, 40/45 giraffe institutions) was the most commonly cited, followed by flunixin meglumine. Doses varied up to 30 fold (1-30 mg/kg) between and within facilities. Subjective efficacy scores ranged from “poor” to “excellent”, with “good” being the most common. Eight out of 64 institutions reported adverse events. Phenylbutazone comprised the most (4/8), including one case of severe gastric ulceration.

Two institutions administered opioids to hippopotami, and 7 institutions to giraffe, with tramadol being the most common (4/7 giraffe, 1/2 hippopotami) followed by butorphanol. Efficacy scores varied for tramadol, ranging from “poor” (2/4) to “excellent” (1/4) in giraffe, and a score of “good” for the hippopotamus. Only 2 adverse events were reported, one of drowsiness in a giraffe, and one of decreased frequency of defecation in a hippopotamus.

23 of 53 institutions exhibiting giraffe utilized alternative analgesia, including gabapentin, glucosamine/chondroitin, and local anesthetics. Six of 19 institutions exhibiting hippopotami administered omega 3/6 fatty acids, gabapentin, glucosamine/chondroitin, and alpha-2 adrenergics.

Analgesic drug dosages varied greatly among institutions. While all reporting zoological institutions administered similar drugs, there was variation and diversity in dosing regimens.
HYPERCALCEMIA AND METASTATIC MINERALIZATION ASSOCIATED WITH RENAL DISEASE IN ROCK HYRAXES (Procavia capensis)

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Abstract

The renal pathway is the primary mode of calcium excretion in the rock hyrax (Procavia capensis).¹ In renal dysfunction, hypercalcemia may develop secondary to decreased calcium excretion. Two rock hyraxes at the Brookfield Zoo were clinically managed with aggressive fluid diuresis and dietary modifications for chronic azotemia and hypercalcemia, as well as hyperphosphatemia in one animal and hypophosphatemia the other. Parathyroid hormone was also elevated in one of the animals and decreased in the other compared to other hyraxes in the collection. Renal dysfunction was highly suspected as the cause for these biochemical abnormalities. In addition, both animals displayed signs of lameness due to footpad lesions. Histologically, these lesions consisted of granulomatous inflammation with mineralization reminiscent of calcinosis circumscripta. Both animals were humanely euthanized due to the severity of their lesions and progression of renal disease, and interstitial nephritis and footpad mineralization were confirmed in both animals on postmortem examination. In addition, one of the animals also exhibited multicentric metastatic mineralization affecting the kidneys, stomach, large intestine, and lung. Metastatic mineralization involving the footpads is an uncommon sequela to renal dysfunction in domestic animals² but has not been reported in rock hyraxes. A retrospective review of mortality data in this collection revealed a high prevalence of renal pathology, including two additional animals with metastatic mineralization and renal failure. Expanding knowledge of renal diseases will further guide preventative medicine measures, including screening for metastatic mineralization.

ACKNOWLEDGEMENTS
We thank Ms. Lauren Kane for her assistance compiling data from the medical records and the Brookfield Zoo’s keeper and veterinary technician staff for their care of these animals.

LITERATURE CITED
DEVELOPMENT OF CRITERIA FOR CATEGORIZING ULTRASONOGRAPHIC IMAGES OF UTERINE HEALTH ASSESSMENTS IN THE SOUTHERN STINGRAY (*Dasyatis americanus*)

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Abstract

Reproductive disease in southern stingrays (*Dasyatis americanus*) has been documented at multiple aquariums. Ultrasonography has been used to establish criteria for normal and abnormal stingray ovaries1 but criteria are lacking for assessment of the uterus. Presented here are categories for defining uterine disease. Physical exam, blood collection and ultrasound were conducted quarterly on captive (n=43) and annually on semi-free ranging (n=30) stingrays. Ultrasonographic video data was reviewed and specific criteria established on a scale of 1-5 similar to previously defined ovarian health scores of ‘normal’ and ‘abnormal’. The criteria were established as follows: 1=no fluid evident in the uterus or pregnant (visible embryo) and a normal sized ovary; 2=a minor amount of uterine fluid and a normal sized ovary; 3=minor or moderate amounts of uterine fluid with an abnormal ovary; 4= moderate amounts of uterine fluid and the organ breaches midline and an abnormal ovary; 5=the uterus is severely filled with fluid, breaches the midline, and cystic structures may be present (apart from the functional left uterine tissue), as well as an abnormal ovary. Preliminary data showed that the mean uterine health score for captive stingrays was 3, and for semi-free ranging rays was 1 (Mann-Whitney rank test; p<0.001). Continued work will investigate endocrine and husbandry parameters to determine potential causes of this condition. Development of clearly defined criteria will aid in diagnosis and treatment of southern stingray reproductive disease.

LITERATURE CITED
ANESTHETIC INDUCTION OF CAPTIVE TIGERS USING ATROPINE SULFATE-XYLAZINE -KETAMINE COMBINATION INTRAVENOUSLY

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Abstract

Ketamine-xylazine combinations have long been used in large felids for routine surgical procedures. Even though studies have been carried out in multiple species on intravenous usage of this combination, there is a scarcity of reports on safe intravenous usage of the combination in large felids. Over a period of six months, eight captive Bengal tigers of different age categories were anesthetized with atropine sulfate-xylazine-ketamine combination intravenously for either surgical procedures or short distance transportation. Food and water were withheld for 12 hours prior to the procedure in all of the tigers. Tigers were secured in a squeeze cage and intravenous cannulation was carried out using either the dorsal or lateral coccygeal vein. Anesthesia was induced with an intravenous bolus dose of atropine sulfate (0.03 mg/kg) and xylazine (1.5 mg/kg) followed by ketamine (2 mg/kg). Overall, induction time was 1-2 minutes, recumbency time without supplementation of ketamine was 35–49 minutes, and recovery time was 50–66 minutes. Depth of anesthesia was constantly observed with palpebral and pedal reflexes. During 2 surgical procedures when tigers showed recovery symptoms, ketamine was given intravenously (1 mg/kg) which prolonged the anesthesia for 20-36 minutes. Heart rate and respiratory rate decreased and remained constant during the entire process but respiratory rate increased rapidly during the recovery process. The present study indicates that an atropine sulfate-xylazine-ketamine combination administered intravenously produces a safe and satisfactory anesthesia in captive Bengal tigers. Further studies to investigate various dosages or the substitution of other drugs for the combination are warranted.

ACKNOWLEDGEMENTS

We would like to thank The Executive Director, Bannerghatta Biological Park for his support during the study. We also thank Range Forest Officers, Veterinary assistants, animal keepers and zoo staff for their kind cooperation and support during the procedures involved in the study.
ADMINISTRATION OF 5% HUMAN SERUM ALBUMIN IN A CRITICALLY ILL ALDABRA TORTOISE (*Aldabrachelys gigantea*) WITH HYPOALBUMINEMIA

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Abstract

A 10-yr old male, captive Aldabra tortoise (*Aldabrachelys gigantea*) presented with decreased activity, appetite, and constipation for 3 months. Husbandry was considered non-optimal. Hematology, plasma biochemical analysis, and physical examination showed the tortoise was dehydrated. Radiographs demonstrated constipation. Initial treatment consisted of fluid therapy, enrofloxacin, metoclopramide, and husbandry improvements. After one week of treatment, the patient’s condition did not improve. Considering the difficulty and stress of force-feeding, we placed an esophagostomy tube under general anesthesia. Vomiting developed after feeding mineral oil through the tube. Subsequently, intra-osseous placement of a 14 gauge catheter in the right tibia followed by infusion of partial parenteral nutrition was performed. In the following days, penile prolapse, hematochezia, and anemia developed. The swollen penis was amputated after failure of manual reduction. A blood transfusion was attempted to correct the anemia. However, hemolysis was noted after blood from the conspecific Aldabra tortoise used for the transfusion came into contact with the citrate anticoagulant1, which had never before been recorded. Moreover, radiography demonstrated accumulation of fluid in the coelomic cavity, indicating hypoproteinemia and low oncotic pressure. Using a treatment performed in small animal medicine patients with hypoproteinemia2-3, a commercially available 25% solution of human albumin4 was diluted to a 5% solution with 0.9% NaCl solution, and was infused at a rate of 2ml/kg/hr for a total dose of 706mls which equaled a 10ml/kg dose2-3. No obvious complications were noted during or after administration. The patient voided a large amount of urine the same day as human albumin administration and within four days there was some resolution radiographically of the coelomic cavity fluid accumulation. The tortoise recovered gradually and uneventfully and continues to be asymptomatic for the last 7 months.

a. Commercially available 25% human albumin product (Albutein 25% (Grifols Biologicals Inc., Los Angeles, Ca, USA)).

LITERATURE CITED

EFFICACY OF GONADOTROPIN-RELEASING HORMONE (GnRH) VACCINE (GonaCon™) ON REPRODUCTION FUNCTION IN FEMALE VERVET MONKEYS (Chlorocebus aethiops)


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Abstract

The green vervet monkey (Chlorocebus aethiops) population on St. Kitts has resulted in a human-monkey conflict with monkeys causing significant damage to agricultural crops. A gonadotropin-releasing hormone (GnRH) immunocontraceptive vaccine (GonaCon™a) was selected for a pilot trial to determine the efficacy and duration of a single vaccine administration in suppressing reproductive function. Four control and six experimental animals were chosen from a group of 22 sexually mature captive adult female vervet monkeys based on regular estrous activity. The control monkeys were given a 0.5 ml saline emulsion injection intramuscularly. The experimental monkeys were given a 0.5 ml, 500 microgram dose of the GnRH vaccine in the same manner. Two separate adjuvants (adjuvant 1 and 2 with associated controls) of the vaccine were used as the first adjuvant caused significant localized reactions. Blood samples were collected on a weekly basis initially and then once a week for 3 weeks with one week off in a repeating schedule. Serum from the females was analyzed for estradiol and progesterone using validated human ELISA kits. Currently 1/3 monkeys in the adjuvant 1 experimental group has started cycling at 33 weeks post-vaccination. 3/3 experimental monkeys in the adjuvant 2 group started cycling on average 25 weeks post-vaccination. It appears that adjuvant 1 provides a longer duration of activity than adjuvant 2 with a single vaccine administration. Unfortunately, both adjuvants led to an increased incidence of localized swelling at the injection site, many leading to abscess formation. An alternative adjuvant will be investigated.

Products Mentioned in the Text: aGonaCon, USDA, APHIS, Wildlife Services, National Wildlife Research Center, Fort Collins, CO, 80521,USA.
DESCRIPTIVE EPIDEMIOLOGICAL STUDY OF KOALA RETROVIRUS AT THE SAN DIEGO ZOO OVER A 20 YEAR PERIOD

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Abstract

Koala retrovirus (KoRV) is an important cause of mortality in wild populations and zoo-based koalas in Australia, Japan, Europe, and North America with deaths resulting from neoplasia and disease from opportunistic pathogens1. The goal of this study was to describe the basic epidemiology of KoRV among 118 koalas housed at San Diego Zoo (SDZ) from 1993-2012. Necropsy reports were used to identify cases of KoRV based on the following: lymphoid neoplasia (n=9), aplastic anemia (n=7), opportunistic infections (e.g. bronchopneumonia, cryptococcal inflammation, pseudomonas infection; n=3), osteochondromatosis (n=1), and other diseases (hyperthermia, nasal cavity osteoma, severe proliferative vasculopathy, arthropathy n=4). Incidence and proportionate mortality were estimated. Among koalas that died, exact logistic regression was used to estimate the unadjusted odds ratios to determine the association between identified demographic characteristics and KoRV-related mortality. The incidence rate was 8.8 cases per every 100 koala-years at risk (51 cases/581.6 koala-years at risk). Proportionate mortality for KoRV was 47% (24 cases/51 mortalities). Deaths in older koalas were less likely due to KoRV than deaths in younger koalas; the odds of KoRV-related mortality decreased by 12% for every increasing year in age (OR=0.88; 95% CI: 0.78-0.98; p=0.02). Longer time periods in the SDZ cohort was also protective from KoRV-related death (OR=0.90; 95% CI: 0.80-1.0; p=0.04). No significant associations (p>0.05) were identified between KoRV mortality and sex, birth location (SDZ vs. born at another institution) and birth year. Adjusted analyses are underway to identify concurrent factors associated with KoRV-related deaths.

LITERATURE CITED
INFRARED THERMOGRAPHY FOR DETECTION OF BUMBLEFOOT (PODODERMATITIS) IN PENGUINS: UNSUCCESSFUL ATTEMPT TO VALIDATE AS A Diagnostic TEST

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Abstract

Bumblefoot (pododermatitis) is an inflammatory or degenerative condition of the foot that causes significant health problems in captive penguins. Penguins with bumblefoot generally develop lesions in the metatarsal pad; early detection is critical to treatment success.2 Captive penguins should be examined regularly for indicators of pododermatitis, including heat, swelling, firmness, or development of lesions. Infrared thermography (IRT) has been utilized to localize areas of inflammation and necrosis by veterinary and human researchers.3 The goal of this study was to validate IRT as a method to diagnose bumblefoot at the subclinical or clinical level. The study group included sixty individuals housed indoors at relatively constant temperature (47-52 F) and humidity (46-51%). Penguins were examined at 3 month intervals. At each exam, bumblefoot lesions were characterized using a previously described scoring system and a series of thermal images was taken over a 2-3 minute period using a standardized protocol.1 Three different methods were utilized to analyze the thermal images: line, shape and concentric square. A subgroup of 11 penguins with unilateral lesions was identified so that an affected foot could be compared to a normal foot. Healthy feet were found to have greater surface temperature variability (within the foot) than feet with lesions; however the variability within an individual over time was such that IRT is not considered a useful tool for detecting pododermatitis in penguins. Furthermore, temperature variability was affected by the length of time the penguin was off the ground, a characteristic that may result from countercurrent blood flow.

ACKNOWLEDGMENTS

I would like to thank the AAZV Zoological Medicine and Wildlife Health Research Grant for funding this research. I would also like to thank the Veterinary, Penguin and Center for Zoo Animal Welfare staffs at the Detroit Zoo for their assistance with this project.

LITERATURE CITED

COMPARISON OF THREE DIFFERENT ANESTHETIC PROTOCOLS IN THE AMERICAN ALLIGATOR (Alligator mississippiensis)

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Abstract

Nine captive, clinically healthy juvenile American alligators (Alligator mississippiensis) were anesthetized, once with each of three protocols, for 45 minutes. Protocols included inhalant sevofluranea via facemask at an 8% flow rate and 1 L/min oxygen (S) initially, intravenous propofolb at a 5 mg/kg bolus (Pr) initially, and intramuscular ketamine c (10 mg/kg) and medetomidined (0.1 mg/kg) (KM). Sevoflurane and propofol were administered as needed to maintain anesthesia. No animals required supplemental ketamine. KM anesthesia was reversed with intramuscular atipamezole e at 5 mg per 1 mg medetomidine. Surgical anesthesia was reached and maintained in all events and routine vital signs were monitored. Intermittent positive pressure ventilation was provided in all three protocols via endotracheal tube until extubation. Extubation occurred when spontaneous respirations were observed.

Each protocol provided safe, reliable, and repeatable anesthesia. There was no difference (P < 0.05) in time to intubation. Mean time to extubation was longer (P < 0.05) following Pr (75.3 minutes) events than KM (11.7 minutes) and S (22.1 minutes) events. Mean heart rate was higher (P < 0.05) during Pr events (37.8 beats per minute (bpm)) than KM (27 bpm) and S (29.5 bpm) events. Mean temperature was higher (P < 0.05) during Pr events (81.2 F) than KM (77.6 F) and S (78.2 F) events. Mean end tidal carbon dioxide was higher (P < 0.05) during Pr events (18.1 mm Hg) than KM (14.1 mm Hg) and S (11.6 mm Hg) events.

aSevoFlo, Abbott Laboratories, Abbott Park, IL 60064 USA; bPropoFlo 10 mg/ml, Abbott Laboratories, Abbott Park, IL 60064 USA; cKetaVed 100 mg/ml, Vedco Inc., Saint Joseph, MO 64507 USA; dDomitor 1 mg/ml (discontinued), Pfizer Animal Health, New York, NY 10017 USA; eAntisedan, Pfizer Animal Health, New York, NY 10017 USA

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RETROSPECTIVE STUDY OF MORBIDITY IN KOALAS (*Phascolarctos cinereus*) HOUSED AT SAN DIEGO ZOO BETWEEN 1967 AND 2013

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Abstract

Recognizing major health problems affecting koalas is key in the conservation of the species. Previous studies have determined the causes of disease in wild koalas presented to wildlife hospitals1,2; however koalas housed in zoos may present pathologies that differ from their wild relatives.

To identify the most common diseases affecting captive koalas, we reviewed the medical records of 158 koalas housed at the San Diego Zoo between 1967 and 2013. During the 46-year period, clinicopathologic entities and abnormalities that affected the koala’s health were assessed and listed in the medical records. In total, 382 medical problems were found affecting 120 (120/158; 76%) koalas. 82.9% of females (63/76) and 72.1% of males (57/79) had at least one reported problem; these proportions were not significantly different (p=0.16). Among those with an identified abnormality (n=120), the average number of problems reported over a lifetime was 2.7 (SD=2.4; range=1-15). Problems were further classified into 14 categories with the highest number of koalas affected in the musculoskeletal category (n=55). Hip and shoulder dysplasia had the highest presentation in this category, with 48 (48/55; 87.3%) and 23 (23/55; 41.8%) koalas affected, respectively. Hip and shoulder dysplasia tended to occur together (kappa= 0.53). Other categories with high numbers of koalas affected by disease were ocular (32/158, 20.3%), gastrointestinal (30/158, 19%) and integument (29/158, 18.4%).

This study highlights the most common categories of diseases presented by koalas housed in zoos. Future studies should be performed to understand risk factors associated with the presentation of these diseases.

ACKNOWLEDGEMENTS:
The authors would like to thank Ms. Donna Vader from the San Diego Zoo for her support during data collection.

LITERATURE CITED
WHAT’S IN A PITUITARY? THE IMPORTANCE OF THE PITUITARY GLAND IN DIAGNOSTIC MEDICINE AND RESEARCH

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Abstract

The pituitary gland is a critical part of the endocrine master control for the body, and particularly a key player in the pituitary-hypothalamic-gonadal axis which regulates reproductive function. Due to its location within the cranium embedded in the sella tursica, the hypophyseal fossa within the sphenoid bone, the pituitary gland is sometimes overlooked in routine postmortem examinations. Reported lesions in zoo animals include amyloidosis, adenomas, carcinomas, pars intermedia dysfunction, as well as bacterial and fungal infections of the pituitary. With the recent advent of gonadotropin agonists (e.g. Deslorelin) as a contraceptive for aggression control in some species, there is an additional need to carefully evaluate and archive the pituitary gland to fully understand the impact these treatments may have. In addition, estrogenic and other hormonally active environmental toxins have been associated with pituitary changes in wildlife species.

Removal of the pituitary gland can be achieved as a part of routine brain extraction using multiple different methods including removal of the skull cap, an off-center longitudinal section through the skull, or a transverse section through the skull and brain. After brain removal, the pituitary is generally retained in the sella tursica and can be elevated and extracted from the hypophyseal fossa. Routine fixation in 10% neutral buffered formalin is sufficient for most diagnostics; however, other fixatives such as ethanol, 4% paraformaldehyde, or gluteraldehyde may be needed for special studies. The pituitary gland should be a part of all routine zoo necropsies and can be archived in paraffin.
DEVELOPMENT OF A DATABASE OF FETAL ULTRASOUND MEASUREMENTS FOR THE CREATION OF ORANGUTAN-SPECIFIC (*PONGO SPP.*) GROWTH CURVES AND DETERMINATION OF PARTURITION DATES

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Abstract

Data from three cases have been used to create a single growth curve for orangutan (*Pongo spp.*) fetal development. This project creates and compares specific growth curves (e.g. Bornean vs. Sumatran and male fetus vs. female fetus) and gestation lengths for orangutans by developing a database using existing ultrasound and breeding information as well as information collected from multiple institutions going forward. The protocol describes detailed guidelines for study participation including breeding data parameters, specific ultrasound views, points to measure, and frequency of collection. A standardized form has been created for institutions to complete and a single certified ultrasonographer is used for analysis in order to make the data as uniform and reliable as possible. Specific data points collected in this study include copulation date, last known menses, birth date, and fetal ultrasound measurements of crown rump length (CRL), biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), femur length (FL), and humerus length (HL).

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